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

Nicholas Wilson

INTERROGATING THE DIVIDE:
A CASE STUDY OF STUDENT TECHNOLOGY USE IN A ONE-TO-ONE LAPTOP SCHOOL

A Dissertation Presented

By

NICHOLAS C. WILSON

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Approved as to style and content by:

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Florence R. Sullivan, Chair

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Denise K. Ives, Member

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Jarice Hanson, Member

_____

Christine B. McCormick, Dean

College of Education

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ABSTRACT

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NICHOLAS C. WILSON, B.A. DUKE UNVERSITY

M.A., UNIVERSITY OF MASSACHUSETTS, AHERST

Ed.D., UNIVERSITY OF MASSACHUSETTS, AMHERST

Directed by: Professor Florence R. Sullivan

Persistent gaps in technology literacy skills between students of differing socioeconomic backgrounds over the past two decades (even despite cases of parity in technology resources (Subramony, 2007) amongst poor and affluent students) have necessitated that researchers now look beyond monetary funding as the primary reason for the existence of the Digital Divide. Rather than looking to quantitative measures of students' technology skills to identify potential areas for skill remediation or special services, some scholars have adopted a sociocultural approach to the problem to examine how the circumstances of technology-related classroom *activities* influence teachers' technology integration strategies, and the ways in which students use technology for learning. This case study will follow four non-dominant high school students in a laptop school to examine how the conditions of activity – institutional structures, the teacher's skills, attitudes, and beliefs about technology, the tools students use to accomplish tasks, etc. – influence the development of agency and one's ability to use technology for academic and personal growth. Field notes, interviews, and video recordings were analyzed using a constant comparative method, drawing on the tenets of Activity Theory (Engeström, 2001) to identify tensions that hinder students' use of technology.

Keywords: digital divide, digital education inequity, one-to-one learning, laptops

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INTRODUCTION

> People are only incidentally born or early enculturated into being different. It is more important to understand how they are put into positions for being treated differently. Notice that, by this approach, no group stands alone, nor even in a simple relation to more dominant other groups, but always in relation to the wider system of which all groups, dominant and minority, are a part (McDermott & Varenne, 1995, p.336)

According to the passage above, it is often the conditions of context that create the differences in literacies, skills, competence, and ability society perceives in others, in particular, within the education system. As school districts look to increase the presence of information and communications technologies (ICT) in the classroom, a persistent gap has emerged between students from dominant and non-dominant backgrounds in how those technologies are used. Despite the fundamental understanding that this gap, or "Digital Divide", derives primarily from issues of funding and access (and is therefore, at its most basic level, a socioeconomic problem), recent research has suggested that this disparity of technology use implicates the quality of youths' digital learning opportunities, and is symptomatic of a new form of social inequity. As such, digital education inequities are a construct of social and structural conditions, and not simply a problem of access to deep pockets (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008).

To understand the conditions in which non-dominant students are not developing ICT-related skills at the same rate or depth as their wealthier counterparts, contemporary research must approach the problem of digital education inequity from a viewpoint similar to the McDermott and Varenne (1995) proposed in the quotation above – that is to say, a holistic one. Scholars have recently begun to examine digital education inequities through a sociocultural approach (Anthony & Clark, 2011; Ito, 2010; Mouza, 2004; Sims, 2013), identifying barriers to technology integration as primary cause in the breakdown of students' opportunities to develop digital literacies (Anthony & Clark, 2011; Bauer & Kenton, 2005; Hew & Brush, 2007; Windschitl & Sahl, 2002). A secondary area of division, however, is the frequency of students' technology use, or time to rehearse technology skills for academic learning (Hohlfeld et al., 2008). Studies on the adoption of ubiquitous computing, such as one-to-one laptop programs, also report a range of systemic problems related to digital literacy development, including school culture, and pressure on instructors to implement to state-mandated curriculum frameworks (Anthony & Clark; Hohlfeld et al.). Few studies, however, have investigated how the contextual conditions of classroom learning environments influence students' technology use (for both academic achievement, and for personal growth), and the relationship between these conditions and the reproduction of digital education inequities. The purpose of this study is to examine the conditions of non-dominant student technology use in a one-to-one laptop environment, and the role that social structures have on the reproduction of inequities associated with those students' opportunities to learn with technology.

Statement of the Problem

The Framework for 21st Century Learning (Partnership for 21st Century Skills, 2009) calls on schools to "better prepare students for the demands of citizenship, college, and careers in this millennium" (Bellanca & Brandt, 2010, p.xiii). It outlines the subjects, themes, skills, literacies, and support mechanisms necessary to prepare today's students to "think, learn, work, solve problems, communicate, collaborate, and contribute effectively throughout their lives" (Bellanca & Brandt, p.xx). In response to this call, many schools have begun ramping up initiatives to increase the presence of technology in the classroom, such as through the implementation of ubiquitous computing environments, one-to-one laptop programs, interactive white board classrooms, and school-wide wireless broadband Internet connectivity. In spite of these developments, however, research shows a persistent gap in technology literacy skills between students of wealthier, privileged communities, and those who come from non-dominant cultural, socioeconomic, and ethnic backgrounds (Warschauer & Matuchniak, 2010). Immersive technology strategies such as the ones just described require complex logistical planning and the procurement of expensive, difficult-to-maintain equipment. As such, widespread computer distribution, high-speed wireless Internet and networking infrastructure, and interactive classroom technology tools are more easily integrated into schools that enjoy access to funding, resources, knowledgeable staff, and technical support. Federal initiatives and private donations aimed at equipping low-socioeconomic schools with 21st Century technologies, have by-and-large been unable to narrow the prevailing digital education gap (Sims, 2013), despite increasing the ratio of computers to students - a small component of the larger issue of "access" (an umbrella term used to convey the availability of computing technology, Internet, knowledgeable resources, and the frequency with which students can make use of them).

While the acquisition of ICT equipment and support represents the most fundamental obstacle to reducing gaps in technology access between students from differing socioeconomic communities, the frequency and purpose of technology use in the classroom are perhaps more powerful indicators of digital education inequities (Hohlfeld, et al. 2008, Warschauer et al., 2004). Even where technology and knowledgeable resources are in long supply, disadvantaged youth still find themselves experiencing far fewer opportunities to use technology for learning, or for the development of critical competencies such as those often packaged together under the term "21st Century Skills" (Hohlfeld, et al.; Sims, 2013). The digital divide therefore represents a problem of infrastructure at only a basic level; another grave concern for digital equity scholars is the organization of learning opportunities within the classroom. This perspective suggests that digital education inequity is not simply a complication of underfunding or monetary disadvantage; rather it is intimately tied to existing social structures and the discourse of schools - in other words, how learning opportunities are made, and how students' learning participation is deemed "legitimate" (Subramony, 2007; Warschauer, et al.; Warschauer & Matuchniak, 2010). Many thus see digital education inequities as a product of social reproduction, implicating a network of interconnected systems and educational stakeholders, all the way from policy makers to students themselves. Unfortunately, this approach is not the norm.

Some claim that ICT has "the potential to transform not only the lives of individuals… but society as a whole" (International ICT Literacy Panel, 2002, p.3). While true in its own right, grand statements like this are at risk of being appropriated to rationalize deterministic policies that foreground the accumulation of technology resources at the expense of oversimplifying historic social inequities. For this reason, scholars have begun to examine digital education inequities from a holistic sociocultural perspective.

For technology integration to benefit any population of students, it must accompany a pedagogy grounded in student learning, and expand upon the action possibilities of the learner (Warschauer, et al., 2004). Some have argued that this necessitates an atmosphere in which teachers and students can challenge and adapt existing schooling practices, especially where systemic tensions inhibit technology use and learning opportunities (Rantala, 2009; Roth & Lee, 2007). When this dissertation research began, few studies explored the connection between students' digital action possibilities and the school-based structures that may inhibit them. The current study examines these issues through a qualitative lens, in an effort to understand the nature of barriers to non-dominant students' use of technology within a one-to-one laptop learning environment.

Barriers, action possibilities, and technology integration. The types of activities students perform with technology, from drill and practice, to research and information analysis, to multimedia production, incorporate a wide range of ICT-related skills and literacies. When these activities center on irrelevant content, are limited by arbitrary time constraints, are confined to pre-defined notions of "right use" (Roth & Barton, 2004), are implemented as "add on" activities (i.e., considered of secondary importance), or are integrated in such a way as to delegitimize students' non-academic uses of technology, the activities themselves have the potential to become barriers to technology use (Anthony & Clark, 2011). Sociocultural learning theorists who have studied these barriers to learning in other fields of education research (such as the study of hegemonic discourse and social structures of power and privilege in literacy research) have reported that students may at times negotiate these barriers in sanctioned and unsanctioned ways in order to create their own learning opportunities (Gutierrez, Rymes, & Larson, 1995; Rantala, 2009; Roth & Barton, 2004). This suggests that digital education scholarship may benefit from examining barriers to technology use from a student perspective, rather than focusing solely on teachers' technology integration strategies. Indeed, one oft-overlooked connection between digital education inequity and technology use is student empowerment. Teaching students to execute drill and practice routines may be valuable for memorization or test taking, but in the spectrum of technology-mediated activities, empowerment (defined here as "the [ability] to independently make decisions… of selecting and using the appropriate ICT for accomplishing personally valuable objectives in efficient ways" [Hohlfeld et al, p.1650]) is a critical aspect of digital education. As Hohlfeld et al. explain,

> [If] students are only using electronic testing software, they will not be prepared to use other types of software that may have a more immediate impact on their careers (e.g., spreadsheets). Likewise, if teachers are not able to model the appropriate uses of technology in the classroom, then students may not acquire the necessary digital

> competencies that can enhance their future academic or professional careers. (p.1650)

While many reports have detailed the time students spend with specific technologies or performing certain tasks such as preparing written text and developing multimedia presentations (Gray, Thomas, Lewis, & NCES, 2010), these studies tend to not analyze the alignment of curriculum, technology integration, and student empowerment. Nebulous and ill-formed definitions of ICT literacy, poorly communicated rationale for enacting grand-scale technology initiatives, and pressure to simply make use of technology rather than to do so meaningfully, do little to help instructors implement classroom activities that provide students with opportunities to develop literacies and skills that might empower them for the betterment of their own lives. One definition of ICT literacy stated, "[Using] digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (International ICT Literacy Panel, 2002, p.2) is simply so broad that it arguably trivializes the value of technology-mediated cultural participation, and dismisses the importance of agency, empowerment, and social justice in student learning. Treating technology literacy acquisition as an endpoint, rather than a process, addresses only one aspect of digital education inequity, and arguably dismisses the importance of student autonomy and empowerment in the process of developing 21st century competencies.

Digital inequity in education. Regarding the nature of technology-mediated tasks students are asked to perform in the classroom, Harris (2010) argued that tasks which "encourage cognitive development, creativity, and deeper understanding of content" (p.61) are more often observed in schools where students not only have access to high-end computing technologies, but also to social capital, privileged cultural mores, well-trained educators, and adaptive, progressive learning environments. Despite occasional access to similar technology resources in school, low-SES students have relatively few opportunities to participate in such environments (Warschauer & Matuchniak, 2010). Assessment-driven curricular goals, lower expectations for student achievement, and pedagogies oriented towards workforce preparation, are systemic aspects of low-SES classrooms, and all influence how ICT literacies are emphasized for learning and empowerment (Warschauer et al., 2004). As such practices systematically close off points of entry for underrepresented students to occupy empowered roles, it is clear that social practices and institutional structures have a significant effect on how students develop technology literacies in formal learning environments, as well as how students perceive the connection between personal (i.e., non-school) uses of technology and valued forms of classroom participation.

Critical examinations of learning in underprivileged schools reflect challenges that compound integrating technology into the curriculum (Aronowitz & Giroux, 1993; Willis, 1977). Though, while some have argued digital education inequity points to a lack of effective teacher training, instructional support, and professional development geared specifically towards ICT literacy acquisition (Belland, 2009), many leave unaccounted the complexities of resistance in schools and symbolic capital that permeate many communities

where educational inequities persist (Anyon, 1980). The reported lack of effective technology integration in underprivileged schools only speaks to larger sociocultural issues at play in the education system.

The trends observed today in digital education inequity beg a qualitative investigation into the assumptions and the social practices, both privileged and constrained, within the context of technology-mediated learning. For those who find themselves on the losing end of the digital divide (even in spite of access to technology) the question of infrastructure answers only a small piece of a complex puzzle. How socio-structural elements of practice, discourse, and power impinge on technology use presents a more pressing concern. As such, sociocultural learning theory serves as framework through which research can better understand the subtle factors at play in the reproduction of the digital divide. The interdependence of technology equipment, integration, and pedagogy in manifesting digital education inequities suggests that numeric data alone (e.g., time spent using a computer, time spent in professional development, numbers of "highly qualified" teachers in a laptop school, etc.) cannot fully grasp the complexity of these inequities. Instead, solving these problems require a qualitative examination of classroom practices – instructional, academic, and social.

The Study

This study examines how students in a ubiquitous computing environment came to terms with potential barriers to technology use, such as institutional structures, instructional practices, technology integration, and privileged school discourse, as well as students' knowledge, attitudes and beliefs about technology. The study documents the issues and challenges students faced in experiencing opportunities to learn with technology and the development of ICT literacies, as well as the ways in which students came to terms with (i.e., responded to, coped with, resisted, or embraced) those issues and challenges.

Purpose

The purpose of this study is to examine how social issues and institutional structures in the classroom environment impact opportunities for students to learn with technology, and how students "come to terms with" (i.e., respond to, cope with, resist, or embrace) sociocultural contradictions that revolve around rules, roles, and mediating artifacts in technology-rich learning environments. Recent research on the nature of barriers to technology integration suggest that institutional structures and teaching practices have a large effect on how technology is used in the classroom (Anthony & Clark, 2011; Windschitl & Sahl, 2002). The underlying assumption of these studies, however, is that technology integration effectiveness is the most significant factor upon which students' ICT literacy and skills development hinges (that is, provided any issues of access have been ameliorated satisfactorily in accordance with contemporary classroom technology standards (Gray, et al., 2010)). Yet what these studies fail to acknowledge are the subtle ways that students resist social regulations (i.e., roles, rules, divisions of labor) (Anyon, 1980; Willis, 1977), make room for learning on their own terms (Roth & Barton, 2004), or take up classroom

technology to achieve their own personal goals (Wang & Ching, 2003) – in other words, how students come to terms with classroom social structures.

As more studies link sociocultural influences to students' ICT literacy development and the digital divide (Harris, 2010; Subramony, 2007; Warschauer et al., 2004; Warschauer & Matuchniak, 2010; Windschitl & Sahl, 2002), there is a growing need for research to qualitatively examine the nature of technology activities that promote academic and personal growth for students of all backgrounds. This study provides a ethnographic analysis of students' practices with technology through a framework of activity theory to examine the nature of tensions that inhibit opportunities for students to learn with technology and the ways in which students and teachers negotiate those tensions.

Scope of the Study

This inquiry is a follow-up to a pilot study that took place in the fall of 2008 at a small liberal arts college in the northeast United States. That study examined the nature of student learning in a ubiquitous computing environment with a specific focus on teacher authority and emergent "third spaces" (Moje, Ciechanowski, McIntosh, & Kramer, 2004). The term "third spaces" was used to describe the navigation, bridging, or challenging of discursive practices for expansion of one's action possibilities. Results from that study indicated that institutional structures and social practices had a negative effect on the "student centeredness" of the classroom when unintended technology complications occurred in spite of teachers' explicit pedagogical goals, and positive attitude towards technology. Results also indicated that students leveraged technology to challenge social norms and create opportunities for learning, but that the lifespan of those opportunities was dependent on the teacher's comfort with such developments in the classroom.

These results led me to question the mechanisms that students employ to develop (and take advantage of) ICT skills in light of social barriers to classroom technology integration. The current case study seeks to identify these social barriers, understand their effects on promoting digital education, and uncover the ways in which a small group of students cope with those effects.

The motivation for conducting this dissertation stems from recent reports of persistent technology learning gaps among students of non-dominant backgrounds. In keeping with that motivation, this study focuses on a small sample of non-dominant students in a public, one-to-one laptop learning school.

Significance of the Study

This study will contribute to existing literature on digital education inequities and issues of technology integration in public schools. The central focus of technology activities 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 how students

are provided opportunities to develop technology literacies, as well as how their non-school technology practices are incorporated into formal learning environments. This study will address the role of social practices and embedded institutional structures in the development of those skills, highlighting the tensions that students and teachers encounter in their attempts to make the use of technology successful and effective for student learning.

As Hohlfeld et al. (2008) and others have suggested, the wide disparity of technology use observed across our classrooms and communities is a primary concern for digital education scholarship. Indeed, the very existence of disparities among students of dominant and non-dominant backgrounds, 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, the current research seeks to understand how technology activities can be arranged to promote agency and knowledge construction, and how that process is impeded or enhanced by social and structural practices.

Assumptions of the Study

An underlying assumption of this study is that literacy development in general, and technology literacy development in particular, is a social process. As such, it is subject to the same influences that sociologists and sociocultural learning theorists claim are irreducible to individuals, such as Discourse (Gee, 1999), social practice and reproduction (Bourdieu, 1977), power and privilege (Foucault, 1972), and community (Lave & Wenger, 1991). Another assumption is that schools are sites where people are shaped into a certain "cultural tradition" through a process that is both invisible and unequal in its distribution of cultural capital (Aronowitz & Giroux, 1993). This process reproduces educational culture by granting legitimacy to particular social values and beliefs – especially those that hold the highest cultural capital (i.e., high art, formal and elite education structures, wealth, etc.).

Additionally, though schools have been criticized for being sites of class hierarchy and hegemonic reproduction, they are sites of "complex and creative fields of resistance through which class-, race- and gender-mediated practices often refuse, reject, and dismiss [schools'] central messages" (Aronowitz & Giroux, 1993, p.68). Aronowitz and Giroux claim that schools are not mere reflections of society, rather they operate within their own cultural traditions, where ways of speaking, knowing, and behaving are socially constructed within local school culture itself. Though school culture may be *constrained* by the larger social culture, it is not necessarily *determined* by it – a notion similar to that of agentive individual action (Holland, 1998). Thus, schools operate with a certain habitus (Bourdieu, 1977) or historicity which serves as a guide for educational structures. Within the context of formal education, therefore, individuals are located within a complex ecology of social practices and structures, which may sometimes be at conflict with one another. Accordingly,

this study assumes that cultural practices are historically situated, but apt to change from context to context across different social backdrops.

Definitions of Terms

One-to-one Student Laptop Program – An educational program where the school or school district provides each student with access to an Internet enabled laptop computer for use at home and at school. Also known as *ubiquitous computing*.

Educational Digital Divide – The disparity of access to, use of, or knowledge of information and communication technologies as related to academic instruction.

Instructional/teacher practices - In this study instructional- or teacher practices are defined as "what teachers do, say, and think with learners, concerning content…" (Cohen, Raudenbush, & Ball, 2003, p. 124).

Sociocultural practices – The term "sociocultural practices" in this study refers to "actions that are repeated, shared with others in a social group, and invested with normative expectations and with meanings or significances that go beyond the immediate goals of actions" (Miller & Goodnow, 1995, p.7).

Technology integration – For this study, technology integration refers to "the sustainable and persistent change in the social system of K-12 schools caused by the adoption of technology to help students construct knowledge (e.g., research and analyze information to solve problems)" (Belland, 2009, p.354).

Conceptual Framework

This study is grounded in the fundamental concepts of sociocultural learning (Vygotsky, 1978) and activity theory (Engeström, 2001). The establishment of social theory as a lens for critical analysis of social practices is fundamental to sociocultural learning theory in general, and the conceptual framework of this study in particular. Activity theory is derived from Vygotsky's theories of sociocultural learning, and thus it is useful to trace the evolution of sociocultural learning theory by uncovering some of its basic assumptions, including theories of social practice (Bourdieu, 1977; Giddens, 1985) and agency (Holland, 1998).

Social reproduction. Critical social theorists have argued that because social practices operate tacitly through social institutions and interactions, the forces of social reproduction are often invisible to members of a given culture. Cultural values and "truths" are derived from traditions and practices (including our ways of speaking) that reflect certain ontological and epistemological assumptions. These become naturalized ways of seeing and making the world around us, through repeating and routinizing processes over the course of multiple generations. This "naturalization" is at the heart of the meaning of social reproduction, social practices, and habitus (Bourdieu, 1977).

Building on this metaphor, "institutionalized" customs represent social practices that reflect the values that structure the arrangement or management of society, for example, marriage

and other legal relationships, health care practices, and the education system. The conventions society uses to describe and enact these practices gives them a semi-permanence, which, as they are adopted over the course of multiple generations, establishes a sense of "culture" and "truth" for what those customs and institutions represent. In this way, "truth" is subjective, a cultural invention, or a social construction; derived from, and informing, the collective consciousness. As such, the "truths" that arrange culture and peoples are thus the means by which society structures itself.

Social structures and agency. Following in this tradition, the structuralist movement proposed that social institutions (or "structures") operate as a deterministic force in society; that is, they simultaneously arrange the conditions of social action, and constrain the possibility of individual action or "agency". Social movements therefore require the intervention of powers working on the behalf of the underprivileged to alter existing social structures, and only through a massive, collective reconceptualization of cultural values or institutions, then, can individuals transcend social class or status. In relation to these institutions, structuralists submit that individuals have limited ability to enact social change, and thus little opportunity to resistance existing structures. The dominant discourse of the media in the 1990s framed the "digital divide" in a similar light, arguing that simply providing the technologically "disadvantaged" with access to technological tools and the Internet could ameliorate the reproduction of social inequalities.

Anthony Giddens (1985) and other social practice theorists (Bourdieu, 1977; Willis, 1977) challenged the structuralist tradition's deterministic approach to social order by emphasizing the relational interdependence between institutions and individual action. These theorists proposed that social structures both guide or influence human action, but they are reciprocally influenced *by* human action. By this account, agency (subjectivism) and structure (objectivism) are neither binary opposites, nor opposing ends of a one-dimensional spectrum. Rather, they are mutually influential aspects in the operation of society. This conceptualization disputed the idea that society is deterministically ordered by social structures to which individuals become "socialized," and instead proposed a concept of society as a constellation of institutions and practices. This constellation thus represents a "virtual order" which exists, in a sense, in the minds of individuals as practical knowledge of what rules (taken-for-granted procedures or conventions) and what resources (material and social facilities used to accomplish goals) constitute "normal" behavior (Seidman, 2008). Thus, as individuals participate in situated activity within historically formed social worlds, they are shaped by relations to those worlds. Society is thus reproduced and changed by participation in historically-influenced social activities.

Humans operate, therefore, within the conventions of both history and tradition, and of individual determination. We carry our customs with us, and are influenced by those we encounter, but we also have the decision-making power to embrace those customs or resist them. Routinized practices that form the basis of social worlds are passed down through generations and become woven into the fabric in society.

Giddens' (1985) proposed that social practices are also thusly influenced by power relationships, which govern rules of behavior and the access to cultural resources, within society. According to Bourdieu (1977), society "privileges" those practices that align with societally valued goals. Over generations of privilege, as follows, certain practices become part and parcel of the social environment, leading to the hegemony of those collective practices, and as a consequence, the marginalization of others. As such, individuals accrue "cultural capital" by taking part in, and contributing to privileged practices.

Modern social apparatuses such as mass media, further reify the hegemony of privileged practices, broadcasting to society messages that convey dominant cultural values (e.g., charity, materialism, formal education). These messages, Bourdieu argued, ultimately reflect and produce a collective understanding of "normalcy" in society, and subsequently, what is "anti-normative". Bourdieu proposed that individuals thus compete for capital in social fields to attain privileged status, contributing to the reproduction of hegemony and marginalization.

While tending towards an "economic determinism" of social- and cultural capital, Bourdieu's (1977) goal was not to offer a cynical account of the inevitability of inequality or marginalization, rather it was to expose the mechanisms of social reproduction that operate at the individual level. Despite agency and free well to do so, humans seldom view the world "objectively", and instead, are always perceiving the world through a culturally-informed lens. This lens, through which humans interpret the events of society, Bourdieu called "habitus".

Roughly speaking, habitus encompasses the universe of mechanisms that mediate and make possible all social behavior, including our semiotic conventions, relational dynamics, historical traditions, and social structures; these are, in other words, the invisible "habits" of society, and represent both material and hidden aspects of social life. Bourdieu (1977) suggested habitus does not determine individual action across situated activities, but rather that habitus serves to generate strategies for individual action. He also suggested that, with the exception of those who for some reason have found themselves "outside of society," habitus operates unconsciously:

> Native experience of the social world never apprehends the system of objective relations other than in profiles, i.e. in the form of relations which present themselves only one by one, and hence successively, in the emergency situations of everyday life. If agents are possessed by their habitus more than they possess it, this is because it acts within them as the organizing principle of their actions, and because this modus operandi informing all thought and action (including thought of action) reveals itself only in the opus operatum. (Bourdieu, 1977, p.18) (Italics in original)

Habitus is thus "…the source of these series of moves which are objectively organized as strategies without being the product of a genuine strategic intention…" (Bourdieu, 1977, p.73). It is the collective memory through which action and experience are guided and informed. It suggests to the initiated what is "sensible and reasonable", and produces the

very mechanisms by which a binary relationship between sensible and insensible, or reasonable and unreasonable, exists at all. It is for the reason that societies have the tendency to reproduce their social practices, and as a result, the mechanisms of marginalization.

Hegemony, marginalization, and resistance in education. Aronowitz and Giroux (1993) argued that schooling culture comprises its own socially constructed ways of speaking, knowing, and behaving, and that these practices are formed in the context of school's own traditional notions of power and authority. The tradition of schooling thus serves as a rationale for the implementation of educational structures, such as the physical formation of classrooms, daily schedules, assessments, regulations aimed at controlling student behavior, and even special accommodations. School is therefore a complex ecology of social practices and structures, which both produces and constrains the action possibilities of individuals (Roth & Barton, 2004; Roth & Lee, 2007). Yet, though schools may also be sites that produce social hierarchy and hegemony, Aronowitz and Giroux argued that schools are homes to "complex and creative fields of resistance through which class-, race- and gender-mediated practices often refuse, reject, and dismiss the central messages [of the institution]" (p.68). While the traditions of schooling systematically disenfranchise certain individuals, individuals may similarly come to reject the practices of schooling (Willis, 1977) in an act of agency. Willis argued that cultures may value physical labor over economic wealth or social status, for instance, and as follows, individuals may disregard mainstream or hegemonic values in order to maintain close relationships with their cultural origins. As such, being marginalized or disenfranchised from the educational institution may be culturally valued, and thus perpetuated by those who come to take on their marginalized positions proudly, or as a matter of cultural survival. In other words, hegemony, marginalization, and disenfranchisement are not necessarily the products of social structures, but rather, may be outcomes of individual action within the context of certain social ecologies. In terms of school, this means that while pedagogy and the educational institution may certainly create the conditions for privilege and marginalization (i.e., inequity), individuals themselves may make use of those conditions to enact privilege and marginalization.

Aronowitz and Giroux (1993) argued that the social practices of schooling have led to a tradition of hegemony, marginalization, and disenfranchisement, as certain epistemic assumptions regarding curriculum and remediation that have led to the institutionalization (or reproduction) of inequity. To disrupt this paradigm of hegemony and marginalization, many schools have implemented accommodations to assimilate the disenfranchised. These accommodations have typically taken the form of "special services" aimed at identifying and targeting inequities, yet ironically, seem to perpetuate an ideology that that essentializes differences in how students learn. This in turn creates the conditions for separating those who have acquired the cultural capital of school from those who have not (McDermott & Varenne, 1995), thus perpetuating a system of hegemony that operates, largely, out of view.

Though the work of Bourdieu (1977), Giddens' (1985), Willis (1977), and Aronowitz and Giroux (1993) has contributed significantly to theories of social class position, schooling, and the processes that make and re-make privilege, other scholars have proposed less rigid accounts of social life that move beyond unchanging structural categories and the corresponding notions of learning as the transmission of culture or socialization. Sociocultural theory takes such an approach, and as such, many have argued that schools' epistemic assumptions about learning itself is in part responsible for educational inequities that persist today.

Sociocultural theory. Lave and Wenger (1991) argued that, traditionally, schools' epistemological assumptions about learning reflect "unproblematic" interpretations of the individual learning process, and emphasize learning as an individual process. As such, teaching practices and academic structures are heavily influenced by those interpretations, and thus form the conditions for some of the inequities observed in today's education system:

> Painting a picture of the person as a primarily 'cognitive' entity tends to promote a nonpersonal view of knowledge, skills, tasks, activities, and learning. As a consequence, both theoretical analyses and instructional prescriptions tend to be driven by reference to reified 'knowledge domains,' and by constraints imposed by the general requirements of universal learning mechanisms understood in terms of acquisition and assimilation. (p.52)

Lave and Wenger proposed, in contrast, that learning is a product of the relationships and interactions between learners, knowledgeable members of the learning context, and the resources available for reference and sense making. Learning thus is an outcome of one's participation in various activities, which are organized within the larger contexts of social structures and culture, and one's relationship to other aspects of those contexts (other individuals, tools, etc.). As such, learning is also largely tied to individuals' identities, as they are constructed within those contexts:

> Activities, tasks, functions, and understandings do not exist in isolation; they are part of broader systems of relations in which they have meaning. These systems of relations arise out of and are reproduced and developed within social communities, which are in part systems of relations among persons. The person is defined by as well as defines these relations. Learning thus implies becoming a different person with respect to the possibilities enabled by these systems of relations. To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities. (p.53)

For the purpose of this dissertation, Lave and Wenger's (1991) argument that learning is inherently connected to identity and "systems of relations" serves to frame digital education inequities as potential outcomes of students' participation in school-based activities, and who students are allowed to be in those activities. Subsequently, how the arrangement of activities (e.g., teaching practices, available tools, rules of behavior, etc.) empowers students to "try on" various identities related to learning and technology, and how that arrangement

affords or constrains such participation, is critical to understanding how opportunities to learn are created in the technology-rich classroom.

Communities of practice. Lave and Wenger (1991) argued that identities are transformed through "legitimate" participation in social formations (activities), and that this process translates into not only access to becoming a member of a "community of practice," but opportunities for agency and empowerment. Legitimate participation is achieved by developing fluency with the various cultural tools used by that particular community of practice. This begins as a process of *peripheral* participation at first, as the individual is scaffolded into becoming more autonomous. As one gains increasing fluency and autonomy in the practices of the community, one's participation becomes increasingly central. Through the process of learning to participate in these activities, individuals encounter tools, language, and other identities (and the knowledge embodied by them) - all of which are the product and producers of culture. As such, access to legitimate participation is inherently subject to the same forces that produce hegemony and marginalization. As a community of practice unto itself, schooling also entails issues of power and authority, which may or may not grant legitimacy to students' participation in community practices, or learning activities.

Foucault (1972) might argue that schools enculturate students into a system that legitimizes academic discourses and delegitimizes non-academic ones, thereby imposing what counts as "valued" knowledge. Further, the ritualized practices of power and knowledge that reinforce this hierarchy become engendered before students are developmentally capable of reflecting on the political and historical nature of those practices. As such, those practices are woven into the fabric of schooling culture, and their meanings begin to "disappear" - something akin to habitus. In other words, by internalizing the social hierarchy (or "knowledge hierarchy") that is propagated through the process of schooling, power relationships and social practices related to those relationships become invisible, or naturalized. Gutierrez, Rymes, and Larson (1995) argued that as the social practices associated with this system become a part of students' in-school cultural routines, so do power relations become part of their academic identities. In other words, as children become members of the schooling community of practice, they are exposed to behavioral norms and rituals associated with the "student" identity, such as subordination to teachers and "dominant forms of knowledge generally valued as legitimate by both the local culture and the larger society" (Gutierrez, Rymes, and Larson, p.447).

Lave and Wenger (1991) further argued that, although students develop fluency in the practices of communities that exist outside of school, some of these practices may not reflect the epistemological values or beliefs of schools. As such, students may find these practices (and thus identities) delegitimized within the context of school-based learning activities. According to Gutierrez, Rymes, and Larson (1995), "…power is not an added feature of relationships; it is an essential element of the construction of self and how we understand the world. Power and the forms of knowledge legitimized in classrooms are inextricably linked" (p.451). Thus by attuning to local activities within schooling

environments, researchers can begin to understand how privilege, and the structures that support privilege, impact participation, and therefore, learning.

Sociocultural learning and activity. Whereas cognitive theory attends to the "activity of the epistemic individual" (Cobb, p.22), sociocultural theorists are concerned with activity as part of cultural practice. Vygotsky (1978) is largely credited with spearheading the work of sociocultural theory during his investigations into the roles of tools in childhood development. He argued that, similar to how humans manipulate physical tools to accomplish certain goals and organize activity, humans use sign systems (i.e., language, number systems, writing, etc.) to organize thought. Sociocultural theorists consider such systems to be *constructed* elements of society (i.e., human inventions that have been adopted and reshaped by societies of peoples), and as such, Vygotsky's work has been appropriated to theorize about how social interaction and the use of these constructed systems influence cognition and learning. Sociocultural theory hence submits that learning is organized by one's *participation* in activity (Cobb, 2007).

Leont'ev argued that human activity could be understood in terms of motivation and goal-oriented drive, suggesting the actions realized within an activity are always executed within the context of goals and available tools (mediating artifacts). Vygotsky proposed a model of learning in which the object of activity (i.e., goal) is mediated by the subject's (i.e., individual's) use of culturally-mediated tools (i.e., language, number systems, writing, etc.). According to this model, every activity is mediated by the use of some cultural device. Vygotsky's protégé, Leont'ev, furthered this concept, proposing a theory of activity that includes the influence of social practice on activity, as well. Activity Theory has been further developed to integrate cultural and historical influence into the context of activity. This latest conception of activity is referred to as Cultural Historical Activity Theory (CHAT), and represents a theoretical framework with which to identify specific points of tension within activity systems that may inhibit the achievement of shared goals, such as the learning of classroom content material. Scholars have used this framework to understand how organizations and institutions might overcome embedded tensions by altering social practices, rules, divisions of labor, etc. (Anthony & Clark, 2011, Engeström, 2001; Karasavvidis, 2009; Roth & Lee, 2007). In the context of schools, these contradictions implicate institutional structures (such as schedules and curriculum standards) and social practices (including ways of speaking, using technology, and rules regarding student behavior) (Roth & Lee). As a component of digital education inequity research, Activity Theory provides a framework for examining not just the social and institutional barriers to technology integration, but to students' use of technology for learning, as well.

Recent studies have utilized a theoretical approach that examines the nature of learning interactions at the level of activity. Cultural Historical Activity Theory (CHAT) (Roth & Lee, 2007) presents a framework for understanding human interaction as an outcome of social and structural forces in a given activity context. Briefly, CHAT assumes knowledge and cognition are socially distributed, historically derived, constructions of human cultural

experience, and that goal directed behavior must be understood within the context of that experience (Engeström, 2001).

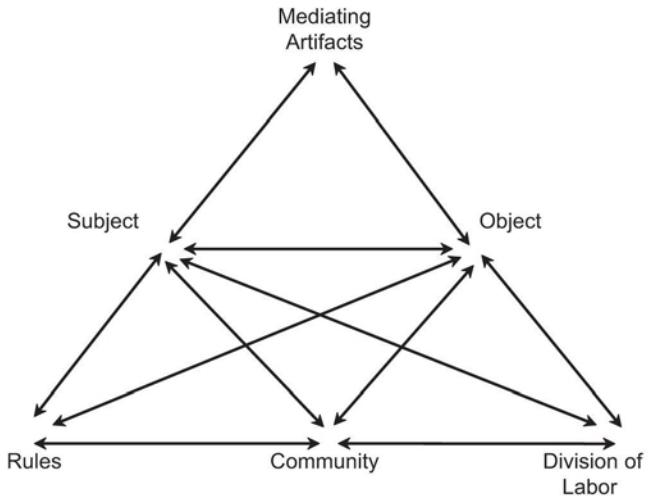

Figure 1: Visual representation of CHAT (Engeström, 2001)

The CHAT framework borrows from Engeström's (1987) interpretation of activity as a constellation of context-based elements including the activity object, subject, mediating artifacts, rules, community, and divisions of labor. The individual or groups participating in the activity account for the "subject", while the "object" represents the "motivating problem or reasons behind why the subject participates in the activity" (Anthony & Clark, 2011, p.1306). "Mediating artifacts" include physical tools and semiotic conventions that negotiate the relationship between subject and object. "Community" refers to the sociohistorical context in which the activity takes place, along with the "rules" or norms of behavior that guide acceptable practices within the activity. As subjects interact within this paradigm of situated, historical activity, they negotiate and perform various tasks to accomplish the object of activity. The distribution of these tasks among activity participants represents the "division of labor" presented in Engeström's model. While subject, object and mediating artifacts represent situated aspects of the activity context, community, rules, and divisions of labor encompass the historical nature of interaction (Anthony & Clark), suggesting all goal-driven activity is a combination of both situated and historical influence.

The CHAT framework has proven itself useful for examining contradictions between activity systems, namely between individuals and organizations that may be working towards similar goals (Anthony & Clark, 2011, Engeström, 2001, Roth & Lee, 2007). These contradictions represent points of conflict or tension, where divisions of labor, rules, mediating artifacts, etc. must be negotiated to accomplish the goal of the activity. Engeström refers to these negotiations as "expansive transformations." Expansive transformations "[are] accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity" (Engeström, 2001, p.137). Anthony and Clark observed these types of breakthroughs in

technology integration activities when teachers challenged institutional barriers such as time constraints and state-mandated curriculum by extending classroom time and slowing the pace of instruction. Though these practices are controversial due to their subversive nature, some might argue that such solutions are necessary for the evolution of instructional practices and for classroom-based praxis (Roth & Lee, 2007; Warschauer, et al., 2004).

Expansive learning transformations. Expansive transformations are made possible by organizing activities "in which conversation, dialogue, and examination of contradictions are privileged across learning activities with varied participation structures: tutorials, comprehension circles, writing conferences, teatro, minilectures, and whole-class discussions" (Gutierrez, 2008, p.154). Indeed, some researchers deliberately attempt to design instructional activities specifically for the creation of expansive learning opportunities (Cook, 2005; Rantala, 2009; Roth & Barton, 2004). By designing collaborative activities that make use of the cultural practices of activity participants, instructors may be able to extend students' action possibilities for knowledge (co)construction (Roth & Barton, 2004).

However, a central consideration for this argument is the process of *creating* such an environment. One cannot simply expect to place a group of students in a room, ask them to produce a personal narrative text that challenges hegemonic schooling practices and makes use of their own cultural discourses, and then observe the creation of meaningful new texts that challenge traditional notions of literacy. Attending to the social structures in the environment may help to engender some new behaviors, but it surely does not guarantee expansive learning transformations or a reconceptualization of literacy practices. To accomplish that, one must look to meaningful cultural resources that can assist (or scaffold) students in making connections between their prior knowledge and the learning object (Moje et al).

In their study, Wang and Ching (2003) proposed a transactional model of social processes and artifacts, which is rooted in sociocultural theories of interaction and activity (Cole, 1985; Vygotsky, 1978). Their model approaches learning and development as a "process of socialization into cultural activity within specific environments" (p.338). As stated above, central to sociocultural theory is the notion that cultural artifacts (semiotic devices) mediate the transaction of meaning between social practices and members of an activity context (Vygotsky, 1978). The affordances of cultural artifacts – "the perceived and actual properties… which determine possible uses in a particular context" (Wang & Ching, p.338) – influence the ways people use artifacts, and for which purposes they do so. In the classroom, cultural artifacts such as computers and other technology devices influence students' social and academic goals, for instance in regards to power and social capital (Sullivan & Wilson, 2014). In the same way, social and academic goals reciprocally influence how students use those artifacts, such as in the production of digital work or in the construction of social rules (Wang & Ching).

> Children therefore interact with classroom technology under the influence of myriad social conventions, peer relationships, and institutional rules (Wang & Ching, 2003). Thus, it is important to understand how students negotiate these influences, and especially how they do so for learning: "[T]he affordances of computers and other artifacts, as well as classroom rules for social and collaborative interaction at computers are essential to understanding how the artifacts both affect and are affected by children's social practice at the computer" (Wang & Ching, p.338).

The sociocultural approach to learning situates the individual as a member of a complex ecology of social structures, practices, and distributed cognition (Lave & Wenger, 1991). And, researchers of situated sociocultural practices have utilized activity theory to frame social interactions and learning outcomes in an effort to explain how knowledge construction is culturally- and contextually dependent. By describing the elements of activity (i.e., subject, object, rules, division of labor, etc.) Anthony and Clark (2011) identified tension between the mediating artifacts (i.e., laptops) students used to learn curriculum, and the technology standards set forth by the state for teachers to instruct. These tensions were exacerbated by teachers' own level of skills with the technology and understanding of how to integrate that technology into instruction. Similarly, Engeström (2011) found that the relationships between primary care staff and hospitals (i.e., the "tools" of health care activity), and moving child patients from primary care to hospital facilities (i.e., the "object" of health activity), formed a tension around the highly-focused, but isolated practices of each institution. As a result of their poor communication and consistency of care across institutions, the relationships between primary care and hospitals were "inadequate for dealing with patients who have multiple simultaneous problems and parallel contacts to different institutions of care" (p.145).

According to Engeström (2001), there are five principles of activity theory that must be taken into account when analyzing such learning environments: (1) the activity system as a whole is the unit of analysis; (2) there exists a "multi-voicedness" in any activity system in which multiple points of view are expressed, and this multi-voicedness is "a source of innovation, demanding actions of translation and negotiation" (p.136); (3) historicity (i.e., historical ways of knowing and doing) is deeply rooted in social culture and necessarily shapes activities in a given community; (4) contradictions between interacting activity systems serve to catalyze the construction of new knowledge; and (5) "expansive transformations" are possible when members of interacting activity systems eschew traditional cultural norms and generate new ways of knowing and doing. These transformations afford opportunities for the creation of new roles, tools, and instruments, and new ways of using those tools and instruments to achieve collectively valued outcomes.

Engeström (2001) demonstrated how these principles led to expansive learning in a case study of how different communities within the health care system co-construct cultural practices and norms of behavior. The three activity systems in the study consisted of (1) primary care staff, (2) hospital staff, and (3) patients' families. The historical norms of behavior, use of tools and resources, and ways of knowing differed between the groups, and,

according to Engeström, served as tensions that both hindered effective communication between activity systems, and ultimately enabled the transformative discussions necessary for a new conception of health care to arise. During initial meetings, the groups adhered firmly to pre-existing roles and means of communication that clearly demonstrated the multivoicedness of the greater activity system. The participants offered solutions based in already-established norms of activity, embedded in the culture of their respective communities and historical practices. As solution proposals met resistance by the other communities, the contradictions and tensions between activity systems became explicit. Once these tensions and contradictions were recognizable to the group, the group's task transformed from arguing one's own cultural point of view into overcoming the tensions and contradictions that were blocking progress to a mutually beneficial solution. Hence, the group's ability to legitimize the cultural practices of the individual activity systems enabled an "expansive transformation" of health care practices.

In Anthony and Clark's (2011) case study, teachers spontaneously rearranged the system of activity to cope with the barriers (i.e., tensions) presented by institutional rules and the mediating artifacts (i.e., "tools") of technology instruction, but oftentimes with results that prevented students from participating in meaningful technology-related tasks. Engeström's (2001) investigation, however, offers an example of how, when the constraints (or tensions) of activity are removed, individuals are empowered to transcend the barriers to their activity objectives. This dissertation examines the nature of barriers to students' classroom technology use, and the coping strategies students and teachers devise to navigate, bridge, or challenge those barriers.

Overview of the conceptual framework. The refashioning of technology to serve unintended instructional purposes, to promote autonomy and authorship, and to rethink the world around us is undoubtedly an area of research that will be worthwhile for future generations of non-dominant students, and for the U.S. education system in general.

Mechanisms of social reproduction inarguably evolved with the recent emergence of personalized production and consumption technologies, and sophisticated techniques used by mass media to target and reach increasing numbers of peoples. This evolution has not only complicated our cultural topography to the extent that non-dominant cultures have increasing access to these channels of vocalization (and therefore more visibility – or at least more potential to be visible to the world), but new modes of cultural participation (such as using social networking sites as vehicles for political action) have emerged that highlight historical tensions between marginalized communities and dominant cultures, and further possibilities for social change (as seen in recent political uprisings such as the Arab Spring and "Twitter Revolution"). While new media and technologies appear to have a large role in mediating these recent changes on a global level, it is clear that within the education system, traditional notions of literacy and the "transcendent script" (Gutierrez, Rymes, and Larson, 1995) still dominate our current paradigm of instruction and our discursive teaching practices, where the tools of reproduction used to separate the culturally-wealthy 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;]) are becoming more entrenched in the operation of schooling (Aronowitz & Giroux, 1993). While cultural participation continues to evolve in its forms and 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), which some argue serves to alienate culturally-active youth from their academic environment, and marginalize the quality and content of their cultural participation (Wang & Ching, 2003).

Postmodern and poststructuralist theories offer some insight into how this paradigm might be disrupted. Moving beyond reductionist theories of behavior and motivation, habitus (Bourdieu, 1977) and social discourse (Foucault, 1972) present two similar perspectives on how social reproduction takes place at the contextual level. Using the context as a unit of analysis, Bourdieu and Foucault urge us to reflect on sociohistorical traditions of power and practice in dominant culture, to see them not as deterministic social structures in themselves, rather as part of culture's momentum. Though invisible to us as participants in their workings, habitus and discourse serve as guideposts for agentive action, a system of rules, roles, and norms of behavior by which we can contextualize our interactions and relationships. Such a view portrays an ecological image of society – a mixture of social structures and situated knowledge communities, influenced by habitus and discourse, but malleable and open to agency and resistance.

Yet as a result of their production and reification, some discourses emerge as dominant systems of social practice, and thusly part of the establishment of cultural hegemony. Non-dominant communities, their social practices and ways of knowing the world, are thereby pushed into the margins, often under-privileged or under-served, and left out of larger societal institutions, such as education (Aronowitz & Giroux, 1987). In a political age where equity and access are touted as core social values, critically examining relationships of power and "what counts" as knowledge (Gutierrez, 2008) is a necessary step in where achievement gaps come from, why such gaps seem to target certain populations, and how cultural participation influences one's literacy- and identity development (Lave & Wenger, 1991).

Sociocultural learning theories propose that learning is a fundamentally social process, influenced by the historicity of tools, behaviors, and tensions in which one's cultural participation and learning are taking place. As such, sociocultural learning theory problematizes our understanding of formal education as a system that both constrains and makes possible individual action. Sociocultural perspectives understand society as a compilation of multiple cultures and ways of knowing the world – a multivocal system. Thus representing the lived experience of generations of peoples constructing and interacting with social structures, this multivocality lies at the heart of historical tensions between those practices and knowledges that are privileged over time, and those that are not. From this perspective, formal education can be seen as a construct of privileged literacy practices with a tradition of rewarding those who assimilate well to its rules, roles, divisions of labor,

and norms of behavior. Those, however, who "need to acquire more" of the cultural capital encompassed by the system's valued traditions are often remediated through lower academic tracks and special services (McDermott & Varenne, 1996; Roth & Barton, 2004).

If we assume a fundamentally social understanding of the learning process, achievement gaps observed across our schools may look less like a problem with districts' abilities to bring non-achievers "up to speed", and more like a systemic problem with education's institutionalized privileging practices. The question then becomes not one of homogenizing the learning experience or making the dominant discourse of schools more "transcendent" (Gutierrez, Rymes, & Larson, 1995), but of embracing the heterogeneity of discourses, identities, and customs brought into the context.

Technology's role in this process has been relatively unexplored, but a handful of studies (Rantala, 2009; Wang & Ching, 2003) point to the importance of today's technological environment as a tool for reshaping the look of education. As youth-based movements involving the technology-mediated production and refashioning of media (e.g., remixing) suggest, the availability of media outside of school is already having an impact on youth culture (Goodman, 2003). Children and young adults are appropriating resources and technologies to create expressive forms of communication, forge cultural identities, and engage with local and global issues (for examples, see Stornaiuolo, Hull, & Nelson, [2009]). Leveraging new media technologies to support non-dominant and marginalized students' literacy development may be a powerful mechanism for disrupting dominant discourses in schooling and empowering the disenfranchised, as exemplified by Gutierrez's (2008) work with the Migrant Student Leadership Institute. As such, we need to better understand how technology tools can mediate that process.

Like other social practices, technology practices are intimately connected to cultural contexts. They do not simply represent physical tools or artifacts unto themselves, rather "specific forms of participation, in which the technology fulfills a mediating function" (Lave & Wenger, 1991, p.102). For that reason, it is important to not only deconstruct technology practices to identify how our epistemic assumptions regarding technology use have influenced education practices (see Roth & Barton [2004] for an insightful look at how "right use" constrains student access to learning), but by reflecting on how technology use is folded into our instructional practices, we may open the door to new possibilities for creation and participation. In short, by letting technologies flexibly mediate learning, instructors might actually empower students from non-dominant cultures to access and engage curriculum in novel ways that are relevant to their own lived experiences.

This study makes use of the fundamental concepts of CHAT to explore issues of technology integration as experienced by students. While barriers to integration exist at the institutional- and instructor-levels, students represent the end-point at which these issues are realized. CHAT represents a valuable tool for zooming in on sociocultural tensions that manifest barriers to effective integration and ICT literacy development. Expansive learning, consequently, serves as a framework with which to examine how students, teachers, and schools can approach such perceived barriers, such as those related to power and authority,

in an effort to achieve successful learning outcomes despite historical inequities related to schooling in general, and learning with technology in particular.

CHAPTER 2

LITERATURE REVIEW

This chapter will explore the issues of student technology use through the lens of the conceptual framework just outlined. School-aged children spend increasing amounts of time interacting, playing, and learning with technology outside of school, and ubiquitous computing and one-to-one laptop programs in schools have recently started to gain real momentum across a wider variety of communities (Zucker, 2004). In the context of technology-ready education, scholars have attempted to gain an understanding of how institutional structures and instructional practices have led to a disparity in ICT skills among students of differing ethnic- and socioeconomic backgrounds. The studies discussed within this review form a small piece of a growing field that has approached this division from a sociological perspective. As such, the literature presents two main concerns regarding the reproduction of digital education inequities: 1) barriers to technology integration, and 2) the role of technology in the expansion of students' action possibilities.

The persistent discrepancy in technology use between the classroom and the outside world has led some to question the relevancy of traditional models of education in a fast changing globalized society (Warschauer et al., 2004). Some researchers and education stake-holders have called for significant changes to the predominant model of schooling, arguing that teachers should focus on equipping students with a range of abilities that reflects a more modern, technology-enriched approach to learning, such as "21st Century Skills" (Bellanca & Brandt, 2010). The influence of this call can be observed across a growing number of institutions as they implement broadband networking and student computing programs at increasing rates (U.S. Department of Education, 2010). Yet while access to these technologies has improved for students in remote, underfunded, and historically marginalized communities, gaps in achievement, and especially in technology skills development, persist (Warschauer & Matuchniak, 2010). The digital divide, it would appear, is not closing, at least not nearly at the speed many educators and policy makers would prefer.

The digital divide originally referred to the binary condition of technology access – specifically to personal computers and Internet-based technologies – observed across a range of socioeconomic, geographic, and ethnic factors during the dot com boom of the 1990s (Clinton & Gore, 1996) – a time marked by a massive proliferation of consumer-level computing technologies, start-up businesses, and investment in networking and telecommunications (Zhang, 2003). Used to describe the unequal distribution of technology within the schools of less-affluent communities and their wealthier counterparts, the term "digital divide" has been adopted to detail issues of infrastructure, funding, and the development of technology-integrated curricula (Hohlfield, et al, 2008). While these issues highlight aspects of the digital divide at the surface level, deeper systemic issues such as empowerment, social justice, and literacy acquisition are now commonly included in scholars' examinations of digital education inequity (Harris, 2010). Their studies highlight the effects of the digital divide in areas ranging from social capital (Mouza, 2004) to cultural

reproduction (Clark & Gorsky, 2002) to technology literacy development (Subramony, 2007) in an effort to problematize the divide as a social issue, not a merely financial one. Research reporting a dearth of technology support mechanisms, lack of teacher training in technology integration, and absence of production-based technology activities in many schools (Garland & Wotton, 2001; Hutchinson & Reinking, 2011; Subramony, 2007) speak to issues that extend beyond access and implicate attitudes towards technology, technology distribution, and the cultural value of technology literacy acquisition shared within communities (Harris 2010; Mouza, 2004; Warschauer et al., 2004; Warschauer & Matuchniak, 2010).

For this reason, scholars have criticized the original conception of the digital divide as being too deterministic; while access to technology is a fundamental steppingstone to overcoming digital education inequities, other factors such as school culture and teachers' technology integration practices have significant impact on students' opportunities to learn and interact with technology to improve their academic achievement (Anthony & Clark, 2011; Warschauer et al., 2004, Windschitl & Sahl, 2002). Effective technology integration represents complex, nuanced challenges that comprise significant divisions among students' digital education experiences (Hohlfeld et al., 2008). As increasing numbers of schools begin integrating digital technologies into their classrooms, scholarship in the field has taken focus on these issues through the lens of qualitative and ethnographic methodologies to better understand how technologically-marginalized children can enjoy the same opportunities for digital literacy acquisition, cultural participation, and 21st century skills development as their more affluent peers. The scope of this review will encompass the role of this genre of ethnographic research, especially in the area of sociocultural learning theory, to examine the nature of barriers to technology integration and student technology use.

The Educational Digital Divide

According to recent research, the problem of the digital divide is multi-faceted. Hohlfeld, et al (2008) constructed a model that segments the divide into three levels, representing issues of digital inequity in hierarchically inter-dependent themes: access, technology use, and student empowerment. Figure 2 depicts this model as a pyramid – the width of each level indicating the relative proportion the issue within the overall scope of digital inequity. Hence, the bottom-most layer (School Infrastructure) is both widespread in scale, and foundational to disparities experienced at narrower, more developed levels of technology implementation, such as use of technology for instruction, and individual student use of technology for personal empowerment.

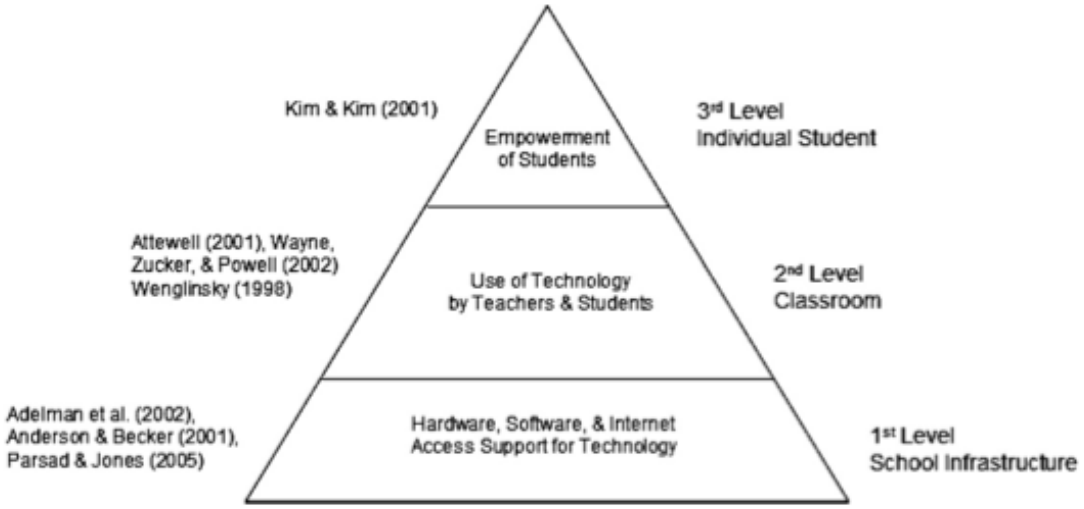

Fig. 1. Levels of digital divide in schools.

Figure 2: Hohlfeld, et al.'s model of the Educational Digital Divide.

Hohlfeld et al.'s (2008) model may be interpreted as follows: the most fundamental level of division, in terms of digital inequity among schools is the disproportionate access to technology resources such as computers, Internet service, and support. Indeed, for underprivileged students to develop the same technology skills as their privileged counterparts, they must first have access to a similar range of technology resources. Without access to technology, there can be no instrument with which to narrow the digital divide, except, of course, by disrupting the access of others. School infrastructure thus represents the largest, most fundamental obstacle to digital equity. Upon securing the infrastructure that is necessary to support educational technology in the curriculum, schools face the challenge of ensuring that teachers and students use technology resources frequently, and for meaningful learning purposes.

Technology use, the second tier, refers to educational use of technology for a spectrum of activities and, subsequently, the creation of learning opportunities. As technology use is largely affected by teachers' comfort with technology, and institutional rules regarding the use of computers (Windschitl & Sahl, 2002), this tier points to socio-structural mechanisms that influence the effectiveness of technology integration. This "Classroom" level of digital education inequity also refers to the working condition of classroom, the frequency with which that technology is used by students and teachers for learning, and the ways students engage with instructional technology (e.g., content delivery, rote drill and practice, information gathering and research, game-playing, critical analysis of media content, etc.). The quality of technology, the amount of time spent using it, and the depth of technology-mediated learning activities all contribute to students' technology skills development, and thus comprise a foundation upon which the third tier, individual empowerment, is constructed.

At the top of the Educational Digital Divide pyramid, "Empowerment of Students" refers to students' ability to employ technology for "the betterment of their quality of life" (Hohlfeld et al., p.1650) – a decidedly broad definition. Put another way, the ability to utilize technology resources for personal goal attainment is contingent on one's fluency with those resources. "Empowerment of Students" therefore represents the disparity among youth to make use of technology for these purposes. Hohlfeld et al. suggested that the complexity of the digital divide thus increases as teachers integrate technology into instruction: the extent to which integration empowers students to become authors of their own work represents a level of division that either endows students with the capacity to use technology for change, or limits technology skills development to specific instructional tasks.

Hohlfeld et al. (2008) argued that the qualities of empowerment are difficult to identify, nevertheless integrate into curriculum and teaching practices. To date, few, if any, measurements of technology literacy and technology skills development include benchmarks of empowerment, especially in historically underserved communities. Because empowerment depends on 1) a base level of (technology) skills, 2) the ability to employ those skills to attain certain (learning) objectives, and 3) the *opportunity* to attain those objectives, the third level of the digital divide seems to have close ties to theoretical notions of agency. Few studies have discussed the role of technology integration in supporting student agency, however, especially within the context of one-to-one computing.

One can draw a theoretical connection between empowerment and agency via the notion of improvisation. According to Holland et al (1998), agency is dependent on the internalization of semiotic practices, such as using signs or symbols to connote certain cultural meanings. Repeated use of these mediating tools for specific tasks produces heuristics, which represent an internalized relationship between tool and task. Holland et al. assert, "to the extent that these productions are used again and again, they can become tools of agency or self-control and change" (p.40). Improvisations are plays on, or renovations of, these heuristics (Holland et al.) – deviations from conventional application for the purpose of achieving one's goals. In this sense, agency is the manifestation of improvisation, and the ability to improvise rests upon one's capacity for autonomous action (Bourdieu, 1977). Hence, to empower is to enable one with the tools of improvisation.

Therefore, it is useful to consider the influence of social structures and instructional practices on student empowerment with technology (such as the ability to rehearse heuristic use of technology tools), as well as the nature of tensions between structures and students (Gutierrez, 2008). The first stop for such an examination is technology integration.

The Second Level of the Digital Divide: Technology Integration

Definition of technology integration in this report. Definitions of technology integration span the literature in a slew of ways, each seemingly with its own interpretation of just what "integration" entails, what it looks like, and how it can be assessed (Hew & Brush, 2007). As noted in chapter one, for this report, I borrow from Belland's (2009) interpretation, which defines technology integration as "the sustainable and persistent

change in the social system of K-12 schools caused by the adoption of technology to help students construct knowledge (e.g., research and analyze information to solve problems)" (p. 354).

Replacement, amplification, and transformation. Technology integration, at its heart, relies on knowledgeable teachers being able to infuse technology into instruction as a tool to meet certain pedagogic goals (Warschauer et al, 2004). Previous studies have categorized integration according to the embeddedness of technology in particular tasks, and the ways in which technology shapes the end product of those tasks (Hew & Brush, 2007). Examples of these categories include: "(a) replacement, (b) amplification, or (c) transformation" (Hew & Brush, p.227). Replacement means to literally use technology in place of an existing "analog" technique, without altering the substance of the task. An example of such might be to use presentation software to project text onto a whiteboard or projector screen, rather than writing the same text with chalk or marker on the classroom chalk- or whiteboard. Amplification refers to an increase in task efficiency through the use of technology, but again without an actual alteration of the task. An example might be using a word-processing template to create several copies of a form letter, as opposed to handwriting each individual copy. Transformation involves the use of technology to "go beyond" what would otherwise be impossible or unrealistic in an analog context. According to Hew and Brush (2007):

> [The] use of technology as transformation has the potential to provide innovative educational opportunities (Hughes, 2005) by reorganizing students' cognitive processes and problem-solving activities (Pea, 1985). For example, students can use computer databases and graphing software as tools for exploratory data analysis, data organization, and for framing and testing hypotheses related to the data. Many teachers have not been exposed to transformative technology-supported-pedagogy because professional development activities have focused primarily on how to merely operate the technology. (p.228)

While replacement and amplification certainly have their value in terms of technology integration and ICT skills development, most studies of digital education inequities tend to focus on disparities of transformative technology use among students (Subramony, 2007). Legitimate assumptions to make would be that transformative tasks are not incorporated into certain classrooms because of issues related to integration, or that teachers fail to integrate transformative tasks into the curriculum because, as Hew and Brush suggest, they lack the knowledge and/or skills to do so. Recent studies that detail numerous barriers to teachers' integration of technology in the classroom suggest behavioral norms, epistemological assumptions about learning, and institutional "rules" have a large effect on how students learn to use technology meaningfully (Anthony & Clark, 2011; Hew & Brush; Warschauer & Matuchniak, 2010). Further, the focus and depth of professional development provided to instructors, may influence teachers' comfort with certain technologies, as Hew and Brush alluded.

In terms of digital education inequities discussed in the previous section, these barriers represent significant concerns for the frequency of technology use, and the empowerment of students through technology. From a sociocultural perspective, many of theses barriers

implicate elements of institutional structures, as well as social practices related to traditional learning environments (e.g., authority, autonomy, and approaches to learning).

Barriers to technology integration. Studies have identified several socio-structural barriers to teachers' effective technology integration, including lack of resources, institutional structures, school culture, personal attitudes and beliefs, knowledge and skills (which include issues of professional development), and pressures associated with frequent high-stakes assessments (Anthony & Clark, 2011; Hew & Brush, 2007).

Knowledge and skills. As Hew and Brush (2007) suggested above, teachers without adequate knowledge of technology-supported-pedagogy may not utilize technology in "transformative" ways, implementing technology instead to only "replace" or "amplify" tasks. Indeed, several studies cite the need for teachers to obtain technology knowledge and skills in order to integrate technology effectively (which is to say, for transformation) into the curriculum (Anthony & Clark, 2011; Bauer & Kenton, 2005; Harris 2010; Hew & Brush; Mouza, 2004). Schools typically rely on professional development as a primary means for supporting teachers' technology knowledge and skills, yet the focus and depth of such programs may not support teachers holistically in their development of technology integration skills (Anthony & Clark). Professional development programs that focus too narrowly on skills acquisition may neglect making connections to subject-specific curricular goals, or even to general pedagogical goals.

A lack of technology skills also seems to make some teachers more hesitant to facilitate technology-related classroom activities, nonetheless integrate technology for transformation. Teachers' discomfort with technology, in particular, has been shown to affect the frequency of technology use in the classroom and the kinds of technology-related tasks students perform (Anthony & Clark; Hew & Brush).

Though the traditionally accepted rules and procedures of classroom activity can be adapted to suit technology-enhanced learning environments, some argue that technology necessarily expands the action possibilities of students in ways for which traditional classroom management structures have yet to establish rules (Wang & Ching, 2003). For instance, the inclusion of computer monitors, mice and keyboards, and access to websites presents potentially distracting temptations for students (Hew & Brush). Inability to maintain control, or fear of losing control, in such an environment arguably puts many instructors on edge. Altering the classroom dynamic, especially in ways that introduce mediating artifacts that teachers have no direct control over, or confidence in using themselves, can potentially shift the balance of power and authority in the classroom (Burns & Polman, 2006; Roth & Lee, 2007). While some may argue these developments present positive challenges to the traditional teacher-centered model of education, many teachers are reluctant to embrace such changes (Roth & Lee).

Providing teachers with opportunities to acquire the skills they need to help end digital education inequities (i.e., incorporate technology-related activities more frequently, or provide opportunities for students to use technology in ways other than for replacement or

amplification) demands significant funding and planning, but money and time alone will do little to close the gap. Conflicts of power and control are especially prescient in technology-enhanced classrooms (Rockman, 2007; Wang & Ching, 2003), and are disparaging to many instructors. The introduction of interactive devices that have the potential to allure, distract, and tempt the subversion of rules serves as a sort of lightning rod for such "chaos", and consequently discourages spontaneous collaborative group activity in favor of restrictive teacher-centered activities (Wang & Ching). Without the skills to ward off or adapt to these situations, teachers might arguably have little energy or motivation to address important ICT literacy skills.

Institutional factors. Institutional factors impinging on technology integration include administrative practices such as scheduling, planning, and leadership (Hew & Brush, 2007). In cases of top-down technology implementation initiatives, Hew and Brush noted that teachers' relationships to administrators, and understanding of technology program objectives, significantly influenced how teachers integrated technology into the curriculum. Lack of administrative support, as well as constraints to in-class time, limited teachers' ability to implement a variety of technology-related activities (Karasavvidis, 2009). Further, insufficient planning for technology implementation, including lack of widespread involvement and training, consequently diminished the expansion of teachers' use of technology (Hew & Brush).

Conversely, Warschauer et al. (2004) found that institutional commitment to inquiry-based learning and student authorship led to highly effective technology integration practices among English language learner classrooms, especially in less top-down, and more "grass roots" environments. In the cases presented by Warschauer et al., administrators supported teachers in movement towards student-centered classrooms by granting teachers the autonomy to set their own schedules based on student- and curricular needs. In the other case, the class met for three hours, considerably longer than average class times.

While one might conclude that teacher autonomy thus increases teachers' ability to integration technology effectively, few studies have considered these institutional barriers from a sociocultural perspective. Anthony and Clark's study (2011), however, provides a thorough glimpse into how institutional structures affected several instructors' use of technology. Under the pressure of meeting state technology standards, and dealing with administrators' and parents' expectations of how teachers should use technology, many instructors developed coping mechanisms for abiding by this "technology as rule" mandate. Indeed, Anthony and Clark found that bell schedules, overload of high-priority, non-technology initiatives, and lack of training made meeting the expectations of administrators and parents very difficult without bending other rules, such as holding class outside of normal class meeting times.

Attitudes and beliefs. Teachers' beliefs about learning and instruction have a profound effect on what takes place in the classroom (Ertmer et al., 2012). As regards technology, several studies have noted that teachers' attitudes about technology's role in curriculum shaped pedagogical goals and influenced the purpose and duration of technology-related

classroom activities (Ertmer et al.; Hew & Brush, 2007). In cases where such beliefs conflicted with institutional rules and expectations for technology use, Anthony and Clark (2011) found that teachers experienced "dilemmas of practice", which ultimately impacted the nature of activities students undertook with technology. Teachers who indicated technology use was secondary to "advancing through the curriculum" or "[integrated] technology to meet others' expectations" limited technology-related activities to rare occasions or utilized a narrow range of resources during the activities.

Some studies indicate that the prolonged use of technology tends to shift teachers' classroom practices towards a constructivist epistemology (Harris, 2010; Burns & Polman, 2006). Broadly, constructivism holds that knowledge is created through experience. As the learner gains new experience with a phenomenon, previous experience acts as a foundation upon which knowledge and skills are further developed (Piaget, 1952). The suggestion that there is a causal relationship between ubiquitous computing and constructivist pedagogy is heavily contested in the literature. Indeed, some scholars assert that any movement towards a constructivist pedagogy is mediated by a combination of contextual social- and cultural factors (Windschitl & Sahl, 2002), not by the mere ubiquity of technology resources.

According to Windschitl and Sahl (2002), though research in the past has highlighted factors such as professional development opportunities, access to technology, and technology support resources as important indicators of teachers' integration practices, these factors are "often treated as *independent* variables whose effects contribute in various magnitudes to the behavior of individuals" (p.166) (emphasis added). Rather than considering constructivist teaching practices as emergent qualities of the social environment in question, these studies seem to draw a direct connection between technology infrastructure (i.e., the working condition of resources and the implementation of skills-based professional development) and the evolution of attitudes and beliefs towards technology. Examples of such findings claim that teachers more quickly adopt constructivist practices after prolonged use of technology in ubiquitous computing environments (Harris, 2010), yet, these findings have been highly contested (Sullivan & Moriarty, 2009) due to evidence that teachers use technology in ways that align with their already-held epistemological and pedagogical beliefs (Zhang, 2009). Indeed, few of the studies reporting a causal relationship between technology and pedagogical shifts towards constructivism have actually investigated the sociocultural conditions in which such shifts took place. Instead, these studies treat constructivism as a trait *to be acquired*, such as through more skills training or access to better technology resources. Studies that approach student literacy in a similar manner (i.e., as a trait to be acquired by individuals), however, have been criticized for presenting too narrow a description of the knowledge construction process (McDermott & Varenne, 1995; Roth & Barton, 2004; Roth & Lee, 2007). In short, while literacy scholars have been critical of positivist and behaviorist approaches to learning, technology integration scholars seem to have been able to make deterministic claims about learning without the same level of criticism from their peers.

Coping with barriers to integration. While some barriers to technology integration point to issues of leadership, infrastructure, and administration, it is clear that there is no simple formula for its effectiveness. Integration practices, like other social practices, reflect complex relationships between individuals and structures, and as this study proposes, should be treated as such. Changes to the classroom orientation brought on by the introduction of technology compound the issues of infrastructure and instructor beliefs, as teachers struggle with changing roles related to discipline and authority, student autonomy, and the organization of technology-mediated learning activities (Bauer & Kenton, 2005). The dynamics of power, rules, social roles, divisions of labor, and mediating artifacts all impinge on human interactions within schools, and the integration of technology is no different. Infrastructural as well as sociocultural factors influence these interactions, resulting in various degrees and interpretations of technology integration in the classroom. Anthony and Clark (2011), for instance, found that teachers experienced a number of dilemmas involving the use of technology with regards to its role in a given activity. As a result of these dilemmas, teachers demonstrated a range of integration techniques and practices encompassing various coping strategies and levels of technology use, often struggling to employ technology in meaningful ways that supported students ICT literacy development. Additive tasks such as online games, puzzles, and manipulatives served to mediate students' learning of curriculum material, but predominantly as ancillaries to more common instructional techniques such as drill and practice. In many of these cases, technology was used as a tool to motivate student engagement, rather than to serve a primary learning objective. To overcome these challenges, teachers routinely "broke rules" by extending class time beyond the standard duration of the period, or slowing down the pace of instruction, but often always with positive outcomes for students' ICT literacy development. The need to subvert institutional structures presents a clear source of conflict between teachers and administrators with obvious implications for student learning. Though even if these barriers to effective technology integration can be overcome for teachers, barriers to student learning may still exist.

Issues of pedagogy and practice in empowering students. Effective technology integration may be difficult to achieve because its success is determined by a number of context-specific factors, such as those mentioned above (i.e., school culture, teacher attitudes and beliefs, access to technology, administrative support, etc.) (Anthony & Clark, 2011; Mouza, 2004; Windschitl & Sahl, 2002). Even within schools, contextual factors at the classroom- and individual levels may result in different integration practices between teachers (Windschitl & Sahl). This has led some to argue that technology integration is situational, and hence, digital education inequities should be considered an outcome of sociocultural factors, not simply a problem of access or lack of technology skills (Hohlfeld, et al., 2008).

In a study of successful technology integration with English Language Learners (ELLs) across two vastly different contexts, Warschauer, Grant, Del Real, and Rousseau (2004) presented examples of instructors leveraging the unique circumstances of their classroom situation (i.e., the student backgrounds, local environment outside the school) to tailor

integration practices that produced high-achieving learning outcomes. While Warschauer, et al. assert, "The keys in both cases are a school-wide commitment to excellence, equity, and development of classroom communities of inquiry" (p.535), it is important to note that in each example presented, the object of activity was not to gain fluency with specific technology tools. Rather, students used technology to mediate the construction of knowledge and knowledge artifacts as a means to "follow through" the process of language learning. Shifting the focus away from learning specific technology tools (such as Microsoft PowerPoint) presents a departure from typical state-regulated technology standards, where proficiency for specific tools is explicitly mandated (Anthony & Clark, 2011). In the cases presented in Warschauer et al.'s report, technology's role was to support student reflection and facilitate the production of representational media, such as CD-ROMs and digital presentations. These types of activities reflect metacognitive tasks that make thinking explicit to the learner, which has been shown to improve student learning in a number of contexts (Lin, Schwartz, & Hatano, 2005). To support reading fluency, the instructor at one of the schools guided students in activities such as vocabulary-picture matching and "Webquests" – Internet searches for pictures of different words – to prepare the students for independent reading exercises. Students used word processing and spreadsheet software to keep track of reading progress, to submit work and receive instructor feedback, to produce multi-media instructional material, and to collectively critique and write book reviews on Amazon.com's website. As a summative assessment, students used Microsoft Excel to analyze character development in a matrix of literacy themes. Though the students in this study no doubt had to become skillful in using different software and hardware technologies to complete the tasks described, the authors do not mention any barriers that arose from students' (or teachers') lack of technology skills, nor did any tensions between institutional structures (such as technology curriculum standards) and instructional practices arise. While it is not out of the question to presume that some stumbling blocks arose throughout daily interactions with technology, it could be argued that any barriers that did arise were confronted with flexible adaptation on the parts of the teacher, the school, and the students. Indeed, as school culture and institutional structures can present substantial barriers to integration, one could make the case that changes within school cultures or to structures might create opportunities for integration where barriers once existed.

In the second case described by Warschauer, et al. (2004), a progressive approach to academics in tandem with access to relevant technology resources was credited for producing successful learning outcomes in a school with the highest number of English Language Learners (ELLs) in the state of Maine. The school's model of education, called "Expeditionary Learning", focused on "the relationship between learning and representation" which was "supported by research indicating that student's best master curriculum that they are required to represent, and consequently, that learning is extended by one's access to, and literacy and facility with, representational media" (p.533). This approach, then, dovetailed easily with the adoption of a one-to-one laptop program, which

provided students with regular access to presentation tools and information resources[1]. According to Warschauer, et al., at the time the school made the move to implement the "Expeditionary Learning" model, it had suffered from "low test scores, deteriorating attendance and discipline, few extracurricular activities, low expectations for teachers and students, and a climate of hostility" (p.532). Drastic changes within the school such as eliminating the bell schedule, mainstreaming all previously tracked classes, and integrating fine arts, special education, and reading specialists into humanities and science subjects, provided necessary reforms that supplanted the move to a project-based learning curriculum. Arguably, these reforms created an atmosphere of support and flexibility that allowed teachers to integrate technology to help differentiate instruction in mainstreamed classes, provide students with access to sophisticated tools, and create authentic learning opportunities regardless of language ability or technical fluency. How, then, might such successful results be replicated in other learning environments, particularly in ones where a total reformation of educational practices seems unlikely or out of the question? A commonality between both scenarios presented by Warschauer, et al. is that technology integration followed a model of instruction that prioritized pedagogical values (e.g., reflection) over technology skills acquisition (e.g., learning specific presentation software). By establishing a culture that enabled instructors to integrate technologies that best fit the needs of a given activity, a potential "dilemma of practice" between teachers and institution did not appear.

From the standpoint of activity theory, in both cases Warschauer, et al. (2004) present, technology served two important functions: 1) to mediate the relationship between subject (students) and object (English language proficiency) in the activity system, and 2) to extend the action possibilities of the activity system subjects (i.e., the students). Engeström (2001) would refer to the second potentiality as "expansive learning opportunities", or the production of "culturally new patterns of activity" (Engeström, p.139). Similar outcomes have been produced in studies of students with learning disabilities (Roth & Barton, 2004), and suggest that traditional notions of literacy need to be reconsidered in light of their epistemological assumptions about the learning process. These studies share an approach that considers learning as a sociocultural process – a process that, most often, plays out in the presence of privileged perspectives, attitudes, pedagogies, instructional models, and even tools (McDermott & Varenne, 1995). To empower the students who struggle in the face of these privileged aspects of the educational system, the schools presented in Warschauer et al.'s study were able to identify and deconstruct barriers to both teachers' integration of technology into curriculum (i.e., rigid technology standards, classroom

[1]It is worth noting, however, that the school's commitment to representational media does not require the use of computerized technology. Before laptops, the school relied heavily on paper- and performance-based forms of representation for student projects.

structures), and students' use of technology (i.e., frequency and purpose of technology use), and arguably, create expansive learning opportunities for all parties involved.

Expansive Learning Opportunities

Engeström, (2001) argued that by explicitly acknowledging cultural tensions and contradictions found in a given social context, "expansive learning" – new forms of cultural activity – can occur:

> As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort. An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity. (Engeström, p.137)

Engeström's (2001) case study subjects engaged in intentional discussions directed at making tensions and contradictions of practice explicit. In so doing, they reconceptualized the object and motive of activity to generate mutually beneficial outcomes for each party involved. In an educational setting, the results of Engeström's study hold promising benefits for similar outcomes related to technology integration. However, a large difference between the context of this study and classrooms, however, is that Engeström's subjects were hospital staff, primary care providers, and patients – an arguably very different context from that of classrooms, where divisions of labor between activity participants are closely tied to relationships of power and authority. Moje et al. (2004) suggested that students may not readily look for opportunities to navigate, bridge, or challenge school-based practices in classroom activities. And so instead, teachers may need to create activities that are structured specifically to legitimize and draw upon multiple funds of knowledge (i.e., non-academic or "cultural" funds of knowledge) to promote the expansion of students' action possibilities. Yet activities that enable students to bridge, navigate, or challenge schooling practices necessitate the understanding of the "discursive conventions" that serve as barriers to achieving the object of activity. Teachers must therefore be able to identify local tensions, where contradictions between social practices and students' roles, use of tools, division of labor, etc. prevent students from becoming agents of their own learning.

Further, instructors must be able to identify the mechanisms available for the appropriation and reconceptualization of mediating artifacts that can be used to expand students' action possibilities (Moje, et al.). Locating four areas from which the students in their study drew upon "funds of knowledge," (family, community, peer groups, and pop culture), Moje et al. place the responsibility of creating such opportunities with teachers and curriculum developers, adding to the call that effective educators need to "know" their content *and* their students.

Wang and Ching (2003) found that students spontaneously negotiate personal goals and social rules in technology mediated environments to expand upon their opportunities to participate in technology-related activities. Restricted to computer time by the instructor

(which was enforced with a timer and waiting lists), students in Wang and Ching's study "socially [constructed] not only their computer experience, but also their early school experience on a whole" (p.335). The spontaneous activity students performed resembled "chaotic" interactions instructors have described as barriers in other studies (Windschitl & Sahl, 2002), with "highly overlapping talk", animated behavior, and groups of students clustering around a single computer screen. Students thereby challenged the rules set forth by the teacher to create opportunities for social interaction, as well as to create opportunities to utilize each other as knowledgeable resources for the development of technology-related skills (in this case, an educational game). Indeed, Wang and Ching argued that challenging the classroom rules was, in fact, an important aspect of social learning processes: "From a Vygotskian perspective…: the children are engaged in valuable social construction and negotiation of their classroom experience and culture by appropriating and transforming the use of a powerful cultural artifact; in this case, the computer" (p.337).

By studying these aspects of children's interactions, Wang and Ching (2003) proposed research could better understand how technology is used to mediate the negotiation of behavioral norms and agency in the classroom. By extension, examining students' spontaneous use of technology can reveal some clues as to how certain integration strategies might promote agency and empowerment. Just as Windschitl and Sahl (2002) found teachers "breaking rules" to achieve pedagogical and instructional goals, so too did students resist imposed social structures to achieve personal goals related to technology use.

Wang and Ching (2003) also found that divisions of labor factored heavily in students' negotiation of social practices. In a classroom equipped with a single functioning computer, only two students could sit at the workstation at any given time. As a result, the teacher had to enact a number of rules to regulate fair and equitable access to all the students. When first called up from the waiting list, students were allowed to act as a workstation observer, sitting next to the "player" – the student in control of the actual computer. After a turn (a standardized unit of time set by the teacher) was over, students would move from the observe position into the player position. The previous player then went back to the waiting area, which was demarcated a certain distance away from the gaming workstation. In some instances, however, students invited others to participate (i.e., observe and give advice) from beyond the teacher-mandated boundary line (Wang and Ching referred to these outside participants as "mobile participants"). Thus, a group of students crowded at the boundary, often trying to observe the game from a distance.

Students routinely challenged the teacher's rules, not as outright resistance to school policy or from any desire to act in a subordinate manner, rather to achieve the simultaneous goals of engaging in social interaction and spending time at the computer. Mobile participants "often scrutinized the computer activity intently from afar and waited for an opportunity to join the action" (p.350). Wang and Ching (2003) argued that this "transformed the meaning of the area around the computer, such that it became a highly significant space with shifting

zones of participatory legitimacy" (p.351). According to Lave & Wenger (1991), it is this sort of engagement through participation that scaffolds students in agency, because the negotiation of social practices is both a legitimate form of participation in the class and the computer activity, as well as evidence of expansive learning opportunities.

Though students in their study appropriated materials in the environment to negotiate their goals (in effect transforming the meanings of certain artifacts, such as the computer controls, the workstation itself, and the physical space separating them from the rest of the classroom), Wang and Ching (2003) do not report on the actual computing skills students learned in the process. Nevertheless, their study highlights the importance of understanding the role of mediating artifacts in the negotiation of social practices. In terms of technology integration, understanding how the material conditions of the environment, in combination with imposed social structures, affects student behavior during technology-related activities can shed some light on where contradictions of practice exist between students, their teachers, and institutional structures. How these contradictions affect student technology use is a question that few studies have considered.

Following Wang & Ching's (2003) study, along with studies of barriers to student technology use (Warschauer et al, 2004), the connection to effective integration appears to be the flexibility of learning environments. The question then, is how do students come to terms with social practices that inhibit or promote their technology use? The current study explores this question through the lens of activity theory.

Closing

The literature discussed in this chapter highlights three major concerns for research on digital inequity and technology integration:

- Instructional technology use for the replacement, amplification, or transformation of learning activities has differing effects on students' opportunities to learn with technology, especially in ways that contribute to the development of agency and empowerment;
- Institutional structures and pedagogical values have a significant impact on the ways instructors integrate technology into the curriculum, and thus have an important effect on students' use of technology for learning;
- Students and teachers come to terms with (i.e., navigate, bridge, and challenge) school-based social practices in various ways to achieve their situated objectives. In technology rich learning environments, students have been shown to spontaneously appropriate technology to mediate this process.

The purpose of this study is to identify the barriers to students' use of technology, both in terms of frequency and purpose of use, and the socio-structural environment's impact on use. The review of literature presented here addresses several concerns of ubiquitous computing environments, ranging from the instructional practices of teachers, to the

institutionalized rules and culture of schools, to perceptions about technology's role in the creation of student-centered learning environments.

While access to technology is the most fundamental issue contributing to digital education equities, the frequency and purpose of technology use in the classroom provides the foundation for students' technology skills, and supplants their facility for agency, and ability to wield technology as a tool for personal and academic growth. Though some approaches to learning, such as constructivism, may lend themselves well to the enabling of students' use of technology for transformational, or agentive activities, tensions between students' use of technology and classroom practices (i.e., rules, division of labor, etc.) often act as barriers to transformative uses of technology. In some cases, students are supported in navigating, bridging, and challenging these tensions to realize opportunities for learning, or more basically, ICT skills development. In others, students come to terms with these tensions in unpredictable ways, with differing results. Approaching the intersection of tensions through the lens of activity theory offers a way to frame the problem of technology education inequity in sociocultural context. To that end, this dissertation examines the nature of students' technology use, and how students might be empowered to navigate, bridge, and challenge barriers to their technology literacy development.

Research Questions

Leading from the overarching research question, "what are the barriers to students' technology use in the classroom?" the current study considers classroom social practices, peer relationships, the affordances of technology, and emergent mediational processes that arise during the research study from an activity theory approach. The research questions guiding this study are:

- What are the institutional and instructional rules regarding classroom technology use? What social practices and behavioral norms emerge in light of these rules?
- How is technology integrated into instruction? How does the integration of technology translate into action possibilities for students in the classroom? How are these action possibilities created?
- How do students use technology for academic participation, and how does this action relate to their situated learning objectives?
- How do students use technology for other forms of cultural (i.e., non-academic) participation? Are these practices leveraged for academic learning or for navigating, bridging, or challenging, classroom practices?
- How do students come to terms with the teachers'/institutions' rules regarding technology use? And how does this affect their learning and attitudes towards technology?

CHAPTER 3

METHODS

Case Study Approach

The goal of this inquiry is to identify tensions and contradictions of practice in students' use of classroom technology, and the coping mechanisms they employ in the face of those tensions and contradictions. According to Bogdan and Biklen (2007), a case study design is appropriate for inquiries that seek to provide a "detailed examination of one setting" (p.59), and especially so for examining "questions, situations, or puzzling occurrences arising from everyday practice" (Merriam, 1998, p.11). Provided that a primary goal of this study is to understand in-depth the barriers that exist to students' technology use, a case study methodology is appropriate because such a study will allow the researcher to "develop general theoretical statements about regularities in social structure and practice" (Becker, 1968, p.33).

According to Merriam, a case study is "an intensive description and analysis of a phenomenon or social unit such as an individual, group, institution, or community" (2002, p.9). As such, the "case" represents a single contained system, the study of which seeks to provide an in-depth description of the phenomenon or entity under investigation. This narrowly focused approach is characterized by the study's unit of analysis, which differs from broader studies in its scope and generalizability (Merriam) by providing the researcher the opportunity to closely examine the nature of practices within a bounded system (e.g., an activity space).

The purpose of qualitative case study research is to uncover the situated meanings of phenomena as they unfold in particular social contexts (Dyson & Genishi, 2005). Yet the perspective from which the researcher selects to approach the case in question (empirical or theoretical, general or specific has a large bearing on how the terms "social" and "context" are bounded (Ragin & Becker, 1992)). For instance, an empirical approach might consider nation-states as bounded empirical social units with which to contrast either specific phenomena (the trade of bulk goods), or generic ones ("misconduct"). Conversely, a theoretical approach might consider cases as constructs, which emerge from one's research evidence. Hence, the observation of common characteristics across settings (e.g., technology literacy disparity between students of differing socioeconomic backgrounds) would serve to identify specific "cases" of the observed phenomenon.

Another perspective of cases as theoretical constructs might consider such cases as invented categories, created by theorists for the purposes of constructing generic frameworks from which to understand certain sociological phenomena (Ragin & Becker, 1992). From this approach, "context" might be conceived of as a theoretically bounded location in which certain behaviors are exhibited, or phenomena are observed (such as an activity system). In other words, when following this approach, the cases in question are

bounded by the researcher's theoretical framework, but exist as conventions independent of one's research evidence (Ragin & Becker). The current study follows this latter approach.

Multiple-Case Design

A descriptive case study design is used in this inquiry to gather a "thick description" (Geertz, 1973) of students' technology-related activities in the classroom. Taking an activity systems approach to case study design invites the potential for more than one single category of cases as, according to Ragin and Becker (1992), the study of multiple cases is appropriate where research combines multiple levels of analysis. The multiple levels of analysis followed by this study concern not just the elements of various activity systems observed in the classroom, but the ways in which students navigate, bridge, or challenge contradictions of practice that emerge from certain activity systems. Hence, this study considers two primary units of analysis: individuals and activities.

Cases of individuals. This study investigates contradictions of practice related to students' classroom use of technology. As such, this study attempts to understand the social context of technology use as it relates to individuals within the classroom. According to Platt (1992), "cases are the outward and visible signs of inferred social-structural principals" (p.46), and for a study in which agency plays a particularly significant theoretical role, adopting the individual as a representation of a case presents a way of perceiving the manifestation of such theoretical concepts. For this reason, a small number of students serve as the focal participants of this study, with each student representing an instance of a "case".

Activity as a unit of analysis. The analytical approach to this study is based on the fundamental tenets of activity systems theory. As the participants in this study interacted with different roles, rules, divisions of labor, and mediating artifacts throughout the school year, contradictions of practice emerged and shifted as social influences on classroom activity systems (e.g., ways of speaking, social capital, etc.) took various shapes (Engeström, 2001). Instead of conceiving of these emergent practices as properties of the classroom, this study takes the approach that social practices are results of interactions within various activity systems' configurations. The activity system therefore represents a theoretical construct that may be used for perceiving different actions in terms of institutional structures and social practices. A focus on technology-related activities helped to establish the social context of technology-mediated learning and the identification of practices that served to supplant and inhibit students' opportunities to learn with technology. The instances of activities discussed in this paper are those in which tensions between students and institutional structures interfered with students' opportunities to learn with technology.

Cross-Case Analysis

Activities were analyzed across the individual cases (i.e., focal student participants) to examine patterns of phenomena related to the elements of Engeström's (2001) model (i.e.,

subject, object, division of labor, etc.). Cross-case comparison necessarily involves a "decontextualization and recontextualization" (Tesch, 1990) of cases, as data are separated into categories (i.e., "stripped" of their context), and then juxtaposed against each other within those categories (i.e., recontextualized as examples of themes). According to Khan and Van Wynsberghe (2008), while the decontextualization of data in a cross-case analysis puts the authenticity of within-case phenomena at-risk, researchers have mitigated this risk by detailing the context in which the phenomena took place, such as through the narrative style of "thick description" (Geertz, 1973). Thus, the categories reported in this study are presented in a narrative format so as to properly "immerse" the data within its original context.

Setting

This study took place at a mid-sized high school located in Bayside (pseudonym), a working-class city in northeast Massachusetts. The Bayside school district serves roughly 4,300 students, and of the approximately 1300 students who attend Bayside High School, 23 percent are eligible for free or reduced lunch, 16 percent require special education services, more than five percent are non-native- or limited English proficient, and 14 percent are non-white.

Scores on the Massachusetts Comprehensive Assessment System (MCAS) exam over the past four years in Bayside indicate a persistent achievement gap between low-income students/students of color and their white counterparts in the areas of English Language Arts, Mathematics, and Science and Technology/Engineering, with the largest disparity being in the fields of Science and Technology/Engineering.

In September 2000, the New England Association of Schools and Colleges (NEASC) placed Bayside High School on "warning" because of "large scale deterioration of the building, its infrastructure, and its instructional equipment." In response, the City of Bayside Building Commission hired an architectural firm to conduct a feasibility study of the high school, and develop options and costs for future facilities needs. The firm's recommendation to construct a new academic building, in addition to renovating the existing field house, auditorium, and cafeteria areas, was adopted by the School Committee and City Council, and in February 2006, the Bayside City Council appropriated $65,000,000 for the project. Two years later, the Bayside City Council approved the price tag of $80.155 million for the new high school to the lowest bidder, and an award letter was issued to begin construction. The Massachusetts School Building Authority agreed to reimburse the city 56.42% of the cost and add another 2% reimbursement if the project is certified as a "green school" upon completion.

During the two years between the NEASC's decision to place Bayside High on warning, and the start of renovations to the old facility, the Bayside district Technology Director and a science teacher from the high school, Mr. Harris, attended a presentation on one-to-one laptop learning. Inspired and intrigued, the two began planning an ambitious program of their own to introduce a one-to-one learning environment to Bayside High School. With the

construction of the new school building, the Technology Director saw a "once in a lifetime opportunity" to incorporate the infrastructure and technology necessary to support a one-to-one program into the building's design. The idea gained the approval of the district Superintendent and the School Committee, and in 2008, construction on the new building began, with the intent of supporting a 1300-student one-to-one laptop learning environment.

The new Bayside High School building, replete with a state-of-the-art wireless network and an electrical system touted for its use of solar and renewable energies, opened for the beginning of the 2010-2011 school year, becoming the first school in Massachusetts designed specifically to support a one-to-one laptop learning environment. The Technology Director purchased six mobile laptop carts, and roughly 200 Apple MacBook laptops to begin piloting one-to-one learning with select faculty.

During that time, Mr. Harris and the Technology Director started a public relations campaign that included gathering research and newspaper articles on existing one-to-one programs, delivering presentations to parents and faculty on the benefits of one-to-one computing, and producing a public website to share the information and materials they had collected to support their initiative. This site became the official message board for Bayside High School's one-to-one laptop program, and on it, families and students could find the district's rationale for going one-to-one, their goals for the program, and expectations for teaching and learning that would result from this new and ambitious endeavor.

To support the initiative, the Bayside Educational Foundation raised $38,000 (part of its five-year, $250,000 capital campaign) from local business and private donations. This money would provide financial assistance to families who would not be able to lease or purchase a laptop for their children at the reduced rate being offered by the school.

The Bayside High School laptop program required all students to lease a MacBook Pro laptop and case. Roughly 25 percent of students' families took advantage of the school's one-to-one financial assistance programs, which include a scholarship program (requiring families to cover 40% or 60% of the laptop lease) and laptop-loaner cart for in-school use.

Participants

A participant teacher for this study was solicited with the assistance of the district technology director and the principal of Bayside High School. A biology teacher, Mr. Harris was selected, due to the relevancy of the subject area both to technology-related activities in the classroom, and to levels of proficiency on the state standardized test subjects mentioned above.

Mr. Harris was solicited with the assistance of the district technology director and the vice principal of Bayside High School, for his reputed level of technology knowledge and skills, and interest in technology integration.

Before conducting the study, I explained to Mr. Harris that participation in the study would involve the completion of a several interviews and daily classroom observations over the course of the year. Focal participants would be ensured anonymity and confidentiality, and that their participation will be completely voluntary, meaning participants had the option to withdraw from the study at any time without penalty. I also discussed with Mr. Harris the terms of the participant consent form, explaining that all data collection would be wholly confidential, and not be available to district or school administrators during the duration of the data collection process.

I selected a purposive sample of focal student participants with a range of non-dominant backgrounds (i.e., ethnic minority, low socioeconomic status, immigrant, and poor academic performance). The set of individual participants also reflected a range of comfort/ability levels with technology, and access to technology outside of school. The range of comfort/ability levels served to compare and contrast students' engagement with technology-related activities, as well as their development of technology literacy skills over the course of the school year. Similarly, a range of access to technologies outside of school served to identify social factors related to students' technology use, such as gaming, cell phone texting, or other personal uses of technology that influenced their classroom fluency and skill level with classroom technology.

Focal students and their parents/guardians were given consent forms to read and sign. Additionally, I explained in person to the entire class that participation in this study would involve frequent observation sessions, and recorded interviews throughout the duration of the data collection process. I also explained that all data collected for the purposes of this study would remain confidential, and that each participant would be granted full anonymity throughout the research process.

Participant profiles.

Mr. Harris. In a school without a full-time technology integration specialist, Mr. Harris was known as Bayside High School's instructional technology guru. Indeed, having been a facilitator of the majority of the district's technology professional development for the several years, and being himself one of the first, or at least most long-standing, classroom computer teachers in the building, Mr. Harris had an outstanding reputation for integrating technology into his instructional practices. When I asked him to qualify his proficiency in using technology for instruction, he answered modestly,

> "I mean, I think I'm pretty good at it. I'm at- at least proficient... You know, a- again, I don't know if I'm ready to meet expectations, because I have high expectations, and I don't think you ever quite get to be perfect."

Despite not being "perfect," I found it easy to describe Mr. Harris as very confident in his ability to learn and adopt technologies for classroom instruction. Perhaps because of this reason, he did not seem very phased by the typical barriers to integration that many school teachers face, such as a lack of comfort in using digital technologies, a lack of technology skills, a lack of training in technology integration strategies, or even a lack of understanding

how the use of digital tools might help make his own teaching practices more efficient (and in some cases more effective).

Mr. Harris did observe such barriers hinder other teachers' use of instructional technologies, however, and he spoke with me at length about his perception of the causes and effects of how technology integration presented dilemmas of practice for his colleagues, and even at times for himself. Widely, these dilemmas surrounded teachers' attempts to square institutional expectations regarding technology integration with their own teaching practices.

Mr. Harris clearly saw the value of using technology with his students - primarily as a mediating artifact. As such, he believed digital technologies were tools that could support the development of higher order thinking skills, and could help create "authentic" learning experiences for his students. By the time of our first interview together, I had observed Mr. Harris in class over the course of four weeks, the equivalent of ten class meetings. Between those observation sessions and our informal discussions regarding the use of technology for instruction, it was apparent that Mr. Harris had both a wealth of skills and experience integrating technology into his teaching practices, and was well at the forefront of Bayside High School's one-to-one laptop initiative in terms of his readiness to embrace a pedagogy of "21st century teaching and learning".

At the time that I met Mr. Harris, he was already invested in having students create digital artifacts, including audio podcasts, videos, and colorful, graphically enhanced "posters", to demonstrate their understanding of science concepts. In describing his reasons for preferring that students create multimedia productions over "simple word processing," he explained that he felt essay writing encouraged students to "find out something, repeat it back to me," as opposed to engaging them in "higher order thinking" processes. Such processes, he stated, incorporate elements of visual literacy, creativity, and reflection of one's understanding of a topic. Mr. Harris saw the construction of such artifacts as potentially extending the audience with which student work could be shared. Intrinsically, Mr. Harris felt that the production of materials "for an audience", as opposed to, say, a sole teacher, created a scenario in which students not only had to consider more closely how the information would be interpreted (easily readable, visually appealing, and providing necessary information in a succinct manner), but that by having a more "authentic" audience for the task (again, not simply the teacher) injected a measure of accountability and ownership that he hoped would motivate students to work at a higher level.

Reggie. Reggie was a senior at Bayside High School, and a Haitian immigrant to the country. After the 2010 earthquake, Reggie's parents returned to Haiti, leaving him and his older brother in Bayside. Reggie was enrolled in the Introduction to Biology class his senior year after having taken, but failed the class in the 11^{th} grade.

Reggie was a member of a popular student-run video production outfit, which had recently won a national award for their series of humorous, but informative "variety shows." While

involved somewhat in the recording and production of the show, Reggie was predominantly the show's "talent," acting as one of the show's main hosts.

Throughout the year, I observed Reggie become hyper-engaged during lectures and class discussions. He was practically on the edge of his seat at times, responding to Mr. Harris's words as if the two of them were wrapped in their own conversation. Reggie seemed to think of Mr. Harris as an infinite resource of experience and knowledge. "Teachers," he told me during one of our interviews, "are supposed to *inspire*." Reggie's constant engagement, however, seemed to earn him the ire of some of his classmates, as eyes roll and students hush their groans at Reggie's asking of yet another question. After some of the more seemingly random or tangential questions, Mr. Harris occasionally scolded Reggie, simply repeating his name, "Reggie. Reggie. Reggie," until Reggie got the hint and withdrew the question. Reggie's social capital, it seemed, was always on display.

Reggie also carried a self-diagnosed learning disability, attention deficit disorder (ADD), which he claimed greatly affected his ability to retain information in the classroom. Having never been tested for ADD by a licensed professional, Reggie did not receive any mandated learning accommodations in the classroom.

Tommy. Tommy was a white, working class native of the city of Bayside. Having failed the Introduction to Biology class in 9th grade, he was re-enrolled in the class for his Sophomore year. Tommy had a history of academic underachievement, having failed out of the nearby vocational high school after a semester before transferring to Bayside High School. In middle school, Tommy had been diagnosed with a learning disability, for which he received numerous academic accommodations, including extended time on tests, preferential seating, and direct instruction from his teachers.

Tommy was highly social, and actively sought to converse with his peers throughout class. His "burnout" appearance and way of speaking also contributed to a reputation for self-medicating and using illegal drugs (marijuana) during the school day. Adding to Tommy's reputation was the frequent regularity with which he checked his cell phone and asked to leave the room. Tommy was a great fan of cell phone technology, and could often be heard chatting with Jake, another student in the class, about the various features of cell phones.

While Tommy clearly saw the value that his cell phone added to his social life and lifestyle, he admitted to not liking to use his Apple MacBook laptop. He listed various reasons for this, including its slowness it comparison to his cell phone, and the fact that many of the web sites he liked to visit were blocked by the school filter.

Angelo. Angelo was a twelfth grade immigrant of Uruguayan descent. Angelo's family moved from Uruguay when he was very young, and he spent his early years in a Latino community outside of Boston, before moving to Bayside in middle school. Having taken Engineering as a 9th grader, Angelo was enrolled in the Introduction to Biology class to fulfill his graduation requirements.

Angelo was an adamant soccer fan. Having had a dispute with the Bayside High School soccer coach, Angelo was kicked off the varsity team, and played for a local club team. Angelo's grandfather had been a professional defenseman for perennial world soccer power FC Barcelona, and played for the Uruguayan national team. Angelo's younger brother also had aspirations for playing professional soccer, and was a member of the New England Revolution development team. Soccer was thus a huge part of Angelo's daily life. After graduating, he hoped to play on a local community college's varsity team.

Wei. Wei was a tenth grade Bayside native of Asian descent. Although her mother also lived in Bayside, Wei lived under another adult's guardianship - the reasons for which were not disclosed to me. Wei was often quiet, and rarely spoke in class, expect to Reggie, who sat next to her during the majority of class meetings. Wei earned good grades in school, and as the Moodle activity logs suggested, she was highly motivated to perform well on assessments, rehearsing practice tests numerous times in preparation for upcoming exams.

Carmella. Carmella arrived to Bayside half-way through the academic year, and was enrolled in the tenth grade. A native of the Philippines, Carmella came to Bayside by way of Missouri, where she had attended another one-to-one laptop school. Carmella was also very quiet in class, and often kept to herself. Although Carmella quickly earned herself the praise of Mr. Harris for her excellent work in class and performance on assignments, I occasionally glimpsed Carmella surfing the Internet during class time, typically on fan forum sites dedicated to the Minecraft video game.

Data Collection

As with other ethnographic studies, data collection for this study encompassed a number of strategies aimed at understanding the social and historical context of the research setting, the location of individuals within that context, and the practices of individuals both in regards to agency and social convention. The primary means of data collection were field notes (Emerson, Fretz, and Shaw, 1995) and interviews, which were supplemented by official documents related to technology planning and integration. Video recording also supplemented my field notes, and provided a more complete, moment-to-moment analysis of technology use. Video recordings included close-up footage of students' computer-mediated actions (e.g., typing, using the mouse, pointing, etc.), and footage of in-class, project-oriented activities.

Role of the researcher. The role of the researcher in this study combined two popular methods of observation: silent observation and participant observation. According to Bogdan and Biklen, (2007), silent observation is a popular method of data collection for case studies such as this one, because it allows to researcher to "take it all in" (p.92) without the need to negotiate one's level of involvement with the study participants or activities. However, while obtaining permission to access the research site, the vie principal and I decided that it would benefit Mr. Harris and his students for the me to occasionally assist with technology support issues in the classroom. This type of involvement with the research participants more closely resembles the description of a participant observer. In both

scenarios, I had hoped to become a "'natural' part of the scene" (Bogdan & Biklen, p.98), and thus at the outset of the study, I began as a silent observer, only occasionally stepping into the participant observer role where necessary.

Bayside High School operates on an alternating daily schedule with four, 82-minute periods meeting each day. Classes meet every other day, and thus alternate between two and three meeting times each week. Observations began half-way through October (roughly five weeks after the beginning of the school year), and took place during each class meeting over the course of the 2012-2013 school year.

Field notes. Field notes were used to establish the physical and social environment. Field notes serve as a standard means for describing observed events, and on the research setting itself (Bogdan & Biklen, 2007). Field notes were collected during classroom observation times, and documented both the classroom setting, as well as classroom activities. Initially, field notes related to classroom activities focused on the questions, "What are the rules/behavioral norms of students' technology use in the classroom?" and, "What are the similarities/differences between how students use technology?" The goal of the former question was to get at the nature of social constraints imposed on students, as well as to identify student agency in the presence of institutional structures, while the latter was used to identify patterns of common technology practices.

Subsequent field notes throughout the study honed more closely in on elements of activity systems theorized by Engeström (2001), including the subject and object of activities, mediating artifacts, norms of behavior, rules, divisions of labor, and community. Thus, field notes also described teachers' instructional practices with technology (i.e., technology tools used, integration strategies, authoritative/subordinate behaviors, etc.), and students' social practices related to the use of technology (e.g., ways of speaking about technology, ways of sharing/collaborating, coping with technology failure, etc.), mediating artifacts (i.e., physical hardware, software, classroom materials, and other resources).

According to the suggestions of Bogdan & Biklen (2007), field notes were immediately transferred to a computer, and in addition to descriptions of people, events, objects, and activities, included "ideas, strategies, reflections, and hunches" (p.118) about the data and any emerging patterns. These notes and memos formed the foundation of data for analysis in this study.

Interviews. Interviews with the focal instructors in the study outlined specific academic goals and the pedagogical/curricular rationale for utilizing technology during specific activities. Initial interview questions with instructors were based on Reinking's (2011) survey of "Teachers' Perceptions of Integrating Information and Communication Technologies Into Literacy Instruction", which focuses on comfort level, skills, and attitudes towards technology (see Appendix A for interview protocol). The purpose of this interview protocol was to identify Mr. Harris's attitudes and beliefs about technology in the classroom, as well as his previous experience with technology integration, such as specific tools and activities used, and potential barriers to integration. I asked Mr. Harris in

subsequent interviews to address any constraints that imposed on students' classroom technology use, and the purposes for implementing such constraints. These questions were aimed at establishing the institution's influence over instructor behavior and pedagogy, particularly in terms of classroom technology deployment. I also conducted irregular semi-structured interviews with Mr. Harris, using questions derived from field notes and observed phenomena that related to emergent themes and patterns that come up during the data collection process.

Interviews with focal students in the study were aimed at answering questions related to technology use, such as 1) for which purposes students used technology in class and at home (e.g., communicating with friends, special interests and hobbies, etc.), 2) self-perceptions of technology proficiency, 3) attitudes towards technology and technology use in school. Juxtaposing students' responses to these questions with the results of my interviews with Mr. Harris aided the process of identifying specific tensions related to technology use and empowerment.

Video recordings. Video recordings also helped identify specific technology practices. These recordings were especially helpful in understanding technological constraints that impinged on students' use of technology, as well as the affordances of technology to enable students' learning.

Data Analysis

A constant comparative analysis (Glaser & Strauss, 1967; Strauss, 1987; Corbin & Strauss, 2008) informed the data collection and the analysis portions of this study. The constant comparative method involves the continual comparison of units of data against each other for the purpose of "[deriving] conceptual elements of… theory" (Merriam, 2002, p.8). 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). As such, constant comparative analysis holds that context-based, substantive theories of phenomena are derived inductively from research data. The purpose of the constant comparative method is to develop theory that is situated in qualitative data, and thus typically involves the analysis of texts, observations, and interviews (Kamberelis & Demetriadis, 2005). This data is scrutinized throughout the data collection process for recurring themes and relationships. A phasic process is employed, which includes rounds of open coding, axial coding, and selective coding, concurrent with frequent cross-checks to establish validity between codes (Kamberelis & Demetriadis). A constant comparative method was particularly useful for the current study, as data collection encompassed a number of sources, and a range of behaviors that evolved and shifted throughout the duration of the data collection process. This revealed new insights, and necessitated new questions to address emergent issues related to barriers to students' technology use (Wang & Ching, 2003).

This study borrowed from Anthony and Clark's (2011) methods of constant comparative analysis to situate the context of technology-related activities, identify barriers to students' technology use, and categorize students' mechanisms for coping with those barriers. Anthony and Clark used 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 (described below). 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 contradictions of practice (i.e., discursive social barriers) with regards to students' technology use by employing an activity systems coding paradigm, and analysis of institutional documents.

As with the constant comparative method, coding took place in phases. The first phase of coding, open coding, refers to the organization of data according to general themes and relationships. For this study, the first phase of coding borrowed directly from Anthony and Clark's (2011) study: field notes, interviews, and video recorded data were categorized using a coding scheme based on Engeström's (2001) elements of activity systems: subject, object, mediating artifacts, rules, community, and division of labor.

From these codes, a more focused, micro-level analysis took place: axial coding, which involves the constant refinement and comparison of coding categories, "until a relatively small, manageable, and maximally relevant set of categories are settled upon" (Kamberelis & Demetriadis, p.99). The purpose of axial coding is to uncover relationships and connections between codes in the data, such as causal conditions of certain events (phenomena), ways of reacting to or dealing with those events, the contexts in which such events happen, intervening conditions, which prevent, constrain, or otherwise shape the strategies people use to interact with certain phenomena, and finally, the consequences or outcomes of interaction with a certain phenomena (Corbin & Strauss, 2008). These relationships and connections, in turn, became categories and themes, which revealed patterns of phenomena that were analyzed in the third stage of coding: selective coding.

The selective coding process begins with the selection of a central category, around which "story lines" (Corbin & Strauss, 2008) are created, connecting other categories and related events back to the core category. Selective coding is the systematic reconnection of this core category to other categories identified in the axial coding process. This final phase of coding identified the central themes related to students' technology use, including the practice-based tensions that arise during activities, and the mechanisms students employed to navigate, bridge, and challenge those tensions.

Informed Consent

Participants were informed of the research project though the informed consent process. During this process, I specified how and when the research would be conducted (see

Appendix B). The informed consent helped to establish guidelines so that the research followed a clear and detailed timeline.

Confidentiality

To ensure the confidentiality of all the participants in this study, pseudonyms will be used in place of proper names of persons and the academic institution.

Limitations of the Study

The results of this study are limited in their generalizability due to the small sample size that a case study requires for close examination of social practices. The limitations of using a small sample is compounded by this study's focus within a single course subject (Introduction to Biology) and classroom. While the concept of a digital divide (as defined in this study) encompasses a wide range of geographic, social, ethnic, and cultural factors, a case study only considers a very small piece of this very complex puzzle, and a highly contextualized one at that. Although findings from the data analysis might be applicable to academic environments not included in this study, results should be taken as context-dependent. The cases of individuals presented herein tell a story of students who live in but one single city in a small corner of the United States, and attend the same class, taught by the same teacher, with the same classmates. Any sense of "typicality" of the circumstances of the individuals in this study and their classroom practices should be interrogated against this backdrop. At the time of this study, Bayside High School was also the sole one-to-one laptop school located in Northeastern Massachusetts. While the city of Bayside has a long history with working class and immigrant peoples, the city's cultural values, social problems, and education system arguably represent a more subdued picture of education inequity in relation to much poorer, struggling communities found in other parts of the country, and indeed, the world. Yet, the naked truth is that few one-to-one laptop programs exist in many struggling communities.

The definition of digital inequity discussed in this report reflects certain ontological and epistemological assumptions, and as such, present another limitation to the study. In the sense that one can only observe what one chooses to look at, the conceptualization of the digital divide in this and other studies reflects the values of the researcher as regards certain aspects of educational inequity. Inequity is an all-too-common symptom of the education system establishment, and it is only those aspects which research considers worthy of study (and publication) that see the light of day. The "divisions" observed during this study reflect a decidedly narrow subset of the possible inequities or tensions that occur in technology learning environments, and hence are by no means a comprehensive detailing of the issues facing digital education today.

Another limitation of this study is the relatively recent implementation of the laptop program at Bayside High School. At the beginning of the study, Bayside High School was only in its second year as a one-to-one laptop school. Some studies of technology integration effectiveness suggest that realizing the benefits of ubiquitous computing is a developmental

process, and may take several years for individual instructors to accomplish, nonetheless entire schools (Belland, 2009; Hew & Brush, 2006; Windschitl & Sahl, 2002). Thus, any tensions or contradictions of practice related to students' technology use may be a factor of the relatively short period of time teachers and administrators have had to develop enduring technology integration strategies that can meet the needs of the school's population of students.

CHAPTER 4

RESULTS

Framing Technology use at Bayside High School Through the Lens of Activity Systems Theory

Activity systems theory (Engestrom, 1987; Roth & Lee, 2004) provides a framework for analyzing the accounts of technology use described in the this study, particularly as they relate to tensions and contradictions that emerged at various levels of power within the social hierarchy of Bayside High School and the Introduction to Biology class. The historicities of the accounts described in this dissertation extend beyond the limited temporal and spatial dimensions of my short time with the focal participants. As systems of activity, each of the contexts in which technology was used entails its own set of subjects, objects, mediating artifacts, community, rules, and division of labor - sociocultural contexts in which the backgrounds, dispositions, and identities of all involved intersect, at times in harmony and with productive results, and at times in tension. In the following sections, I report on the various uses of technology that I observed, represented as meso- and micro-level systems of activity that operated within and across the greater system of technology integration, the laptop program, and schooling practices in general. As such, the systems of activity presented in this study focus on those that were teacher-defined: assignments, projects, and in class activities that included clearly outlined objectives. By framing actual technology use within (and against) the perspective of teacher-defined activities, I propose that it is possible to examine how the focal students gained entry into the larger school community as legitimate students, and how they were further marginalized as a consequence of their resistance to teacher-defined roles, rules, and objectives.

Subjects. For analytical purposes, I selected to focus on student participants described in the previous chapter as the activity subjects of this study. Occasionally, the "subjects" node encompassed dyads of students, small groups, and even the whole class, depending on the activity.

Objects. In activity theory, objects represent the motivating reasons why subjects participate in a given activity. Traversing the landscape of the laptop program, it is evident that what motivated the institution of Bayside High School, Mr. Harris, and the focal students fluctuated wildly, spanning a wide spectrum of spatial and temporal contexts. As such, the objectives motivating the focal students' participation in academic, technology, and other activities, shifted and intersected frequently, sometimes from moment to moment. This made the identification of single activities confusing at times. To simplify the process of identifying and analyzing activity systems, the focus of this study centers on discrete, teacher-defined activities: assessments, online worksheets, digital posters, and other uses of technology around which various Biology concepts and course materials were organized. As such, the sanctioned (teacher-defined) objects of activity often comprised benchmarks of task completion, and occasionally, "higher order" learning outcomes such as critical thinking, creativity, metacognition, etc. For reasons discussed below, the focal

students in this study often saw task completion as the primary objective motivating their participation in these sanctioned technology activities. Many times, however, students' orientation towards task completion left many of them overlooking the "higher order" objectives Mr. Harris intended for students to achieve. Over the course of the year, I observed technology activities become ever more scripted and managed - a phenomena that put into question the purpose of technology-mediated activities, and the connection that these activities have to progressive as well as canonical pedagogies.

Objects of activity did not only consist of the completion of discrete tasks, however, nor the development of specific skills (an orientation towards learning and instruction that I will discuss later). Rather, technology itself sometimes took on the role of "object of activity" - the purpose of which was simply to make use of technology "for technology's sake." Throughout the year, however, the objective of activities centered around learning the concepts of biology as outlined by the state curriculum, and demonstrating the pre-defined technology skills that were outlined in the school's technology rubric.

Mediating artifacts. Mr. Harris and his students used a number of tools, including digital-, paper-, and human resources to achieve the goals of the various activities they engaged in over the year. Mediating artifacts negotiate the relationship between the subject and object of activity, which as stated above, were institutionally defined as the learning of mandated biology subject matter and the demonstration of select technology skills. The most relevant mediating artifacts to this analysis were the students' laptops, Internet and Internet-based tools, software applications, worksheets, prior technology skills, student peers, and although not sanctioned for classroom use, cell phones. At times, these mediating artifacts disappeared within the context of activity, as certain activities became so routinized that technology itself played an invisible role in the achievement of goals. Multiple-choice assessments, for instance, were always delivered through the use of Moodle, which, over time, resulted in a blurring of the distinction between assessments and technology. In such a way, I argue, technology became married into the activity of assessment through its close association with the mechanics of test taking, in a sense, becoming a representation of assessment and the forces that imposed canonical learning structures.

While the laptops afforded a great amount of flexibility in being used to mediate various activities, I observed students use their laptops for sanctioned in-class activity in a relatively narrow spectrum of ways. As tools of instruction, the students' laptops served as an extension of schooling practices, which several of the focal participants in this study resisted at various times. A critical part of the following analysis will be the examination of *how* certain tools were used. Indeed, students occasionally used technology in ways that Mr. Harris did not intend, resulting in outcomes that sometimes contradicted the pedagogical or curricular objectives of the activity. These episodes constituted tensions that drove, and more times than not, served as constraints over students' use of technology for learning.

Community. The "community" of activity comprises all the interactants (subjects) who share the same goal for participating in an activity. As such, community mediates, and is mediated by, the rules and division of labor of the activity. Community thusly also regards

the sociocultural context of activity, or what Barab et al. (2002) call "emergent norms" of the "classroom microculture." For the Introduction to Biology class, microculture shifted slightly around different activities, but there were some consistent elements of classroom culture that transcended individual activities. Community thus equated to legitimate participation in the culture of schooling, or "playing the game of school" as Mr. Harris referred to it. In this way, entry into the community meant participating in activities along the lines of typically subordinate student behavior - engaging in assigned tasks in ways that exhibited a motivation to do well, all the while observing the rules of the school and the division of labor set out during in class activities.

Some examples of community included observing beginning-of-class rituals, abiding the expectations for behavior during certain activities, and using appropriate ways to speak to and about other students. To illustrate the concept community, during lectures students were expected to copy the text from the lecture slides presented by Mr. Harris. The students could use different software or media (i.e., pencil and paper), but they were all expected to be sitting quietly, paying attention, and taking notes. Mr. Harris had the floor at all times, unless he directed a question towards the class. Mr. Harris typically followed a Socratic method, asking students questions that probed their understanding more deeply after an initial response. Usually, especially in instances where the class was particularly engaged and riled up, Mr. Harris enforced certain rules of behavior, such as raising one's hand to be called upon before answering, and telling the students to close their laptops "three-quarters the way shut" as a way to gather their attention. By adhering to these rules, students demonstrated their alignment with the teacher-defined classroom (and school) community.

During activities, community mediated different ways of engaging with the material, with technology, and with one's peers. As such, community represented a significant part of performing the role of "biology student" throughout the year. Types of interactions, like Reggie's enthusiastic participation in lecture activities, grated against the class's community culture, as noticeably many of the students in the class remained relatively silent throughout the year, and only socialized with their immediate neighbors. What emerged from these interactions were three main scrums of social and cultural identity. Mr. Harris and I both noticed this odd occurrence (as it happened seemingly as a coincidence), and remarked to each other about it on occasion. I refer to these three groups as "The Gamers," "The Smart Kids," and "The Bad Students."

During class discussions, both the Gamers and the Smart Kids remained relatively silent, and only spoke aloud when asked by Mr. Harris. Conversely, the "Bad Students" were frequent participants in class discussions, often vying for attention. This group was also the most vocal during other activities, as well as the most disruptive. Three of the focal students (Reggie, Tommy, and Angelo) were a part of this group, who were marked most easily by their outward defiance of school rules, and poor academic performance (which was lamentably often on display for the entire classroom to observe).

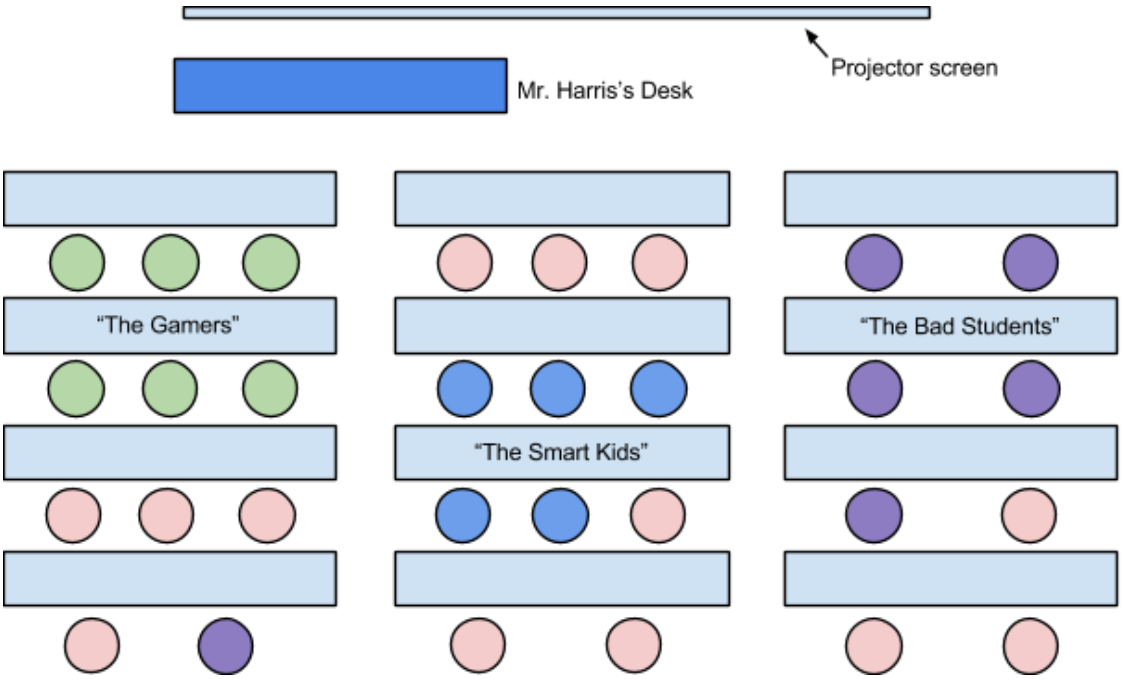

Figure 3: Social organization in the Introduction to Biology class.

Rules. The "rules" node in activity systems theory refers to the norms and expectations of behavior that inform, and are informed by, the history of the activity. This includes, however, structural rules as well as social ones, as they mediated the subject's entry in, or proximity to, the greater community. Though structural rules do not determine social behavior, they can act as social forces that bound behavior in ways that are normative or anti-normative. For example, the Bayside school district was very concerned with the safety and online conduct of its students, and as such, instituted an Acceptable Use Policy (AUP) to lay the ground rules for student technology use at the high school. In its AUP, the district outlined more than 48 stipulations pertaining to the use and access of information retrieved through the school's Internet system, including numerous regulations regarding cyberbullying, copyright, and the use of school computing technology for commercial purposes. Among those rules pertaining directly to learning and instruction, included: 1) students were not allowed to access social networking sites (which were blocked unless explicitly sanctioned for educational use by the district Technology Director), 2) students must not plagiarize or violate copyright law, and 3) students were forbidden from downloading "large files" from the Internet while using the school's wireless network. Such provisions arguably limited the ways students could engage with technologies, but nonetheless begged questions about power relations and the process for sanctioning certain artifacts that had the potential to expand students' learning opportunities. A critical aspect of this study is the examination of the rules of various technology activities observed in the Introduction to Biology class, as rules tend to be regulating forces that may inhibit, as well as afford, various action possibilities. These, in turn, may lead to opportunities for learning, and entry into sanctioned enclaves of school-based "communities of practice" (Lave & Wenger, 1991).

Certain activities were also forbidden by the administration, such as the use of cellphones and headphones in class. While Mr. Harris sometimes allowed certain students to use headphones because he saw that it help them focus their concentration during class, this lax headphone rule was abused by other students, who would take the opportunity to simply go through their music collection, at times at the risk of being distracted from the task at hand. In a special case, Mr. Harris was told by administrators to not enforce the cell phone rule with one student, Jake, because the local police wanted to track his potentially illegal activities (Jake was on parole at the time for selling drugs in school). Sometimes, such discrepancies appeared to create areas of tension between students, as certain forms of behavior (e.g., being a "good student") were rewarded with a relaxation of rule enforcement. Rules were thus distributed unequally at times amongst the class.

During technology activities, rules often pertained to regulations of behavior, such as limiting students' access to the internet during assessments, restricting students to partnerships with only certain peers during collaborative activities, or to limited modes of expression, such as text-only responses to daily questions.

Division of labor. The division of labor mediates the relationship between the community and the object of the activity. Or as Yamagata-Lynch (2007) describes, "The division of labor is the tasks that community members share while the subject is participating in the activity." As such, the division of labor also refers to the various roles community members can occupy during an activity, such as administrator, teacher, student, family-member, etc., and the tasks that constitute those roles. One of the often-championed causes of one-to-one learning environments is their ability to enable a shift traditional teacher and students, and create a learning space that is more egalitarian and autonomously student-centered. Interestingly, the rhetoric delivered in the district's official documentation (e.g., the technology rubric) and its public relations artifacts (e.g., the Technology Director's presentation on one-to-one teaching and learning) made no mention of topics such as student-centered learning, or the ability of technology to reconceptualize classroom learning spaces. Rather, by emphasizing the use of technology to deliver materials electronically, complete assessments online, substitute digital textbooks for paper-based ones, and access information via the Internet, school administrators seemed to suggest that the "dramatic changes" to instruction and learning that they expected to observe pertained primarily to the efficiency of content delivery and feedback on assessments. While these changes necessarily translated into new demands for teachers in terms of lesson preparation and grading, practically no emphasis was placed on the reframing of student roles in the classroom.

Though the use of technology has the potential to create new ways to engage students in class, "teacher-centered" environments operate as such that it is often implicit on the teacher to create such opportunities. In this sense, a teacher serves as a "gatekeeper" to learning opportunities, with the authority to distribute roles and tasks to students as they fit the objective of the activity. Towards the end of the school year, I had observed very few instances of students occupying non-traditional, student-centered roles in the Introduction

to Biology class. Mr. Harris typically doled out assignments, often with explicit step-by-step instructions for students to follow, providing only a few degrees of freedom for engaging with the material in creative ways. When I asked Mr. Harris about these practices, he replied,

> ...The open-ended assignments that I could have done, were dr- dramatically limited. Because I couldn't let Tommy, and Angelo, and Reggie on an open-end assignment, because Reggie would go all over, Tommy would get lost, and ask to go to the bathroom to, you know, go smoke, and Angelo would be hitting on all the girls. So that negatively affected, like, [the higher achieving students]. You know? And those kids would check out… And in reality, one of the things I probably would have liked to do stuff, is to do more open-ended things with them. But the fact that I couldn't get through a set of notes in forty five minutes, and it would take three days, um, that kind of eliminates all of your time to do open-end things… Tommy had no ability to get started. He would look at something and say, "Okay, what do I do?"
> "Alright, look at number one."
> "Okay, what do I do?"
> "Have you read the question?"
> And I would literally go through him, and sit with him even- "Have- what is the question asking you? Alright, well what do you need to do?"
> "Can I put on my headphones?"
> Um, he just had the- such a- which again, that's where a- some worksheets came in, was, okay, he needed it to be written, number one. Number two, number three- He needed the direction. So if I unleashed an open-ended thing on him, he'd be like, "Um. You want me to write a commercial? What's a commercial?" You're kidding me!

The perception that students would get off task, or needed very rigid structures to follow through with assignments, made Mr. Harris feel that he needed to retain a heavy amount of authority, hence maintaining the teacher-centeredness of the classroom.

Occasionally, students resisted the roles distributed to them by Mr. Harris, sometimes resulting in incomplete work, and sometimes with more drastic consequences, such as disciplinary action. Ultimately, the narrow set of roles students could typically occupy provided limited opportunities for technology skills development and agency, but as I will also discuss in the following sections, the students in this study also found room to negotiate the rules and division of labor of certain activities, and thus achieve their own objectives. What is significant, however, are the ways in which these goals merged with, or contradicted, the sanctioned (i.e., teacher-defined) goals of the activity.

A forecast of tensions that emerged in the division of labor in this study. As Mr. Harris assigned different creativity-based projects over the year, he found that students tended to "do the minimum amount of work" need to satisfy the assignment requirements (although they often did less than that). Students also tended to use the less-structured environment to socialize and participate in unsanctioned activities, such as playing video games and surfing the Internet. While the projects Mr. Harris assigned were meant to engage students in course content through creative processes, they became more tightly structured to

discourage such behaviors on the part of the students, and as a result, came to resemble canonical modes of teacher-centered instruction. In this sense, the structure of certain technology activities came to undermine the very ideals of progressive education the Bayside school system hoped to deliver. As Sims (2012) noted, many schooling practices are geared towards managing the challenges of establishing and maintaining authority in a setting where those in authoritative positions are heavily outnumbered by subordinates. The pressure to produce measured educational outcomes may therefore influence educators to grasp for control in ways that may be seen as necessary and good for student learning, including implementing highly structured forms of activity, and enforcing rules to maintain those structures. The exclusion of students deemed "resistant" or "defiant" is thus legitimized as a tactic for sustaining power and authority in the classroom, commonly referred to as "classroom management". As such, opportunities for these students to participate in certain activities may be duly affected.

As noted earlier, the Bayside High School administration was rather mum when it came to classroom management of their newly technologized student body, expecting students to honor the AUP, and teachers to keep students accountable to its stipulations. The district's public relations materials appealed to the presumably motivating power of technology and multimedia production to portray an image of a school where teachers did not have to discipline students. Yet, from the beginning of my classroom observations, forms of resistance, defiance, and rule breaking were abundant and obvious. Some students talked back, others surreptitiously checked their cell phones, played video games, or simply refused to do the assigned work. In response, Mr. Harris often established restrictions on students' movement (i.e., revoking bathroom privileges, or assigning students to specific seats), or removed access to certain tools that might be used for distraction, such as the laptops themselves.

All of this is not to suggest that rules are merely restrictive in nature, or only serve to constrain behavior. Rules also provide guidance for participation in activity. Note taking, for example, was one of the primary ways in which students used technology in the Introduction to Biology class. Whenever Mr. Harris loaded up his projector, and displayed some form of text-based information on the screen, students were expected to follow along, recording vocabulary terms and other content, as well as the meanings of topics under discussion. Students typically used programs like Evernote, Pages, or OpenOffice to record these notes. Two things struck me as significant in these activities over the course of the year. First, in all of my observations, "note taking" equated to copying down only the text that was displayed on the screen. The students did not elaborate on the bullet points or brief definitions of terms that appeared in the numerous PowerPoint slides Mr. Harris presented. In this way, students' notes resembled one-dimensional texts that often lacked the inclusion of context or connections to other topics covered in class. Second, when I asked students about their study habits, they all (except for Angelo) replied that they did not use their notes for studying. While it is possible to conjecture that the process of copying text assisted the students in committing certain facts to memory, it became clear that note taking did not serve to achieve any objective for the students. Rather, note taking,

or the use of technology to copy down text that was displayed during lectures, served as a rule of activity. In other words, using technology to record text was an expectation of student participation in the class. Indeed, students who deviated from this behavior were often called out by Mr. Harris. "You're not taking notes," he would say, using an authoritarian tone, which indicated to students that they were breaking the rules. Note taking was a complex activity, and deserves much further treatment than given here. I will return to the tensions that surrounded note taking later in this chapter.

The purpose of this dissertation is to uncover the nature of these tensions, and understand how such tensions affected what and how the focal participants in this study learned through the use of technology. As such, the presentation of data in this chapter is organized around the central tensions that regulated student technology use.

Going one-to-one: History and context of the Bayside Laptop Program

Leading up the 2011-2012 school year, and the full launch of the laptop program, the rhetoric surrounding one-to-one learning, 21st century skills, and digital learning tools, began to paint the picture of a school that was eager, indeed "ready" to start its path on a new way of teaching and learning. "It'll set the stage for 21st century teaching and learning at Bayside High School. It will enable learning opportunities for students that simply don't exist right now," the Principal proclaimed on video. "We are all very excited for our one-to-one laptop program, which will enable all students to have access to the technology needed for 21st century skills[2]."

Indeed, at the top of its twenty-nine question FAQ, published on the school's "One-to-One Laptop Learning Initiative" website, the school listed the following overall reason for implementing the program:

> We believe that a 1- 1 laptop learning environment is the model for technology in the new BHS that will best support 21st century teaching and learning. We also believe that personal computing devices will most likely be the norm in the near future and we should prepare students to make intelligent use of them.

The program gained notoriety in the region, and several articles appeared in local newspapers, focusing primarily on the cost of the program and the district's decision to use expensive Apple laptops for the initiative. Unrolling a full one-to-one laptop program at a time when many families in Bayside were still feeling the effects of the recent economic recession raised many questions in the community, and local media focused its attention on the specific issue of funding.

Feelings were mixed among Bayside High faculty, as well. Teachers voiced concerns about distraction, behavior management, and their own level of comfort with the technology. In

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[2]To maintain confidentiality with the study participants and the participating school, citations from the Bayside High School's public relations media are unreferenced.

response, the administration broadcast a passive message of encouragement, telling faculty that they would not mandate the integration of laptops into instruction, but rather,

> There are some teachers who feel comfortable with the technology but they are not going to be doing it. That's OK if that's not their style. We're not forcing anyone to do it. We're saying this is the way of the future and let's start heading there.

Teachers received four days of technology integration training in the interim, mostly directed towards the use of specific technologies and activities, such as podcasting, multimedia presentations, and using the new learning management system (LMS). With a sense of anxiety and excitement, Bayside High School opened the 2011-2012 school year with a full one-to-one laptop program.

Setting the stage for 21st century teaching and learning. In 2012, the district drew up a three-year technology action plan, outlining its vision for the adoption and integration of technology in the Bayside Public Schools system. Seeking to implement a program that would "provide a foundation for development of other skills necessary for competition in a growing, global marketplace… [and] to cultivate career and life skills such as social and cross cultural interaction and improve productivity and accountability", the district recognized the need to prepare its students for life beyond high school, and to participate in an increasingly "global" world. In the statement, the district referenced six main competencies to define the skills students would need for success in this new environment: critical thinking, problem solving, creativity, innovation, communication, and collaboration.

To achieve this vision, the district outlined a road map to guide the implementation of instructional technology across the district, including necessary changes to staffing, infrastructure, and curriculum that addressed the Massachusetts Department of Education's Educational Technology Advisory Council's vision for educational technology use across the state[3]. The road map was divided into multiple categories addressing each of the state's mandates: 1) technology integration and literacy, 2) technology professional development, 3) accessibility of technology, and 4) virtual learning and communications. Within each category, the district outlined several benchmarks against which to measure its progress and effectiveness in delivering an education that would "prepare its children for the future."

Laying the foundation for technology integration. At Bayside High School, technology integration was believed to have the ability to "significantly improve teaching and learning," which the district promoted by stating in its technology plan that an explicit goal of the laptop program was to have 90% of the school's teachers integrating technology effectively every day. Thus, teachers were expected to develop the skills necessary to meet such goals, by attending school professional development opportunities, and demonstrating a

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[3] http://www.doe.mass.edu/boe/sac/edtech/default.html?section=vision

"dedication" to students using technology for learning. "Technology should not be taught as a subject area," the school committee proclaimed, rather, it "should be 'embedded' within the school day as much as possible."

School administrators planned to provide professional development and training for all of its teachers, which it hoped would lead to the effective integration of technology into the curriculum across all subjects, within two years. Despite, or perhaps because of, the school's lack of a full-time technology integration specialist at the beginning of the 2011-2012 school year, the district administration placed a high value on the development of technology integration skills, noting,

> The integration of technology into the instructional process has potential to significantly improve teaching and learning and is essential in bringing schools and students to the level required for success in an information oriented society.

The district believed that integrating technology into the curriculum effectively would provide students with rich experiences that they would not otherwise have access to, and further, that such technology-enhanced experiences would "improve teaching and learning" because of the authenticity and insight that the use of technology has the potential to provide.

In her three-part multimedia presentation on the purpose of the one-to-one laptop learning program, the district Technology Director provided some examples of technology-integrated activities that made use of digital resources the school expected teachers to take advantage of. Examples included formative assessments and "authentic resources" such as archival materials made available through the Library of Congress. One specific example included an audio recording of a phone conversation between Presidents Kennedy and Eisenhower during the Cuban Missile Crisis. The Technology Director proclaimed that such resources could provide a richer learning experience than print-based materials or lectures, supporting the school's decision to cease purchasing print-based textbooks for all its classes.

> [A digitized phone recording, available from the John. F. Kennedy Library's website, of Kennedy and Dwight Eisenhower briefly discussing the Cuban Missile Crisis is played.] Listening to recordings like this just really gives you a perspective that you can't get from a textbook or a lecture. And authentic resources like this will be just a click away in the classroom, online, anytime, when it best supports teaching and learning.

Formative assessments, the director continued, could provide an teachers with "just in time" tools to assess and adapt their instruction to better suit their students' needs, explaining, "Students can take [formative] assessments online, and the teacher can get the results instantly, so they know if the students understand what's being taught."

The Bayside High School administrators found that, to effectively support these activities, they would need to implement a number of technological and human resources to their day-to-day operations. This included the Moodle LMS, a technology rubric to communicate the

essential skills and literacies students were expected to learn as a result of the program, professional develop to train teachers on the technologies required to guide students through the development of such skills and literacies, and a technology "help desk" to support the over 1300 student laptops that would be accessing the school's wireless network on a daily basis. As such, these four items represented the foundation upon which Bayside High School expected to support and maintain academic technology use.

The Structures of Instruction: Institutional Factors that Influenced the Implementation of Curriculum and the Frequency and Purpose of Technology Activities

Before analyzing the emergent tensions of the technology activities I observed in the course of this study, it is critical to establish the socio-historical context in which technology use in the Introduction to Biology class took place. This section attempts to provide a "thick description" (Geertz, 1973) of that context by examining the institutional structures and teacher perspective of instruction and learning at Bayside High School. Consistent with subsequent sections in which I analyze technology activities through the lens of activity systems theory, this section considers emergent tensions within the teaching and administrative cultures of the school through an activity systems framework.

Institutional structures at Bayside High School. In their qualitative study on the dilemmas of practice middle school mathematics teachers experience using technology for instruction, Anthony and Clark (2011) found that teachers who shared views on learning, curriculum, and technology with institution administrators, who were more comfortable experimenting with technology tools, and who adjusted activities to incorporate multiple instructional goals, experienced greater success coping with dilemmas that surrounded various institutional rules. Teachers who struggled to negotiate the demands of state-mandated curriculum, the implementation of technology, and apparently competing goals, however, limited the time for students to use technology, and integrated less purposeful technology activities into instruction. As such, identifying the dilemmas of practice Mr. Harris experienced is significant for understanding how institutional structures influenced the frequency and purpose of technology activities, and how these structures constrained (or afforded) the action possibilities of Mr. Harris and his students.

As described earlier, Mr. Harris shared the same vision for technology-mediated instruction as his administrators and the district. Throughout the course of the year, however, Mr. Harris expressed difficulty meeting the administration's expectations regarding curriculum and the integration of technology. This difficulty focused heavily on negotiating the size and scope of the biology curriculum frameworks, the nature of the school's rotating daily schedule, and the technological resources that the school administration mandated to be a part of classroom instruction. These institutional structures represented rules of activity, which informed much of Mr. Harris's instructional practice through the year. Occasionally, Mr. Harris felt that these rules contradicted each other, resulting in dilemmas of practice

that summarily impacted the ways in which he integrated technology into the course, and the structure of activities that he assigned[4].

Competing rules of instruction: schedules, curriculum, and mandated instructional resources. One area of tension Mr. Harris experienced was negotiating the various rules and expectations of the Bayside school district and state Department of Education - namely, in the areas of scheduling, curriculum, and mandated instructional resources. These rule-based tensions most directly implicated Mr. Harris's own sense of the effectiveness of his instruction (i.e., meeting community expectations of behavior for teachers) but indirectly, impinged on the frequency and purpose of student technology use.

Mr. Harris expressed difficulty in determining how to simultaneously implement the state curriculum, integrate technology effectively, and utilize district-mandated tools in ways that created meaningful learning opportunities for students. Mr. Harris and I spoke of these difficulties regularly, which he often described in a reflective, but frustrated manner. The example below comes from my field notes, one April morning before class.

> Mr. Harris begins to lament to me that his teaching in the Biology class is the worst teaching he's ever done. He tells me that he feels he's losing his better students, partly because of the attention he feels he has to pay to his lower achieving students (whom he feels still don't receive enough attention). He expresses his frustration with some of the lower level students, such as Angelo, whom he considers "smart enough", but who sometimes has a bad attitude in class. He then complains of the curriculum, and questions, "How many of these kids are going to need genetics?" He feels the curriculum is too out of touch - not based on authentic biology activities (such as what "real" biologists do in the field), and that he doesn't have the proper resources to do the types of activities that he wants.

During this brief conversation, Mr. Harris implicated institutionally mandated curriculum, a lack of instructional resources and support, and poor student behavior, on what he felt was an inability on his part to create an adequate learning experience for his students. The combination of these stresses forced Mr. Harris to navigate the rules and expectations of teaching at Bayside High School by making adjustments to the structure of assignments, activities, and to the pace with which the class progressed through the biology frameworks. Ultimately, these adjustments faced a second barrier of tensions - at the student level - that only added to Mr. Harris's frustration.

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[4]It is important to note here, that institutional structures alone cannot be blamed for any lack of technology integration, or of curriculum implementation. Many teachers are successful in incorporating multiple goals, technology initiatives, and mandated curricula, despite the numerous tensions that might arise as a result of their conflicting rules. Yet as subsequent sections in this report will show, the juxtaposition of the Bayside High School laptop program, the biology curriculum frameworks, and the expectation to effectively integrate both into the Introduction to Biology class presented serious dilemmas which contributed to a greater sense of powerlessness and frustration for Mr. Harris.

Limited time to create meaningful learning activities: tensions involving the daily schedule. Mr. Harris found the daily rotating schedule impeded his ability to implement the curriculum frameworks, satisfy his students' learning needs, and integrate technology. In previous years, the Bayside High School schedule was "semesterized," meaning classes met every school day, in 84-minute long blocks, but for just one half of the year. During the year of the current study, however, the administration had altered the schedule so that classes lasted an entire school year, but met only every other school day. This change in the schedule meant that teachers now had to juggle five or six classes simultaneously, rather than the three that was typical during the days of the semesterized schedule. As Mr. Harris explained, this not only appeared to double teachers' workload, especially with regards to preparing materials and activities for class, but it created a scenario where students were simultaneously enrolled in eight classes, which Mr. Harris believed made it difficult for them to stay organized and on top of class work.

> MH: 'Cause ultimately, it goes down to scheduling… And if our schedule was what it used to be, with- and I don't know if you can hear me on the computer- Um, we used to have a four-by-four block, which meant we had four, eighty-four-minute blocks. But it was semesterized. So at max, a kid had four, to possibly six classes, if they had a, you know, class in there. So you could have four classes at a time, and not have to juggle, "What's my math homework? English homewo-". Like-
> NW: Yeah, eight classes.
> MH: They switched, and I'm not really sure how the switch helped, because, if we're a semester- like, if we're Day 1, Day 2, you're now holding the same basic schedule, except it's every other day. And I don't really understand- and, they have their reasons, and I'm not gonna berate their reasons, but I don't know what their reasons are, and I don't see it, and I- I can see it actually having a real hindrance on what the kids are capable of doing. 'Cause there's not a college in the world that- where a kid takes eight classes at the same time. And I think, especially one where eighty-four minute blocks, eight- having eight, eighty-four minute classes is tough for these kids. And I know I have a tough time figuring out, "I got six classes? Alright, which class am I walking into?" Is it a biology class, or forensics class?

Mr. Harris effectively had to prepare for twice as many 84-minute classes as he did in previous years. What's more, as he alluded in the excerpt above, is that during the Spring semester in the year of this study, he was asked to take on the responsibility of teaching a sixth class, further increasing his already difficult-to-manage workload. It is significant to acknowledge that these changes to the school schedule did not accompany an increase in preparation time for teachers. As such, Mr. Harris felt that implementing all of the mandated curriculum frameworks, and creating interesting, meaningful technology activities for students to engage with during class was becoming ever less feasible.

> MH: But you know what? When we had the old schedule, and you were juggling three classes at max as a teacher, at a time. Um, you could be a little more creative with your lessons, because you had so much more time to prep. I mean, I could write a brand new assignment every day of class. I mean, having six classes that meet every other day, you know what? I- you had to rely a little bit more on stuff that was

already created, and m- maybe, "Okay, I got this new lesson on ecology. Okay, let me think of, like, three different ways of doing it," instead of six different ways.

Even as someone who considered himself proficient in technology, Mr. Harris felt the schedule left him with insufficient time to prepare thoughtful activities that create "higher level engagement."

MH: If I had a little more structured time in my schedule, I think I could create some more higher level of engagement.
NW: Sure.
MH: You know, rather than just, "Okay, let's get you something that you can use that shows you this concept of polarity."
NW: Mm hmm.
MH: You know? I just need more time to do that. You know?

This point is highly significant in that, here, Mr. Harris saw technology not as an end-point, or object of instruction, but rather as a mediating artifact - a tool, which could be used to leverage engagement with biology concepts. The constraints of the schedule thus contributed to Mr. Harris's sense that it was difficult to design activities in which technology could mediate such engagement, hence adding significantly to the dilemmas of practice he experienced surrounding instruction and technology integration. Indeed, over the course of the year, many of the technology activities Mr. Harris did assign were either appropriated from other sources, or highly structured, rather than flexible enough to easily tailor to meet students' learning needs. I discuss some of these activities in greater detail later in this chapter.

Mr. Harris also found that new schedule created a scenario that was difficult for many students to manage in terms of recall and organization. For this reason, he felt he often had to spend an inordinate amount of time reviewing material that had been covered in the previous class, before introducing new content. This heightened the sense of pressure he felt in pacing through the entire curriculum.

MH: Um, the other biggie for me, was recall. You know? 'Cause I tried to start off class with either a question that, grant- started with past knowledge or a little review. Those became twenty-five, thirty minutes of, "Do you remember this?" In the old schedule, they remembered that. Even the Reggies. Even the- you know, Tommys. They would remember that material.
NW: But when they spend-
MH: And they'd pass in there.
NW: - two, three, four days-
MH: Mm hmm.
NW: - between then and the last class-
MH: Even the better kids sometimes had trouble. You know? The kids who knew how to play school. They had trouble with the retention.

Tensions involving the implementation of curriculum. Mr. Harris felt that the size and scope of the state-mandated biology curriculum was also a "huge hindrance" to what he considered to be "effective" instruction. The Massachusetts curriculum frameworks include

32 specific biology standards, which for teachers instructing within the alternating daily schedule at Bayside High School, translated roughly into one standard to be covered every two or three class meetings. This demanding number of standards, Mr. Harris told me, impeded effective instruction by heightening the pressure to control the pace of students' learning. With a diversity of ages, achievement levels, and learning needs among his 28 students, Mr. Harris reported that without extra instructional support or better instructional technology resources, implementing the entire biology curriculum was unfeasible. He lamented that the size and scope of the curriculum frameworks impeded his ability to create higher-order actives that engaged students' critical thinking.

> NW: Yeah, was that- do you feel like that at all was a hindrance? Like, the fact that you had so much content to get through in the year? Was that-
> MH: Um, I didn't even touch two large units of the year.
> NW: Really?
> MH: We didn't touch any photosynthesis and cellular respiration.
> NW: Mmm.
> MH: We didn't touch any body systems.
> NW: Mmm.
> MH: So, if you think about it- well, it was probably three of the twelve power standards.
> NW: Yeah, wow.
> MH: So twenty five percent of the curriculum, we didn't touch… So, if I had fewer content areas to touch, I could get [the students] to really, actually, think.

The quantity of standards was not the only tension that originated at the state-level, however. As noted above, Mr. Harris felt the content standards themselves were too "out of touch" with the kind of work "real biologists" do in the field. The state mandated curriculum thus seemed to conflict with Mr. Harris's perceptions of what constituted effective biology learning.

Hindrances to assigning production-based projects. While implementing the state curriculum, teachers at Bayside High School were also expected to integrate differentiated, student-centered technology activities into instruction as part of their new laptop learning initiative. For Mr. Harris, this meant assigning open-ended activities and projects, which students could work on independently, utilizing multiple technology tools. Yet, the pressure to complete the state-mandated biology curriculum impeded Mr. Harris's perceived ability to create more open-ended activities for his students, whose learning needs and lack of motivation in class slowed the pace of things. This pitted against each other the rules of implementing the biology curriculum, and creating opportunities for student-centered learning.

Dilemmas of practice caused by tensions between instructional resources and teaching objectives. Institutionally mandated technology resources also influenced Mr. Harris's teaching practices. These technologies, such as Pearson's NovaNet (a content delivery solution offered by the world's largest education company) the district perceived as enhancing learning opportunities for students who were chronic absentees, who

struggled with the curriculum, or who otherwise needed some avenue to recover missing academic credits. While many of Mr. Harris's students exhibited these characteristics academically, and were, in that sense, prime candidates for utilizing NovaNet as an additional learning tool, Mr. Harris had many complaints about the software.

> MH: I don't know if you've ever used NovaNet.
> NW: No, you told me about them, too.
> MH: Yeah. It's like, it gives you a multiple choice question, and you get four chances to, you know, get it right.
> NW: Mm hmm.
> MH: And if you get it right on the fourth chance, you move on. There's no second question-
> NW: Right. It's great for being- but you have to be motivated to actually, like, learn from your response instead of just going through until you get the right one.
> MH: W- which- le- that's part of our department meeting yesterday, was, is we're creating this whole culture of, "What's the minimum amount of work I need to do to get a decent grade?"
> NW: Mm hmm.
> MH: And that bothers me in particular, because it should be, "What do I need to do to get the good grade?"
> NW: Right.
> MH: You know?
> NW: Right. Yeah, but-
> MH: I- I can teach them with these virtual manipulatives, how to have basic knowledge.
> NW: Mm hmm.
> MH: And how to get- find their answer. And how to- how to actually go about getting an answer. And maybe even understand the answer.
> NW: Mm hmm.
> MH: But I want to be able to get them to have in-depth understanding. And some of these manipulatives do a very good job of that. Some of them just gloss the surface.
> NW: Mm hmm.
> MH: I feel if I had more time, I could definitely, you know?

Earlier in the year, Mr. Harris foreshadowed this tension in his work, explaining that the already difficult workload was going to hinder his ability to create effective curriculum materials of his own. Where the various technologies that were accessible to him might have been leveraged to reduce the groundwork necessary to create such materials, Mr. Harris found the digital instructional resources that were available offered little such help.

> You know, I think part of my frustration in not being able to use some of these things as effectively as I want to, is I don't have time to create my own curriculum [materials] around that. And I'm from people that create great, great curriculum [materials] yet. You know? And NovaNet isn't going to give it to me.

An interesting epilogue to this note, Mr. Harris explained to me that by the end of the year, the district had neither provided training, nor access credentials to the NovaNet to teachers.

> He then tells me that the district implemented their NovaNet tool to allow for more in-class tracking (the "Scandinavian model" as Mr. Harris puts it), but then reveals that no one has received 1) any training on NovaNet, nor 2) any access credentials, meaning that cannot even access NovaNet.

Further, Mr. Harris felt that the number of technology initiatives that have been implemented by the superintendent and assistant superintendent (both of whom resigned near the end of this study) was too large and disconnected, encompassing a confusing web of technologies that carried expensive price tags. Many of these technologies, however, had not been adopted by teachers, due to their complexity, and the lack of seamless integration between them.

The institutional rules regarding the daily schedule, curriculum, and mandated technology resources, including the school technology rubric, intersected at times in contradictory ways. Tasked with interpreting these rules, and implementing them in his instruction, Mr. Harris experienced several dilemmas of practice, which arguably constrained his perception of what was feasible to accomplish within the confines of the school year. While it is difficult to draw causal relationships between such institutional structures and individual agency, theories of social practice (Bourdieu, 1977; Engeström, 1987; Giddens, 1988) allow us to contextualize certain activities within a socio-historical setting. As such, I argue that the pressures Mr. Harris felt due to his perception that the rules regarding scheduling, curriculum, and technology competed with one another, influenced, in turn, how he structured learning activities, particularly technology activities, in class.

Understanding Mr. Harris's perspective on the influence of institutional structures on his teaching practice is a critical aspect of analyzing students' technology use, for over the course of the year, these structures appeared to hold sway not only over the flexibility with which Mr. Harris implemented curriculum and technology, but in the way that the division of labor was distributed amongst the class members. Other factors were involved in this process as well, such as the lack of instructional support available to Mr. Harris, and students' prior experiences with the sanctioned learning technologies.

As a teacher in the Bayside school system, Mr. Harris was tasked with both implementing the state-mandated biology curriculum[5] and simultaneously integrating technology "into

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[5]I believe it is important here to distinguish the goal of curriculum implementation from the goal of learning subject matter content. As a prescribed set of frameworks and standards, state-mandated curriculum represents an institutional structure, and as such, suggests to administrators, teachers, and students what content is to be taught and "known." Learning content subject matter, however, was framed by the Bayside High School administration as an *outcome* of engagement with curriculum materials and technology resources. As such, curriculum and technology, in the context of learning, represent mediating artifacts. I believe this distinction is important for understanding the tensions Mr. Harris and his students experienced, and the coping strategies they adopted for dealing with those tensions.

all areas of curriculum, instruction, and administration." Curriculum implementation required the use of resources pertaining to the biology subject matter. As noted earlier, however, Mr. Harris felt that many of these resources were insufficient for instruction, and sometimes arbitrary with regards to what "real world" biologists do. But Mr. Harris also felt strongly that he needed to maintain a sustainable workload for himself, especially when he took on a sixth class during the spring semester. He therefore compromised certain activities and mediating artifacts by appropriating materials that even he lamented were not the most effective for instruction.

At times, these same pressures influenced Mr. Harris's decision to foreground the goal of implementing curriculum at the expense of integrating time-consuming, and less controllable technology activities. For instance, Mr. Harris adopted strategies to deliver content in "efficient", controllable ways, such as lecturing and worksheets, which provided students with very few roles to occupy, and as noted above, had the effect of making technology use a rule of activity, rather than tool for mediating students' learning of the biology content.

In terms of integrating technology, Mr. Harris had access to technology tools and resources, but occasionally complained that access to Google Docs, for instance, was unreliable, and therefore could not be used. Further, Mr. Harris's adamant stance against using his class time to "teach technology" meant that effective technology integration relied on students having prior knowledge of and experience with using certain technologies, such as GarageBand and OpenOffice. Thus, in a sense, many of the mediating artifacts available to Mr. Harris to achieve the multiple goals of implementing curriculum and integrating technology were insufficient. While Mr. Harris was confident and knowledgeable enough to possibly appropriate or craft better resources to more effectively achieve these goals, the competing rules of daily schedules and workload prevented him from doing so. This affected both the types of activities students engaged in over the course of the year, as well as the material with which they engaged. Notably, students did not have much of any role in the creation or negotiation of resources and activities, and as such, experienced very few opportunities to hold epistemic authority. This reified canonical structures related to student autonomy (i.e., few opportunities to share authority) and the privileging of certain schooling practices (i.e., behavioral "norms" and the use of sanctioned learning tools). Further, the use of a school-wide technology rubric arguably established what technology literacy looked like at he school, and as such, what types of activities to integrate into instruction.

Finding 1: Systematic Tensions Regarding Legitimate Participation in Technology Activities

As mentioned above, the administrative team, perhaps in an attempt to mollify the swell of parental and teacher concerns regarding ubiquitous student access to technology devices at school, presented a rather utopian view of education reform and one-to-one learning. The Bayside district administration arguably offered a view of one-to-one learning as fun and intrinsically motivating, a view that closely resembles the sort of idealized approach to student-centered learning and egalitarianism that many progressive reform efforts have championed. Yet, such approaches to instruction have significant consequences for teachers, as their roles in the classroom are thusly imagined to be more facilitating, rather than authoritative - a shift away from canonical modes of teacher-centered instruction, which entails new expectations, new teaching practices, and new pedagogies. Mr. Harris idealized technology use as facilitating agentive learning behaviors and social pathways to knowledge construction. This approach to technology use for learning and instruction was meant to provide new, previously unavailable, ways for students to access the biology curriculum, to develop self-regulatory learning practices, and to make Mr. Harris's own teaching more efficient. Yet, while technology's role in mediating that process was clear and obvious to Mr. Harris himself, the context of learning and instruction resembled learning environments that foreground the importance of knowledge acquisition and teacher control (i.e., canonical pedagogies) over student-centered learning and the development of 21st century competencies.

This was evidenced in two ways. First, the school's technology rubric served as an artifact to both identify those technology practices that were most valued in terms of academic participation, and to locate students along a spectrum of competencies with those practices. As an extension of administrators' view of "what counts" as technology literacy (digital publishing, data organization and analysis, and multimedia presentation), the technology rubric broadcast the most highly valued forms of technology use that students should perform. As such, it outlined the boundaries of what constituted legitimate participation in technology activities. Secondly, students were expected to have enrolled in the Web 2.0 and Presentation course during the 9th grade, and hence to have acquired a base level of technology literacy that supported the types of activities listed on the rubric, which they would perform throughout high school. Yet due to administrative circumstances, not all students were enrolled in this course during the 9th grade. This affected not only their ability to use technology in prescribed ways as they were outlined in the school's technology rubric, but their performance on projects and assessments that necessitated the use of sanctioned and prescribed technologies. The school's technology rubric and registration practices for enrolling students in the Web 2.0 and Presentation class provide two illustrative examples of how legitimate participation in technology activities was actualized at an institutional level, and how the school overlooked and delegitimized certain technology practices. As I will later discuss, the systematic arrangement of sanctioned and unsanctioned technology uses symbolized mechanisms of social reproduction that marginalized students' technology practices, and by extension, students' identities.

Institutional structures and teaching practices overlooked students' "hidden" literacies. Recent sociocultural research has cautioned students' literacies are sometimes overlooked, or perhaps even actively hidden from the teacher's view (Ives, 2011). One of the critical projects of this dissertation is to understand how systems of education reproduce the conditions by which students from diverse backgrounds and dispositions are marginalized. In the process of valuing specific uses of technology, other skills and literacies may be pushed to the background, risking further marginalization of students whose technology knowledge and practices are seen as irrelevant to school. As I observed tensions arise around students' independent use of technology for academic work during this study, I began to ponder how the marginalization of students' other technology skills such as socializing, finding and sharing information with others in unsanctioned ways, and participating in digital forms of popular culture (which at times grated coarsely against what counted as legitimate use of technology in the class) became a systemic, and internalized, aspect of schooling for these teenagers. It would be remiss to assume that such tensions existed only within the context of specific, isolated moments of technology use. Understanding the role of institutional structures in the formation of these tensions is critical to the process of unpacking students' use of technology.

In the examples of technology use described later in this chapter, technology's mediating role was called into question. The objectives, rules, and division of labor of the activities pivoted around technology, and as such, shifted depending on the mediating role technology served (e.g., as a mediating artifact, as a rule of activity, or as an object itself). This subsequently led to outcomes involving the undermining of much of the instructional purpose of the activities (predominantly organized around the delivery of state-mandated curriculum) and the reinforcement of canonical pedagogic practices (i.e., structuring future activities, and enforcing rules of behavior). Students responded to activities in which they held little epistemic or logistic authority by creating epistemic short cuts, and finding ways around having to engage with prescribed biology content *on Mr. Harris's terms*. In attempt to look "on task," and yet fulfill temporary objectifies, such as socializing, playing video games, or checking cell phones, students developed ways to use personal technologies surreptitiously. Participation in lecture/note taking activities involved a complex organization of artifacts and behaviors as students navigated the sanctioned rules and division of labor of the exercise. Indeed, I found the students did serious work arranging opportunities to be found looking on task, despite actually doing the opposite behind the turned back of Mr. Harris. While appearing to copy the text from the lecture slides, for instance, several students in the class would shift from their note taking applications to video games and Internet browsers, changing back to their notes as their screen's entered Mr. Harris's wandering view.

In so doing, students not only resisted their division of labor in these teacher-assigned activities, they risked their status as legitimate "students" within the school community. Reggie exemplified this process, and as a result, his participation in classroom discussions, as well as his overall academic status, was frequently delegitimized by his peers and by Mr. Harris. Despite this, however, Reggie's eagerness to "be inspired" by science persisted.

Systematic foreclosure to Reggie's claims to legitimate participation. Reggie was a frequent participant in whole class discussions, often shouting out answers and asking questions about the content. Reggie also made frequent attempts to contribute his own stories or anecdotes, which often seemed tangential to the conversation. As such, they were typically dismissed. In response, sometimes Reggie became more adamant and persistent, trying to earn Mr. Harris's attention.

One day during a lecture, for example, Reggie sought an answer to a compelling question regarding intelligence and genetics. As was typical, interrupting the lecture was treated as breaking the rules - a violation for which students were often reprimanded. On this occasion, Reggie's question was taken up by Mr. Harris, but only momentarily before reprimanding the class.

> Reggie asks, "Are people naturally born smarter than each other, or is it something that is [developed]?" Mr. Harris explains that humans can learn to make themselves "smarter". He talks about the actress from "Taxi", who has the (dis)ability of remembering everything in her past.
> "What makes an IQ?" Reggie asks.
> Mr. Harris tells him that intelligence is "not innate" and can be learned.
> "Wait, my question is, like, can people make their IQ go higher and lower? Can your IQ drop? Yes or no?" Reggie asks.
> "Reggie," Mr. Harris replies, trying to get Reggie to stop asking questions.
> "Can your IQ drop? Yes or no?" Reggie persists.
> "Yes," Mr. Harris answers. The students talk about IQ for a brief moment, then Mr. Harris tells them to stop. "You are making a choice," he says, agitated, and tells the students that the next time they act up, they have been made aware that they are making a choice. The students stop chatting, and Mr. Harris continues the lecture.

Other times, Reggie's interruptions were dismissed altogether. In the following excerpt, Reggie failed to obey the rule of raising his hand. As a result, he received little attention.

> "So what do enzymes do, Mr. H.?" Reggie asks in a funny voice. Mr. Harris ignores him. "Mr. H., answer the question, Mr. H." Reggie implores. Greg (another student) tells Reggie to raise his hand, and maybe he'll get a response. Reggie raises his hand. Mr. Harris walks over and asks, "What's up, Reggie?" Reggie asks him about enzymes, but Mr. Harris doesn't spend much time with him before he moves on.

Before class one day, Reggie explained to me why he did not enjoy the subject of math anymore. He related this sentiment to the dominant format of mathematics instruction he experienced at Bayside High School, which he believed put undue importance on the memorization of formulas - arguably a type of instruction that left little for Reggie in the way of how to learn fundamental mathematics concepts or their origins.

> Before class, Reggie tells me why he doesn't like math: in middle school, apparently, Reggie's teachers taught a sort of discovery-style method, and the students would come up with their own formulas, or heuristics, for solving problems/equations. He preferred this style of teaching, which is different from how he is being taught math at Bayside High School. Now, he tells me, he is given a formula, and told to memorize

> it. He tells me that in this method of instruction, he's "using less of [his] brain." He reiterates for me something he said earlier in the semester: teachers should inspire. He doesn't like memorizing formulas. He is not inspired by memorizing formulas.

I believe these passages exemplified some of Reggie's struggles throughout his schooling experience. As a student who was inarguably engaged during class, and an eager learner, Reggie often encountered institutional structures that constrained the ways with which he could access the learning material. In a profound example, however, I observed Reggie make use of his background knowledge in the technological function of cameras to challenge these constraints, and carve out a new way of participating of an activity involving a digital microscope (ProScope). This example resembled the type of expansive learning Engeström (2001) theorized as the outcome of tensions between interacting activity systems.

> Reggie and Natalie begin the lab exercise. Natalie adjusts the focus of the scope while Reggie looks on, but Natalie is unable to center and focus the scope on the slide. Mr. Harris goes over to help them. He takes the Proscope off of the eyepiece and adjusts something. He then goes to float around the room some more, but Natalie and Reggie are still having issues. I go over to help, and find out that Mr. Harris knows what the problem is, and is looking for a "set screw" that is missing from Reggie and Natalie's microscope. I adjust the Proscope with my hand so that it is reasonably focused, and the two students can see that there is a set of cells on the laptop screen. Reggie adjusts the focus some more and looks at the image on his laptop. I leave Reggie and Natalie to check in on other students, and Reggie continues to adjust the focus, and click the "capture" button to collect images. They collect several.
>
> Reggie and Greg inspect the eyepiece that was removed so that the Proscope could be mounted. Pointing the lens at Mr. Harris, Reggie asks, "Why are you upside down?" Mr. Harris explains that all lenses flip the image, and that they'll return to that concept later in the year. A moment later, I return to Reggie and Natalie's desk and help them some more with adjusting the lens on their microscope. Reggie asks me what they are looking at (i.e., what parts of the cell), but I do not know. Reggie proceeds to tell me that he "loves science", but he doesn't pay attention because they "test him too much."
>
> "I hate being tested," he tells me, in a somewhat defeated tone. "That's my thing," he adds.
>
> Greg asks Reggie what he's going to be when he grows up, and Reggie responds, "I'm gonna run stuff." Reggie, Will, Greg, and Natalie then begin talking about a girl.
>
> Mr. Harris comes over and reprimands Reggie for bothering Will, who is talking, too. "Do me a favor, Reggie," he says, "Stop touching the microscope and teach Natalie how to use it." Reggie moves the scope over in front of Natalie, and then proceeds to show her where the focus and centering knobs are.
>
> "Have you ever used a camera?" Reggie asks her. He tells her that the focus on the scope is like the focus on a camera, and then describes how it works, moving in and out. Natalie asks something to Reggie, and he responds, "My father is a doctor."
>
> "So you're smart," Natalie says.
>
> "I am smart!" Reggie replies.
>
> "So how come they [Reggie's parents] don't push you?" Natalie asks.
>
> "I'm just not into that," Reggie replies.

> Natalie manipulates the controls on the scope, and Reggie notices that it's on the wrong magnification setting.
> "Okay, this is the power," Reggie says, showing Natalie the light setting. "See how I do this?" He adjusts the light so that more and less light passes through the slide, revealing different parts of the stain. "See how you can use this… [inaudible]?" Reggie then turns around to help Greg and Rebecca with their microscope. He fine-focuses the scope, and because their Proscope is not operational, he takes off his glasses and adjusts the focus using the eyepiece.
> "I want you to discover something, Reggie. I want you to like [something about becoming an inventor or scientist]," Greg says to Reggie as he adjusts the scope. Reggie tells Greg about his mother's work, but I am too far away to hear the details.

Engeström (2001) theorized "expansive learning transformations" in such a way: transcending the perceived constraints (tensions) of activity systems to generate novel practices that achieve previously unattainable goals. Operating without epistemic authority, Reggie found a way to leverage his limited authority to achieve a temporary new role in the ProScope activity. In this moment, I observed technology fulfill a mediating role, enabling the transformation of authority to Reggie. Other times, students used the logistic authority endowed to them to seemingly negotiate the rules of activity. For example, the majority of online-based activities involved guided step-by-step directions, rather than open-ended procedures. Students utilized questionably sanctioned means to accomplish the assigned tasks. Many of the questions the worksheets asked were easily answered by entering a simple Google search. Other times, students shared answers with each other, providing a shortcut to completing worksheets that was difficult for Mr. Harris to keep tabs on while providing one-on-one instructional support to students in other areas of the classroom. What was different about Reggie's actions in the ProScope activity, however, was that his participation became legitimized by Mr. Harris and by his peers. Sims (2013) argued that such forms of participation are crucial for students while learning with digital media - especially for students who have been otherwise disenfranchised by educational structures.

> From a practice perspective, persons acquire skills as part of a larger process that Lave and Wenger (1991) referred to as 'legitimate peripheral participation'. From this perspective, it is by coming to participate legitimately in different 'communities of practice' that someone learns to use digital media in different ways, just as they learn to talk in certain ways, dress in certain ways, have specialized knowledge, and so forth. Once viewed from such a perspective, the factors that contribute to different uses of digital media are greatly expanded, often in ways that vary across space, time, and distributions of power. (Sims, 2013)

What counted as "legitimate", however, was often a matter of tension between Reggie, his peers, and Mr. Harris. Tommy had less success challenging these tensions.

Tommy's situation was such that he performed best on highly structured tasks - activities that included explicit step-by-step instructions that he could follow. Even when provided such instruction, however, Tommy often needed the help of Mr. Harris to get started on his classwork. The somewhat open-ended nature of the two-column notes activity, which entailed a relatively unstructured process of reflection and self-regulation, interpreting the

reading, and selecting important information to highlight and record, seemed enough of a challenge for Tommy to warrant significant personal attention from Mr. Harris. Yet, while he was able to procure the assistance of a classmate to help him (unsuccessfully) upload his two-column notes to Moodle, Tommy had to attempt the two-column notes activity largely by himself. As time passed on this day, I observed Tommy repeatedly leave his work alone to chat with Reggie, or listen to music. This behavior was typical of Tommy throughout the year, and usually occurred while he waited for Mr. Harris to circle back around the room and check in on his progress. As was inevitable, this behavior caught the eye of Tommy's other teachers and classmates.

Yet, as I watched Tommy's behavior during the two-column notes activity, it became clear that an essential piece of the activity system was missing - artifacts that could mediate the accomplishment of the learning goals Mr. Harris had put forth. Without the aid of peers, direct instruction from his teacher, or step-by-step instructions, these artifacts were few and far between. While technology served as the sanctioned medium of production for the assignment, the use of technology in the two-column notes activity represented an element of cultural practice that Tommy struggled to negotiate. In this case, the resources Tommy needed to progress towards accomplishing the assignment appeared to hover just out of his reach.

Reggie, who was so often engaged in whole class discussions and during lectures, displayed an entirely different type of behavior during this and other in-class activities. Whereas Tommy often exhibited a level of interest in completing the tasks Mr. Harris set forth, Reggie seemed to pass intended class work time without much care or initiative in completing the assigned tasks. Arguably, such behavior, which was almost always on display for anyone to see, contributed significantly to the positioning of Reggie as a "bad student", and summarily, to the low amount of social capital he was ascribed. Yet the agency with which Reggie seemingly disregarded classroom tasks reveals an issue of critical importance to this study: tensions of object alignment between traditional modes of teaching and students who desire a different form of education. As mentioned before, Reggie held deep epistemological beliefs about the nature of learning and teaching. "Teachers should inspire," he repeated on so many occasions. It deserves note here that Reggie in no way gave me the impression that he was "passing the buck" to relieve himself of any personal responsibility or participatory obligation in his learning. Rather, Reggie seemed acutely aware that his preferred learning environment, one in which he was free to explore areas of interest that his teachers and peers inspired him to be passionate about, was not a part of the common learning experience at Bayside High School. Individuated classwork that held little intrinsic or inspirational value for Reggie, he quickly dismissed, opting instead to spend his class time on other, more personally interesting matters, such as listening to music or asking seemingly off-topic questions. Reggie's agency and willingness to resist the objectives set forth by Mr. Harris thus created a tension that encompassed most of the activities, especially the open-ended technology activities, that Mr. Harris assigned. As such, these instances of passive resistance constitute epistemological tensions that hindered Reggie's engagement in many sanctioned activities in the class. As regards the use of

technology, therefore, the purpose of the two-column notes activity seemed to fail in motivating Reggie's participation.

In Tommy's case, however, we can imagine a metaphorical gap emerging between Tommy and legitimate forms of participation in those activities. From a practice perspective, persons acquire skills as they cycle through peripheral, but legitimate, participation in collective cultural activity (Lave & Wenger, 1991). Potentially assistive resources, however, were not available to Tommy at the beginning of the two-column note activity, and thus could not provide a bridge towards legitimate participation in the activity. As he wrestled to locate the reading material, or make any significant headway on the assignment, Tommy first floundered in his work, and then struggled to gain any traction. Consequently, he gravitated towards his usual distractions: socializing, hanging out with peers, and checking his cell phone. To the naked eye, Tommy's lack of progress on the assignment seemed to stem from his willingness to "check out" - a form of behavior that entails a certain amount of agency on behalf of the student to disregard institutional expectations or the rules of the classroom (a la Reggie). Yet when we consider that, for Tommy, (who over the course of the year expressed an interest in completing many of the tasks put before him) it was difficult of engage in legitimate participation on the two-column notes assignment despite a displayed interest at the get go, the lack of available instructional resources for him resulted in a tension that implicates both the community (ie., legitimate participation), and the division of labor of the activity.

As is typical of the culture of schooling, emphasis in class work is often placed on individual accomplishments. The Introduction to Biology class was not much of an exception in this regard. Besides a few special occasions in which students were asked to pair up or form groups, assignments were by and large an individual affair. Rather than a rule of activity, which again, mediates individual action within a community, I consider these tendencies to be an ingrained aspect of school culture, a property of the historical context of schooling. As such, individuated work permeated how the students in Mr. Harris made their way through the class. Indeed, even when Mr. Harris assigned group work, students often favored working as individuals. This is perhaps an artifact of long-standing traditions in the education system that group students by age and ability. As described earlier, however, this class was non-standard in that regard, as the student body consisted of 10th, 11th, and 12th graders with widely varying background of academic achievement. Without question, being grouped with members from differing echelons in the social hierarchy of the school was a cause for anxiety for many of the students. Hence, although some affinity groups emerged in the class over the course of the year, when it came to class work, the students seemed much more comfortable (and enculturated in functioning) in a collective practice of "doing school" as individuals. This seemingly low level of cross-group interaction meant that Tommy, whose classroom social connections consisted mainly of Reggie and Angelo, two other struggling students, had access to few other classmates who were willing to help him navigate his way towards legitimate participation in class activities.

Inconsistent registration practices for enrolling students in the Web 2.0 and Presentation course. The division of labor in activity serves to mediate the accomplishment of shared group goals. In terms of class work, this meant being able to assign individual and group projects, with the assumption that students could accomplish the necessary tasks on their own, or with little instructional intervention. This is not to say that students could accomplish the goals of activities without instruction or scaffolding from Mr. Harris, but rather in terms of technology processes, students were expected to have the capacity to access or produce knowledge artifacts, such as reading material, PowerPoint style presentations, and audio podcasts, on their own. Those who struggled to accomplish these assignments on their own received lower scores, per the outlines of the technology rubric.

When Bayside High School implemented its laptop learning program, the school designed a specialized technology skills course - "Web 2.0 and Presentation" - to provide students with a foundational set of competencies, which they would utilize across subject areas. This course was a requirement of graduation, and typically, students enrolled in the course during their first semester in the 9th grade. As with the school-wide technology rubric, the Web 2.0 and Presentation class prescribed a set of skills and literacies that would lay a foundation for student technology use at Bayside High. These skills and literacies, therefore, comprised a list of highly valued practices that counted as legitimate forms of technology use, and as a list of competencies students were expected to master after the 9th grade. Yet as Mr. Harris noted, students often passed out of the required course by scoring high on an "essential technology skills" assessment that was given in the 8th grade, as part of the middle school technology curriculum. Mr. Harris explained to me that the middle school and Web 2.0 and Presentation curricula, however, were not aligned, leaving some skills missing from students' repertoires.

Bypassing the Web 2.0 and Presentation also class also meant that students missed other critical elements of media literacy and digital media production. In the following excerpt, Mr. Harris discussed with me his sense of the tensions this created for certain students.

> MH: Um, we made a very- we're very cognizant of the fact that we couldn't expect the teachers to teach software.
> NW: Sure.
> MH: So we had to make sure that we had a class that taught the kids how to use software that- in the ways they were gonna be using it in-
> NW: Mm hmm.
> MH: - the- you know? The classes.
> NW: So do they have to take that as a freshman? They can, but they can place out of it.
> NW: Okay.
> MH: Um, our middle school teaches the test that we give, to place out of it.
> NW: Alright. Wow.
> MH: Like, literally *teaches* the test.
> NW: Mm hmm.
> MH: You know? And, um, and we- we're trying to work with them. You know?

NW: So that they don't do that?
MH: Well, up until recently, you could test out of multimedia where- the class is called Web 2.0 and Presentation.
NW: Okay.
MH: Um.
NW: And that's the- the general sort of- it's the skills class?
MH: Yeah, well, no. We expect that you know how to use a word processor, s- spreadsheet, and PowerPoint from middle school.
NW: Mm hmm.
MH: You sh- unless you failed the test, you don't have to take that class. If you failed the test you have to take, really, beyond intro. It's like, intro for middle school-
NW: Remedial.
MH: Yeah. Um, but you also, if you scored advanced, you were able to place out of the high school intro class, Web 2.0 and Presentation.
NW: Mm hmm.
MH: Which was stupid. You know? Because you were asked within the first month- within the first week the freshman are asking you to do podcasts.
NW: Hmm.
MH: So, it's like, you're testing them out of a class that they're going to have to use constantly.
NW: Right.

Mr. Harris found that students sometimes were also not enrolled in the Web 2.0 and Presentation course because of unknown circumstances involving guidance counselors and course selection. As a result, Mr. Harris suggested, students brought remarkably different levels of technological and multimedia literacy skills with them. This not only affected the quality of student work, it caused Mr. Harris dilemmas when trying to organize assignments in which all students could effectively participate. Researchers have tied institutional procedures such as course selection and enrollment, which may systematically foreclose opportunities for some students to build and develop their technology expertise, to sources of digital education inequity (Margolis, 2008). As such, it deserves question why certain students are not enrolled in the Web 2.0 and Presentation course, and how this affects their academic progress and technology literacy development[6].

MH: So there're some kids who were a freshman, a sophomore, and a junior, now, who have the laptops, who just took Web 2.0 as a junior.
NW: Mm hmm.
MH: So they don't understand why we're doing pod- they know how to- technically, they know how to do a podcast, 'cause they had to do them in freshman and sophomore year.
NW: Mm hmm.
MH: But, do they- do they understand that we're trying to get them to talk to an audience?

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[6] This question is beyond the scope of this study, but it is significant nonetheless to interrogate the systematic distribution of students into certain academic tracks, and equitable opportunities to use technology for learning.

NW: Right. There's no mapping between the skill-
MH: Yeah.
NW: And what the- what the goal is.
MH: Now there are other kids-
NW: For graduating col- high school.
MH: Yeah, there are other kids who had that class as a freshman-
NW: Mm hmm.
MH: And you see their work as a sophomore or a junior, and it's so dramatically better than the kids who never had that class as a freshman. And they- they understand that you're talking to somebody, and that you're- you're trying to express to the people who aren't right here, who don't have a knowledge base-
NW: Mm hmm.
MH: You know? And to read your audience.
NW: Right.
MH: And you know what? You don't always have to throw them- down every bit of information. You have to figure out what your audience needs, and put it in.
NW: Right.
MH: Um, those kids- you know, that understand that, do a much better job with the laptops, and focus a little better.

Students who were thus unable to complete technology assignments on time (or at all) because of a lack of familiarity with technology tools or digital production techniques could not fulfill their division of labor in certain activities. Yet interestingly, Mr. Harris was adamant about not spending valuable class time remediating students on technology processes they were expected to previously know. He also believed that his students could easily pick up how to use different learning technologies (despite my observations to the opposite). For this and other reasons (such as the time pressures associated with advancing through the curriculum, as described in the previous section), Mr. Harris spent little to no time instructing students on how to use different technologies, or modeling technology processes.

NW: Alright, how about not having time to teach students the basic computer skills needed for more complex tasks?
MH: Umm. I don't know. I- I haven't seen them as being a problem in the biology class.
NW: No?
MH: I've had to sit next to them, and, "You guys gotta remember this, this, this, and this."
NW: Right. Mm hmm.
MH: But never- I've never had to sit down and actually teach a technology in biology class.
NW: Like, teach them how to, like, go through the actual program with them, or application, or-
MH: You've seen them use Google Docs in class.
NW: Right.
MH: I know they've had no formal training in Google Docs.
NW: Mm hmm.
MH: I've never actually taught them how to use Google Docs. They just figure it out.
NW: Same thing with, like Pages-

MH: Yeah.
NW: - and like, for the poster assignment, and that kind of stuff?
MH: I mean, their posters look great.
NW: Yeah.
MH: I have a problems with their, you know, literally plagiarizing the whole thing, or, you know, you plagiarize it, it's clear you don't understand the materials. You just put some pictures and a couple definitions.
NW: Sure. Yeah.
MH: You know? But do I have to teach that? No.

According to Hohlfeld et al. (2008), "if teachers are not able to model the appropriate uses of technology in the classroom, then students may not acquire the necessary digital competencies that can enhance their future academic or professional careers" (p.1650). Beyond issues of agency and empowerment, however, not modeling or teaching various technology uses arguably risks putting students whose technology literacies are already lagging behind at further disadvantage. In terms of legitimate participation in school-based activities, then, not modeling or teaching technology use foreclosed opportunities for some students to access participatory structures that might have served as entry points to greater cultural (i.e., academic) capital, as a breakdown in the division of labor meant students could not accomplish activity goals. This also implicated their entry into the classroom "community". Tensions surrounding the division of labor thus influenced the accomplishment of certain activities, especially those during which Mr. Harris incorporated learning technologies for the purpose of mediating students' engagement with the biology curriculum.

Highly valued technology activities and the technology rubric. In keeping with its objective to support "21st century teaching and learning," Bayside High School administrators implemented a school-wide technology rubric to guide instructors in the integration of certain technology activities across content areas, as well as the evaluation of various technology skills. Rubrics provide teachers with guides for standardizing measures of competence in domains that are difficult to quantify, and from a sociocultural perspective, they also serve as telling artifacts of the privileged discourses and ways of knowing that carry the highest cultural capital.

The Bayside High School technology rubric focused on three specific activities: 1) digital publishing, 2) data organization and analysis, and 3) the creation and delivery of multimedia presentations. Each activity included four indicators of performance: exceeds expectations, meets expectations, working towards expectations, and below expectations. The rubric provided exemplars for each performance level. See Appendix C for further description of each performance level indicated in the technology rubric.

The technology rubric reflected an orientation towards technology literacy that suggested the privileging of individual accomplishments and skills acquisition. While "exceeding expectations" and "meet[ing] expectations" indicated a level of technical sophistication and the use of technology to support one's "story" or analysis, students scored higher on the rubric by including "enhancements" and avoiding "flaws." Notably, the rubric left out any

discussion on how technology might serve to mediate students' engagement with content, however - a significant aspect of technology use in the Introduction to Biology class. Rather students were expected to demonstrate their competence by being able to make use of certain features of software applications, and to "tell a story" through the presentation of numeric data and of images. "Technical flaws," "needing support," and "make[ing] good use," were indicative of students' ability to use various technologies and technology features, and factored heavily into a student's rating within the rubric matrix. In the areas of digital publishing and data organization and analysis, the "complexity" of one's work indicated one's technological competence, while students who "needed support" (i.e., could not fulfill their division of labor either individually or in groups) were identified as working at a level below expectations.

Risk-taking, innovation, and making use of peer networks are increasingly touted as essential aspects of students' learning in the digital age, but how the penalization of technical flaws or the use of supports affect students' willingness to incorporate complicated or exciting new technologies into their presentations was not a common part of classroom dialogue during my time at Bayside High School. Even self-directed, technology savvy learners may require support to solve challenging problems, or perform complicated data analysis, but these learners may use personal networks to find the relevant information in a "just in time" fashion. By emphasizing that the need for support is indicative of under-performance, the school's technology rubric arguably de-legitimized the vast wealth of resources, such as tutorials, wikis, online discussion boards, and social media tools that can be used to help students create, design, organize, analyze, and communicate information, all of which are considered by many to be necessary tools in the 21st century (Ito, 2010). As such, the school wide technology rubric reified canonical structures of individuation while simultaneously putting forth an image of technology literacy that overlooked students' non-school technology practices. Interestingly, students appeared willing to forego academic performance in order to spend time surreptitiously using technology for unsanctioned activities, such as playing video games.

As Mr. Harris explained in the excerpt below, even the "smarter kids" began to satisfice assignments, handing in work that was only worthy of a 3-rating on the technology rubric, as opposed to the 4-rating work they turned in at the beginning of the year. As Mr. Harris observed, students such as Mike, a technology-savvy, self-identified "gamer", chose to use classroom downtime to surreptitiously play video games in class - an unsanctioned and delegitimized behavior that earned other students disciplinary action during the school year - instead of refining his work or including more enhancements to his digital media projects.

> MH: Um, the- the interesting thing is, at the end of the year, the smarter kids went from a four to a three. And you could see them actually just trying to get an answer down, rather than actually thinking about it.
> NW: Why do you think that is? What do you think that?
> MH: I think they played to the level of the class. Um, and in reality, the standards had to be lowered, because, "Hey, we're waiting twenty five minutes for them to finish. If

I write my essay in a paragraph, I can play my game, 'cause I know I can get through three levels."
MH: And that's what Mike was doing.
NW: Right.
MH: Um, you know? Mike was very happy with a B-.

Indeed, Angelo, Tommy, Reggie, and Carmella all expressed an interest in technologies that were, in one way or another, left out of the repertoire of classroom technology uses. During our first interview together, Angelo and Tommy enthused over their cell phones and the AirDrop feature of the Macintosh operating system - a functionality that allowed students to illegally share both music and classwork. Further, they demonstrated a sophisticated understanding of "Wifi hotspots," which enabled them to create spontaneous wireless networks that allowed them to connect their laptops to the Internet via their cell phones, therefore bypassing the school's Internet filter. Tommy compared his interest in using his cell phone to the school laptop, which he did not seem to care to use for academic work.

NW: Yeah. Do you like it? It seems to me like you have sort of, like this love-hate relationship with technology, so I'm kind of curious-
T: Nah, I- I like my phone.
NW: Right, yeah, I've noticed that you really like your phone-
T: But I- I don't really like my MacBook. Like, I don't really care for it.
A: Yeah, it's like, the thing that I've noticed is that, once I got my iPhone-
T: [inaudible]
A: - I don't carry my laptop as much. Like, once I got my iPhone.
NW: Why do you think that is? For both you guys.
A: I guess it's, like, smaller, and, like-
T: It's just beautiful, like.
A: [laughs] Yeah. It really is. The iPhone - yeah- the iPhone is, like, so much better. It's so much better. I think it's just smaller. Like-
T: I think it's faster than MacBooks, too. Like, I can get Wifi anywhere I want, and on this, like, and I can do anything, like- … What's that thing called? I have, like, hot spot or something.
A: The hot- yeah. There's this little thing, like, with the iPhone, what you can do - or like, any kind of smart phone - it's like, download-
T: It's called a mobile hot spot.
A: Yeah, you can download your app-
T: It comes free with, like, the 4S and the 5, so, like- If I wanted to, I could just go on anything I wanted to anytime I want.
A: Like, the- the wi- the internet that- the internet access like he has on his phone, he can use it to use on his computer.
T: Yeah.
A: Like as a hotspot. It's not that bad.
T: They think-
A: The thing is that-
T: -that they're smart, but we're way- way smarter, you know what I'm saying? Tech center don't know what they talking about, so [laughs]…
A: [laughs]
NW: Are there other things you guys use either your phones for, or the laptop for, that are similar?

T: I've used- I use Siri-
A: - like I remember I was out for, like, a week- I was out for a week, and, um, my physics teacher, like he's so hard, he, like made me took a test. And I was there by myself, and I used Siri to answer all the questions.
T: Haha!
A: She did it for me!
T: Siri's smart! I swear to god. It's smart.
A: She's like a girlfriend. Like, she tells you everything.
NW: So you use it for- for that. So you know, like, you know, to get- basically, like to get- to find information, right?
T: Mm hmm.
A: Yep.

I asked Angelo and Tommy to consider a scenario in which cell phones were sanctioned tools for classroom learning. Interesting, both agreed that they would be too distracted by the ability to send text messages to their friends, which might become problematic if all students had the same level of access. In spite of this, Tommy began to describe how he then began finding ways to have his text messages forwarded from his phone to his laptop, which enabled him to text during class, yet look like he was using his laptop for sanctioned purposes.

T: I mean, if they let us use [cell phones] in class, that would be cool, but, like, no one would get their work done, 'cause I'd just be looking at my phone the whole time.
NW: Mm hmm.
A: And we- to be honest, I don't think it's really necessary, because we have our, like, our laptops.
T: Yeah.
A: But I mean sometimes it's-
T: No, I have my text messages, like, hooked up to my laptop. When, like, since I got my iPhone, like last week. Like, I did this thing where, like, like you plug in your charger, and like, you can, like, you go to your Apple uh, like, thing store- And you can, like, download this thing that, like, if your phone's like, if your phone's like in fifty feet of your, uh, MacBook, like- Yeah, just it just goes to your MacBook instead of your phone.
NW: Yeah. I've seen that-
T: Yeah, so it goes to your phone, too, but it goes to your MacBook, too. So, like, I can just, like, text, like, in class, like, on my laptop, but the- no one else knows that. You know what I'm saying?
NW: [laughs] Right.
A: Dude, I didn't know about that.
T: It's fresh, dude.
A: Like, Einstein over here… Also, one thing is, like, like new MacBook Pro's, it's called, um, AirDrop-
T: AirDrop! That's fresh!
A: That thing is cray-zee.
T: It's fresh.
A: Have you heard of that?
NW: Yeah, that is pretty cool.
T: You can, like, download, like games and stuff, like the people, like, "I want that"-

A: Like, movies, everything.
T: Like music and stuff.

Despite having relatively little interest in using their laptops in the ways Mr. Harris and the Bayside High School administration sanctioned for learning, Tommy and Angelo demonstrated a strong understanding of how they could appropriate the laptops for unsanctioned, personally relevant uses in school. As illegitimate forms of classroom participation, however, these uses of technology were therefore systematically excluded from the range of technology literacies the students were expected to develop as part of the school's laptop program, despite their obvious utility in empowering students to find, create, and share knowledge with their peers. The teacher-defined division of labor during technology activities left little room for these students to make use of these practices in legitimate ways, which resulted in students having had few opportunities to negotiate their division of labor. I interpreted this tension as contributing to not only the marginalization of certain uses of technology, but arguably to Tommy's and Angelo's in-class identities. Both Angelo and Tommy were aware that the ways they preferred to use technology would get them into trouble, and both seemed keenly aware during the school year that they held little cultural capital with regards to academic achievement. As opportunities to contribute to the class's understanding of technology (as well as how it might serve students' personal, and perhaps academic, interests) were systematically foreclosed, Tommy and Angelo maintained their "outsider" status.

Finding 2: Students Resisted Fulfilling their Assigned (Teacher-Defined) Division of Labor During Project-Based and Structured Activities

Throughout the course of the year, the focal students resisted doing the work that Mr. Harris assigned. This resistance came in two forms: not doing the work, and satisficing - an approach to tasks that demonstrated, rather than the motivation to meet the highest expectations or performance indicators outlined in the technology rubric, a willingness to do the minimal amount of work necessary to satisfying assignment requirements, the partial implication of which was to foreground completing the work at the surface level, while backgrounding institutional objectives, such as meaningful learning of the biology content.

Many of the activities Mr. Harris assigned called on students to be self regulatory or metacognitive about their learning. He typically assigned such tasks with the expressed goal of "getting [the students] to think" about their understanding of concepts and the learning process. One such activity involved reading a section from the digital textbook on the properties of water. Using a template created in Google Docs by Mr. Harris, students were assigned the task of creating a list of two-column notes. In the left column of the document, students would record facts and key concepts covered in the handout. In the right column, Mr. Harris instructed the students to record details and definitions of the corresponding items listed on the left side. The object of this activity was to have students reflect on key terms and concepts, and to summarize, in their own words, the meanings of various items in the reading. This technique is popular among teachers who wish to engage their students in active reading - the object of which is to have students think and reflect critically on a piece of text. Many scholars of digital technologies in education consider critical thinking to be an essential 21st century skill, and in this regard, Mr. Harris was doing his students a service by incorporating technology tools into the activity. Two-column notes activities have close ties to metacognitive principles of reflection and self-regulated learning (Santa, 2006), but the success of the activities is reliant on students asking critical questions that penetrate their understanding of terms and ideas. Indeed, the two-column notes exercise was configured to be part of a larger activity in which students created quizzes and answer keys to share with the rest of the class. By using their notes to capture essential vocabulary and key ideas, Mr. Harris hoped the students would engage in a process of reflection and thinking that empowered them to both "own" the content material, and pinpoint crucial gaps in their knowledge of the properties of water.

Tommy, Angelo, and Reggie all resisted getting started on the assignment in a timely manner, foremost because they did not pay attention to Mr. Harris's instructions about accessing the two-column notes template. Instead, as was usual, Tommy and Angelo used the beginning of class to catch up on social matters, chatting quietly while Mr. Harris explained the day's agenda to the rest of the students. Reggie, who often came to class late, took his time removing his laptop and other materials from his backpack, scanned the room, and checked his cell phone. Eventually, all the students began to settle into their work, yet they struggled to stay on task, as my field notes from that day suggest:

"Do we have to read the whole thing?" Tommy asks.
"You have to read it and take two-column notes," Mr. Harris replies. Before Mr. Harris is even done answering Tommy's question, Tommy and Reggie are talking about something. As Mr. Harris floats around the room, checking in on students and making sure they know where to find the reading, he tells the class the name of link for the article, "Reading: Properties of Water." It is located on their Moodle page. A few moments later, Tommy asks Mr. Harris, "How do I get to this reading?" As Mr. Harris is explaining to Tommy where to log into Moodle and find the reading, Angelo asks, "Where's the reading?"
Reggie starts dancing in his seat as Tommy pulls the template up for his two-column notes. Reggie, still dancing, looks on at Tommy's laptop. As Tommy begins perusing the document, Reggie still has not attempted to access or read the article.
Mr. Harris floats around the room, checking in with students. Reggie asks him what to do with the template. Tommy tells Mr. Harris that he can help Reggie, but Mr. Harris insists, "I got this." He takes control of Reggie's laptop, and while driving, tells Reggie where the template file is for downloading. He downloads the template and opens it for Reggie. "Here's the deal," Mr. Harris then tells Reggie. "Main ideas and supporting details go here," he says, pointing to the template. Scanning the article, Tommy asks Mr. Harris if he needs to read the whole thing. "Mr. Harris, we go all the way down, right?" he asks. Mr. Harris affirms, and Tommy turns to tell Reggie.
Reggie uses the Spaces function on his Macintosh laptop to create multiple, isolated desktops. He selects an alternate desktop space for working on his template. He switches between the reading and the template, which are displayed on mutually exclusive "screens". He moves some of the windows around, and begins slowly typing with one hand. He switches back between the reading and template several times. Many other students have both the article and template up on the screen simultaneously. Reggie seems to be the only one using Spaces to switch between the two.
Mr. Harris walks over to Angelo and shows him how to set up his screen for taking notes, with the reading on one side of the screen and his template on the other.
Tommy and Reggie begin chatting. After a couple of minutes, Reggie is staring around the room, clearly not reading the article. He dances around, looks and Tommy's screen, and then on his own laptop, opens iTunes. He switches back to the reading, then closes his eyes.
Moments later, Reggie hands Tommy one of his earbuds, and they listen together to a song played from Reggie's laptop. "Oh, that's nasty," Reggie remarks. "Ill shit."
Mr. Harris suggests to the class that they take screenshots, or grab images to include in their notes. Reggie and Tommy are chatting, and both seem to miss, or ignore, Mr. Harris's suggestion.
Tommy, having copied a couple of key words from the text of the article (without their corresponding definitions) asks Mr. Harris what to do when they are done. Mr. Harris, however, is tied up with another student, so another student rolls over to Tommy and shows him how to download his notes as a PDF and upload it to Moodle. When Mr. Harris finishes helping the other student, he looks at Tommy, and decides to not interfere, allowing the student who has been helping him to continue doing so. Not working, Reggie starts to sing a song.
Angelo and another student chat, while Angelo scrolls up and down the article, apparently not reading it.
Reggie, apparently done with his notes, exclaims, "Done. Shit is done." (Although when I check the Moodle page later, Reggie has not uploaded his notes.) The student

> helping Tommy shows him how to download his notes and upload them to Moodle (these are also missing when I check later). Reggie immediately takes out his cell phone, but hides it from Mr. Harris's view using his backpack. After Mr. Harris instructs the class on the next activity, he separates Tommy and Reggie.

Of the focal participants in class that day - Angelo, Tommy, Reggie, and Wei - only Wei completed the assignment. When I checked to see if Tommy and Reggie had uploaded the notes they claimed were completed, neither had submitted anything, evidencing a resistance to the teacher-defined division of labor for the activity.

In this section, I describe how students resisted the (teacher-defined) division of labor by both satisficing work and not completing work on time. Through these forms of resistance, the focal students effectively created tensions within the division of labor node that undermined the achievement of teacher-centered goals, and subsequently, negatively affected students' legitimate participation within the (institutionally-defined) school community. I provide six accounts of this resistance, four describing activities that centered around the creation of "open-ended," digital media based projects, and two that exemplified three of the focal students' resistance to doing work during structured, content-based activities. During these assignments, Mr. Harris granted students varying amounts of two forms of authority: logistic and epistemic. Logistic authority refers to the *how* of accomplishing set tasks, such as deciding which tools to make use of, which resources to appropriate, time management, and other forms of planning. Epistemic authority refers to the *what* of these tasks, such as what content to study, what questions to ask, and what information is most important to present. In the episodes I describe regarding project-based activities, resisting the teacher-defined division of labor in ways compelled Mr. Harris to enact greater control over the learning environment in order to manage students' learning of the biology content matter through teacher-centered pedagogical practices that limited student autonomy, authority, and pathways to learning. These practices included the use of structured technology-mediated content delivery activities, as well as canonical forms of schooling, such as lecturing.

Resisting the division of labor in project-based assignments. Mr. Harris implemented nine project-based assignments into the curriculum during the school year. The timeframe and complexity of projects varied, spanning sometimes just one or two class periods, and other times extending into lengthier durations of over a week or even longer. These projects were organized around the production of artifacts, which included: image-based flash cards of biology vocabulary, advertisement-like digital posters, an audio podcast explaining how to solve a given genetics problem, a self-assessment quiz, a set of biology "trading cards", a list of biology content "standards", and an "animal relocation application". The majority of these projects made use of digital media production tools and information resources, including desktop publishing software (Google Presentations and Pages), audio editing tools (GarageBand), Google Image Search and Wikipedia, and the digital biology textbook, although in some cases, such as with the "Evolution Poster Project" assignment, students were allowed to use tangible materials such as colored markers, construction paper, tape, and glue.

One of the ways the Bayside High School administration promoted digital publishing and multimedia production was by requiring students to take the "Web 2.0 and Presentation" course. The content of this course was not driven by state-mandated curricula, but rather was guided by the skills and principles of "21st century learning" the school deemed necessary for engagement in the world outside of school (namely for the job force and college), including digital publishing, data organization and analysis, multimedia presentations, and podcasting. Many of the projects Mr. Harris assigned were designed to take advantage of the prior technology literacies students' would have learned in the Web 2.0 and Presentation class, and as such, assumed a base level of familiarity with, and agility in using, certain tools. Demonstrating proficiency in this base-level of technology literacy formed a significant portion of the students' division of labor during these project-based activities. That is to say, in their project work, students were expected to be creative, make use of the sanctioned technologies, and incorporate various "enhancements" into their work, as outlined in the technology rubric.

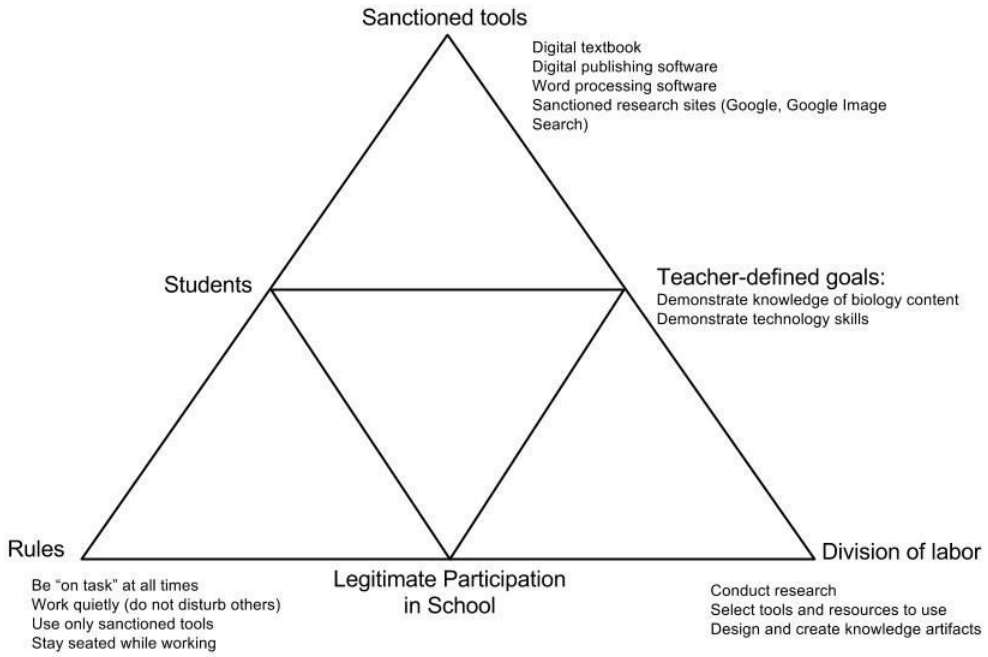

Figure 4: Diagram of teacher-defined activity system for project-based assignments.

Project assignments encouraged students to take "ownership" of their work in the spirit of creation, while simultaneously demonstrating one's knowledge of the content material and technology skills (again, as outlined in the technology rubric). Occasionally, students could select the topic of their projects, and in many cases, project work was "open-ended",

meaning Mr. Harris did not provide explicit instructions on which technologies to use, or how to use them. Students' division of labor during projects activities thus included a greater level of autonomy over the epistemic and logistical aspects of the activity than in highly structured activities, such as filling out worksheets.

Despite this authority, the focal students commonly used project time to socialize and initiate unsanctioned uses of technology, such as playing video games, listening to music, and using social media on their cell phones. This created tensions around the division of labor, which summarily undermined the purpose of activities meant to engage the students "on their own terms." These tensions within the division of labor node of activity were evidenced in several ways, but most saliently in two particular ways: 1) in the behavior the focal students exhibited during project time, and 2) in the artifacts they produced. Tensions around behavior typically involved students being visibly "off task" or not doing work. This earned them frequent reprimands from Mr. Harris, and even disciplinary action, such as being sent to the Vice Principal's office. Tensions involving the artifacts students produced centered on project work that was often late and incomplete, plagiarized other sources, and did not demonstrate the detailed use of enhancements stipulated in the technology rubric. The focal students' projects seemed to incorporate a minimal amount of effort in many areas, not only in terms of enhancements, but in content as well. For example, the focal students copied and pasted text verbatim from sources like Yahoo! Answers and Wikipedia into their posters, and ignoring the need to attribute or proper cite sources. The same was done with images on assignments that required the incorporation of visual elements.

By adopting this "effort efficient" way of completing tasks (though again, most of their project work was never completed), the focal students resisted the division of labor that Mr. Harris assigned to them. In this section, I will discuss how students responded to project-based assignments, and how the work they produced contributed to Mr. Harris's decision to implement canonical, teacher-centered activities at the expense of student authority.

Teacher-defined division of labor in poster activities. Mr. Harris assigned three poster projects over the year, two of which required the use of digital media production tools. Alone or in pairs, students were directed to use Internet resources to conduct research on various topics (sometimes of their own choosing), and incorporate elements of science vocabulary and concepts into their artifacts. Students worked on their posters in segments (from fifteen minutes to an hour) over the course of several days. Assignments emphasized creativity by removing the typical structures, such as templates, that guided students towards narrow interpretations of what their final artifacts would look like. While Mr. Harris provided students with explicit requirements regarding the science *content* students were expected to incorporate into their projects (e.g., terms to use, number of informational excerpts), he often left the format and design of each project up the students. This represented a significant portion of the teacher-defined division of labor for students, who were expected to make decisions about how to execute the assignment (i.e., logistic authority). For two of these posters projects, students could also select their own research topics, representing a shift in "epistemic" authority (Patchen & Smithenry, 2014) towards a

student-centered pedagogy. Epistemic authority relates to decisions regarding the content and quality of work, such as what elements are most important to include, the format of the work, and its overall presentation. Though Mr. Harris often required students to hand in their work through the Moodle course site, he did allow students to procure their own paper-based materials and construct actual posters, if they so preferred. As such, these project assignments represented the most student-centered activities I observed.

Poster assignments as systems of activity. To understand how tensions involving the division of labor emerged during poster activities, it is useful to frame poster work as a system of activity, and to examine its constituent elements. Similar to other in-class activities, the subject of the poster activities remained either individual students, or dyads of students. The objective of poster projects was to have students learn about three biology-related areas over the year: 1) macromolecules, 2) the properties of water, and 3) the evolution of a self-selected topic. Built into each assignment was the need for students to conduct research on their topic, through some loose form of creative "expression". As noted above, Mr. Harris granted students both epistemic and logistic authority during poster projects, meaning planning and creativity formed the basis of students' division of labor. Students were required to incorporate numerous visual elements into their posters, including images and text, but design of the poster layout and the inclusion of enhancements such as graphical effects were left for students to determine. It is important to note that again, the inclusion of such "enhancements" were a significant measure of a student's level of technology literacy, as defined by the school's technology rubric. By leaving these aspects of the assignment open-ended, Mr. Harris also hoped students would "have fun" with the production process. Logistically, students were responsible for directing themselves in the completion of the assignment tasks. As a resource, Mr. Harris could provide scaffolds and guidance for students in need of greater support, but he remained largely "on the side" during poster activities.

Students used a range of materials and resources (mediating artifacts) during their poster work, mostly in the form of online search tools, such as Google, Google Image Search, Wikipedia, and Yahoo! Answers. Typically, Mr. Harris provided students with a handout of explicit instructions for the assignment in terms of the amount of biology content students needed to incorporate into their posters. Mr. Harris encouraged students to use their lecture notes as well, but I rarely observed students use their notes as resources for such project work. Students created the posters in desktop publishing applications, such as Pages, which allowed for flexibility in the arrangement of text and images on the page. For the Evolution poster, students either drew their own images, wrote by hand text on the poster, or printed out text and images, and affixed the items onto the poster using tape or glue.

Though Mr. Harris attempted to encourage students to take up a division of labor that included authority, students were expected to follow the same general rules that guided their behavior in the Introduction to Biology class while working on their posters. Students were expected to remain relatively quiet, and not distract others. Mr. Harris occasionally

allowed students to listen to music on their headphones during individual work, but students were always expected to be on task, never playing video games or navigating to non-academic web sites. During small group work, students were expected to quietly discuss the subject matter or the nature of their projects, though students often broke these rules in minor ways to socialize and participate in brief conversation. Students were expected to turn in their work at the assigned date and time, and with the exception of the Evolution poster project, through the Moodle course site.

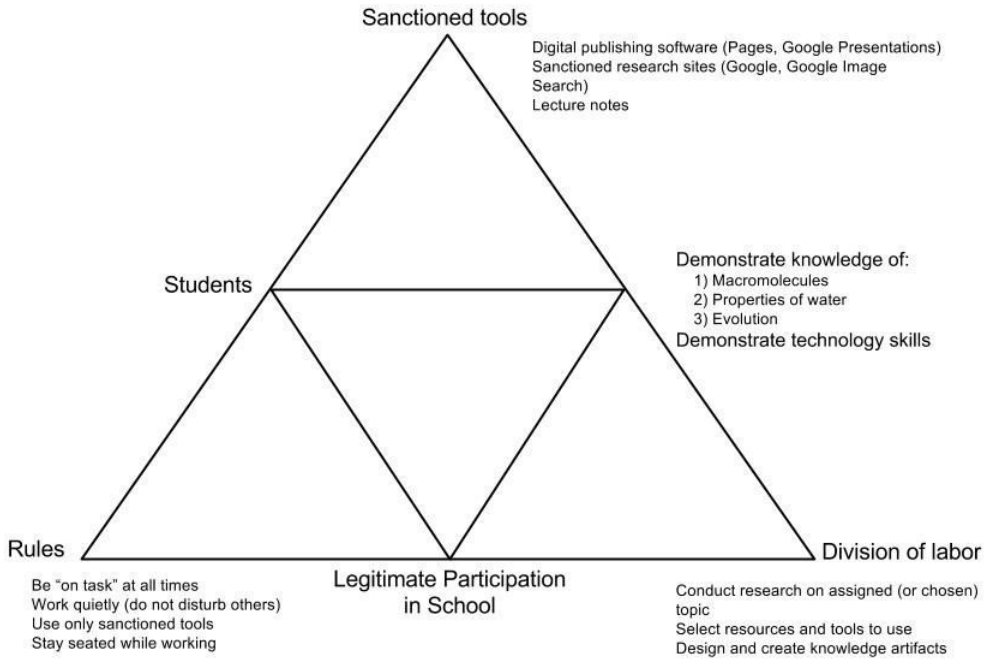

Figure 5: Teacher-defined system of activity for poster projects.

Resisting work on the macromolecule poster project. The first poster assignment of the year was distributed in early November, roughly two months after the first days of the class. For this project, students were randomly assigned various macromolecules (carbohydrates, lipids, proteins, etc.), which they had to research and "report back" on in the form of a poster or commercial (no students took up the option to produce a commercial). Mr. Harris introduced the poster activity at the beginning of class one morning:

> "I give you one of the macromolecules… Let's say you have carbohydrates. You have to sell carbohydrates… you have to have a sales pitch around it."

Mr. Harris then distributed a handout (shown below) one day while they finished a worksheet activity. He listed the types of macromolecules they might be assigned: carbohydrates, proteins, nucleic acids, and lipids.

Macromolecules Poster

Each student will be assigned a macromolecule to investigate. It is your job to investigate the inner workings of this macromolecule and to report back your findings to the class through a poster/commercial presentation.

Here is your job…

1. Create a poster for your assigned macromolecule that includes the following information:

   a. The name of the Macromolecule (nice and big for everyone to see)
   b. The building blocks of your macromolecule (what is the "big" structure made from?)
   c. A chemical drawing/representation of the building block you stated above. Be creative not only with colors, but also with how it is drawn/represented (i.e. construct with atom cut-outs of different color construction paper, bring in gumdrops or marshmallows with toothpicks to glue to your poster, etc…)
   d. At least 2-3 molecular examples (types) of your macromolecule.
   e. A drawing/representation of all examples you listed above.
   f. At least 3 specific ways these macromolecules are used by/in the cell.
   g. At least 3 different food sources these macromolecules are found in.

Figure 6: Macromolecules Poster assignment handout.

Structuring the assignment around the pretense of an investigation, the assignment also stressed students to be "creative not only with colors, but also with how it is drawn/represented," suggesting the use of enhancements to create a visually appealing and expressive display.

Mr. Harris distributed the assignment with roughly thirty minutes left in the period. Rather than use this time to make headway on their posters many students, including the focal students, decided to spend the time surfing the Internet, playing with the cell phones, or listening to music. Mr. Harris noticed this and reprimanded the class for their off task

behavior, reinforcing the rules of the activity (be on task, working quietly). As the excerpt from my field notes on that day demonstrate, even despite these recriminations, the focal students continued to take advantage of Mr. Harris's instructional technique of passing up and down the aisles of the classroom, checking in on individual students. This technique created plenty of opportunities for students outside of Mr. Harris's momentary gaze to take out their cell phones, socialize, and play video games, or in other words, to resist working on the macromolecules poster.

> The class grows louder as the students seem to be wrapping up their work... Mr. Harris notices the rise in commotion and coughs loudly to get the class's attention. "Pardon. Time out. You guys saw that I was busy so you started chatting, right?"
> "Yep," someone says.
> "You have to get better at staying focused," Mr. Harris implores the group. A few minutes later, Reggie is checking Facebook on his phone.
> Mr. Harris assigns Reggie "proteins" for his multimedia project. Reggie is now just sitting at his desk, seemingly staring off into space. He plays with his phone, twirling it around. Mr. Harris comes over and urges Reggie to get back to work. "Remember, orange hair, Reggie. Orange hair," Mr. Harris says, referring to the bet he made with Reggie. The stipulations of the bet were that if Reggie earned an "A" for the year, Mr. Harris would dye his hair orange.
> 12:47pm. Reggie has his headphones in and his hands over his face. Mr. Harris floats towards the back of the class and checks in with Reggie, who hasn't done any work since Mr. Harris's last trip to that part of the room. "Reggie, orange hair," he reminds him.

Minutes later, recognizing that Reggie was still off task, Mr. Harris attempted to scaffold Reggie through the beginning of the assignment, providing direct instruction (even taking control over Reggie's laptop) in an effort to help Reggie gain traction on the assignment. In spite of Mr. Harris's assistance, however Reggie appeared disinterested in completing the assignment as Mr. Harris modeled it. Reggie then quickly transitioned back to doing tasks unrelated to the assignment.

> 12:54pm. Mr. Harris again tells Reggie to get back to work. Reggie opens iTunes and watches a video of himself and a friend. It looks like they are rapping to the camera. Reggie starts beat boxing aloud, and Mr. Harris walks by again. This time, instead of urging Reggie to get back to work, he sits down and starts going over the project assignment with him. "How do we find the building blocks of carbohydrates?" Mr. Harris asks.
> "Google," Reggie replies.
> "So let's go to Google."
> Reggie navigates his browser to Google. Mr. Harris tells him that since he is using the Chrome browser, he can use the address bar as a search field. Mr. Harris tells him to enter into the search field "what are the building blocks of carbohydrates?" Reggie enters the phrase into the search field and clicks on the first search result. Mr. Harris takes control of the laptop and right-clicks on one of the words that appears on the page. He then selects to look up the word in the Dictionary application that comes packaged with the Macintosh operating system. Mr. Harris is unhappy with the definition the Dictionary application has provided, so he shows

> Reggie how to look up the word in Google. Mr. Harris briefly turns around to help Jake with an issue, and as he does, Reggie switches back to iTunes, puts his pencil down, and stretches. He stares off towards the front of the room, playing with his pen. He goes back to Google, and then looks over at his neighbor's computer screen, which is displaying a "Cannot connect to server" page.
> "What happened?" Reggie asks her.
> Mr. Harris, who has now stood up to check in on other students, walks by, and Reggie quickly goes back to Google and clicks on "Images". Distracted again, he looks at his arm and begins flexing. He makes a face to Wei and tries to look at her laptop screen. She is on Facebook, and turns her laptop away from him. He goes back to his own laptop and clicks on an image of a beer glass and a cell phone. He lifts his head and stares off into space. He then clicks on the Mission Control/Spaces settings on his laptop, and starts bobbing his head.

By resisting the tasks Mr. Harris tried to encourage Reggie to take up, tensions began to emerge within the division of labor node of the activity. When he was off task, Reggie made no progress towards completing the assignment. This compelled Mr. Harris to intervene, and direct Reggie towards Google in an effort to begin the research process. Scaffolding Reggie - indeed, by physically taking control of Reggie's laptop - Mr. Harris assumed the responsibility (division of labor) he had assigned to Reggie; in a sense revoking logistic authority, and managing the learning process. Reggie's off task behavior continued into the following day, and became a common way for him, Angelo, and Tommy to approach in-class assignments.

The next class meeting, Mr. Harris set aside the last thirty minutes of class for students to continue working on their macromolecule posters. Again, he went about checking in on individual students, occasionally reprimanding those who were off task. As Reggie's behavior during the previous class meeting seemed to indicate a willingness to resist Mr. Harris's requests to "stay on task," I turned much of my attention to him on this day. In the excerpts below, it is apparent that Reggie spent a great amount of time engaging in tasks that were unrelated to the poster activity (although they were not entirely unrelated to other academic work). Most notably, Reggie displayed an interest in engaging with the biology subject matter, but through means that were unsanctioned during this part of the class period, namely, retaking a practice test. Later, while resisting the assigned task of work on his macromolecule poster, Reggie implored Mr. Harris to "teach [them] something big" instead. I interpreted both events as forms of resistance, representing another emergent tension around the teacher-defined division of labor.

> 12:24pm. Mr. Harris walks to the back of the class and reprimands Greg, who has been talking to his neighbors. Reggie jumps into the conversation, "How DARE you disappoint Mr. H.," he jokes sarcastically at Greg. Reggie turns, and then starts to wave his hand in front of the face of the girl next to him. Mr. Harris asks what he is doing. Reggie gives an inaudible answer, and looks for a moment like he is going to get back on task, but as Mr. Harris turns away to talk to Jake and the girl next to him, Reggie immediately goes back to singing and tapping his pencil. As Mr. Harris begins to answer the girl's question about nucleic acids, Reggie puts his head down on his desk.

12:33pm. Reggie is searching for MP3s online.
Thirty minutes have elapsed since Reggie took the practice test Mr. Harris assigned as the first activity of the day. After his first attempt, Reggie tried to retake the practice test, but could no longer access it. Mr. Harris explained that there was a thirty-minute "lock out" on the practice test, after which he could re-access it. Reggie tells Mr. Harris that "it's been 30 minutes," (he has been keeping time on his iPod mini), and that he would like to retake the practice test. Mr. Harris explains to Reggie that the class is on a different activity (working on their posters), and that Reggie (and the others) should take more practice tests at home. The class grows louder and more disruptive. Reggie has forgotten which macromolecule he has been assigned, and asks Mr. Harris, "What am I doing again?". Mr. Harris tells him that his assigned molecule is on his worksheet. During the last class, Mr. Harris wrote the assigned molecule on the top of Reggie's worksheet, but Reggie seems to think that he has lost it. Mr. Harris does not seem to take an interest in helping Reggie remember, or find, his assigned molecule - or perhaps he expects Reggie to find the answer himself. But rather than look through his materials, Reggie seems somehow satisfied to remain seated, not working on anything. He checks Facebook on his cell phone.
12:44pm. Mr. Harris tells the students to put their headphones in. "I'm trying to give you guys an open-ended assignment that you can do well on," he explains. Reggie gets up to go to the bathroom, but as there have been several requests from other students to use the restroom, Reggie must wait in line. One of Mr. Harris's hall passes is sitting on his desk. Reggie picks it up, and says, "But Mr. Harris. Here." (referring to the hall pass toy) Reggie remains standing at the front of the room for a few moments, then walks back to his desk, grabbing Jake's Cheez-Its on the way. Jake's phone falls off his desk as Reggie passes, and soon, Reggie, Jake, and Will are in a discussion about cell phone technology. As the class is now rather loud, Mr. Harris shouts, "Quiet right now! Do you guys know what the lemon rule is? It is the legal reason that I can remove you from the classroom. Now sometimes -"
"-It's extremely easy, though," Reggie interrupts, referring to the assignment.
Mr. Harris tells the class that they need more "internal focus".
"Why do they call it the lemon rule?" Greg asks.
"Because one bad lemon can ruin a batch of lemonade," Mr. Harris replies. He explains that the rule enables teachers with the decision-making power to remove students who are interfering with others' learning opportunities. He seems to be saying this as a threat, but he does not explicitly threaten any student, or any course of action. Reggie does a quick little beat box sound, and then loudly proclaims to Mr. Harris, "I want you to teach us something BIG, like 'mass consciousness." Mr. Harris tells Reggie to get back to work. "Orange hair, Reggie," he says, reminding Reggie of their bet. Mr. Harris implores the class to help Reggie stay on task. He says he will blame them if Reggie loses the bet.
Reggie tries to negotiate with Will about going to the bathroom before him. He makes another beat boxing sound and types something on his neighbor's keyboard. He does a Google search for "Google Gravity" and clicks "I'm feeling lucky today." The page loads, which looks like a basic Google search page. But through some sort of flash animation, the elements on the page crash down to the bottom of the window, like they are under the influence of gravity. The girl's browser crashes and she has to restart her computer. "That's mean," she says. Reggie apologizes. He then reaches for Jake's cell phone cable, which is plugged into Jake's cell phone and laptop. Jake scoffs at Reggie and says, "Reggie, you're crazy. Don't touch my shit."

This was the last day Mr. Harris's students worked on their macromolecule posters in class. By the end of class Reggie had done little work, and did not turn in a project. While some of the other students vacillated between on task productivity and off task activities such as chatting and playing video games, Reggie appeared clearly distracted throughout the period, and failed to make any progress towards completing the assignment. Whereas on the previous day, Mr. Harris attempted to scaffold Reggie in doing some online research, on this day, Mr. Harris attempted to motivate Reggie through self-effacing actions, reiterating that if Reggie could achieve an A grade, Mr. Harris would publicly embarrass himself by dyeing his hair orange. Still, Reggie persisted to make no progress on the assignment, again resisting his assigned division of labor.

It is difficult to speculate what effect Mr. Harris's public reiteration of "the bet" had on Reggie psychologically, or what effect involving the rest of the class had on Reggie's motivation for accomplishing the tasks Mr. Harris defined, but it is worth noting that from a sociocultural context, these events present significant issues with regards to Reggie's in-class identity, and the social capital he carried when Mr. Harris ascribed him the role of "underachiever". I will later discuss what influence such events had on Reggie's legitimate participation as a "student" in the teacher-defined system of activity, and how this was mediated by Reggie's resistance to the division of labor, as well as his interactions with the social norms (i.e., rules) of the Introduction to Biology class.

Resisting work on the "Properties of Water" poster. Later in the month, Mr. Harris assigned the students another poster project, this time to be completed with a partner. The assignment was given in conjunction with what Mr. Harris called a "5-4-3-2-1" self-assessment - a quiz that the students were to create themselves, featuring five multiple choice questions, four fill-in-the-blank questions, three true-or-false questions, two short answer questions, and an essay, all on the topic "The Properties of Water." For their poster, the students were instructed to create digital presentations, in similar vein to the macromolecules poster assignment, using digital production tools. On the poster, students were required to include the following information:

- A description of the structure of water
- An explanation of what a hydrogen bond is, and how hydrogen bonds affect the properties of water
- A description of water's ability to dissolve many different substances
- An explanation of what a solution is
- An explanation of what a suspension is
- An explanation of acids, bases and pH
- Pictures to support the included information

To accomplish all of this, students were expected to use their laptops to access the Internet for research, as well as use the digital textbook and their lecture notes. From Mr. Harris's standpoint, the object of the "Properties of Water" poster activity was to engage students in the water curriculum unit, and to provide students with opportunities for creative expression of the knowledge they gained through research. Unlike the macromolecules poster, however, the properties of water assignment was not introduced through the use of a "real life" or "fantasy" scenario, and instead was meant to be purely didactic, containing only relevant content (although in a visually-stylized display). Thus, the teacher-defined object of the activity was to demonstrate one's understanding of the properties of water (as defined above), and demonstrate one's ability to find and present relevant images in a visual display. The division of labor mediating these teacher-defined objectives included having students conduct research to find the required information, locate and select images to support that information, and use sanctioned tools (e.g., Pages or Google Presentations) to design and create learning artifacts that both met the assignment requirements and the indicators of technology literacy described in the school's technology rubric.

Keeping in line with his stance against using class time to teach students how to use specific technologies, Mr. Harris did not model or explain to students how to utilize the technologies at their disposal for the Properties of Water assignment, including how to use the available desktop publishing tools (e.g., Pages) to design visually appealing, yet informative posters. That is to say, he did not explicitly state, "Your poster should look like this," or "These are the techniques you need to use to create this poster." By limiting the assignment's structure to the seven requirements listed above, Mr. Harris, in a way, provided students with a combination of both logistic and (in terms of creative expression), epistemic authority, except for two significant restrictions: 1) the poster had to be a static, visual piece of work (e.g., not video- or audio-based), and 2) students were expected to use their class notes as the primary information resource. Beyond these constraints, however, the students would have to decide how to define and fulfill the division of labor. This division of labor chiefly consisted of meeting the seven assignment requirements (e.g., a description of the structure of water). By providing the students with the autonomy to work out how to produce responses to those requirements, Mr. Harris arguably created an opportunity for students to invent novel pathways towards accomplishing the assignment. What he did not intend, however, was that students would overwhelmingly approach their division of labor in ways that maximized "efficiency" (i.e., minimal work), such as "Googling" answers and sharing work with each other across groups. Despite this authority, however, only a few students in the class submitted completed projects, even though they had numerous opportunities during class to work on them.

This form of autonomy presents a complex paradox: though Mr. Harris arguably attempted to create an open-ended, student-centered assignment, his students still failed to produce any substantial learning artifacts, or to engage with the properties of water curriculum unit in a meaningful way. I believe this example serves to highlight the importance of framing students' participation in learning activities within a socio-historical context, and the impact of seemingly minor, but perhaps "arbitrary constraints" (McDermott & Varenne, 1995). By

providing the students with more autonomy over their poster project work, and authority to decide "how" to accomplish the (teacher-defined) objectives for the assignment and "what" (in terms of creative expression) to include visually, Mr. Harris adhered to constructivist pedagogies that associate autonomy with engagement. For Reggie, who frequently voiced to me and others his desire to be "inspired", to have his curiosity piqued, and to engage with more meaningful scientific questions, such autonomy might have served as a point of entry into fuller participation in classroom activities. Yet, as I observed Reggie and Tommy interact throughout the Properties of Water poster activity, it was clear that the dyad experienced significant trouble getting started on the task, as well as gaining any momentum once they began their work. Further, they did not make use of their class notes, as Mr. Harris suggested. It is significant to note that throughout the year, Reggie did not take notes during class. Tommy seldom took notes, and did so in cryptic, disorganized ways. Thus their class notes would have served a questionable role in terms of mediating the dyad's ability to successfully produce the information required in the Properties of Water poster assignment.

My field notes from that day demonstrate the seemingly non-stop flow of interruptions and distractions that Tommy and Reggie both encountered *and* initiated, which appeared to prevent them from remaining focused on the task. Indeed, even Tommy's urgency to "get this done" was short lived, as the two boys quickly returned to socializing after brief moments of on task work. As the field notes indicate, Reggie and Tommy seemed to flow in and out of productive participation in creating the poster. The two adopted a strategy to utilize an "effort efficient" approach, satisficing the assignment requirements by copying and pasting items verbatim from various Internet sources into their poster document, which they seemed to think left plenty of free time to socialize. Yet even despite this shortened path to the completion of the Properties of Water poster, the two failed to hand in their project on time, or meet the assignment requirements, again forming a tension within the teacher-defined division of labor. To illustrate the tensions that surrounded this paradox, I present below a full account from my field notes how Tommy and Reggie failed to produce their poster - a result of their resistance to foregrounding "productive" work in favor of socializing and participating in other activities during the sanctioned poster work time.

I focused the majority of my attention during the Properties of Water unit on Reggie and Tommy. My interest in Reggie's participation in this assignment stemmed from both his behavior during the previous poster activity, and the developing relationship he was having with Mr. Harris and the rest of the Introduction to Biology class. As noted above, in an attempt to motivate a stronger dedication to completing his assignments and achieving a higher grade, Mr. Harris had made a "bet" with Reggie, which, by this point, had become public knowledge amongst the class. I was interested in seeing how this public positioning of Reggie was unfolding, and if indeed, he demonstrated greater initiative in completing his course work as a result. Reggie's attitudes towards schooling, and his own personal sense of his learning processes, grated against the external expectations of Mr. Harris and the

Bayside High School administration, making this a particularly interesting time to follow Reggie's progress through the course.

At the beginning of the day's activities, Mr. Harris had threatened to pick the groups himself, but relented, issuing two conditions to the class upon which they could pick their own partners: 1) the students would have to move their seats, and 2) students were not allowed to talk while they moved about the room. He then asked the students to suggest possible resources for finding information, as well as which tools to use for their projects. Mr. Harris then suggested himself that students divide the work up among the pairs, with one working on the quiz, while the partner who is "better with graphics" possibly taking responsibility for creating the poster.

> "Here's the rule," Mr. Harris says. You can't sit at any table you're sitting at. But you can't talk (as you get up to move). If you speak, I pick partners for you." Tommy and Reggie ask why they have to move. Reggie stands up and jokes with the girl behind him. He postures like a bully, trying to be physically intimidating, but he is joking and chuckles as he moves away from her. Reggie and Tommy pack up their belongings and move to the table at the very back of the room, where Jake usually sits. Mr. Harris reminds the class that the activity includes creating a poster. "What are the ways you can do a poster?" Mr. Harris asks. He calls on Jake.
> "Google Docs," Jake responds.
> "Pages," says Tommy.
> "Can I do a video?" asks Reggie.
> "No," Mr. Harris responds. "Where would you go to get information on your poster?"
> "Google," says Greg.
> "Your notes!" Mr. Harris corrects him. He tells the students that they can use their notes for the project, and that he suggests they "divide and conquer," meaning they divide the labor between the two partners: one person works on creating the quiz, the other works on the poster. "Who's better with graphics?" Mr. Harris asks, as a hypothetical question to ask amongst themselves. Reggie raises his hand and says, "I'm better."
> Tommy takes out his phone, and holds it close to his screen so Mr. Harris can't see that he has it out. Reggie takes out his phone, too. Mr. Harris tells the class that, for the quiz assignment, they can write an answer to a given question, create a grading rubric, or create an outline of what the answer must include.
> "What are we doing?" Tommy asks Reggie.
> "You're asking me?" Reggie laughs. Mr. Harris comes over to them, and swivels Reggie's chair around so that Reggie is facing him. Reggie tells Mr. Harris that someone keeps "harassing [his] phone", and that Mr. Harris should answer it. Mr. Harris tells Reggie to stop, and then explains to the two boys what the assignment is. As he is explaining the instructions, Reggie drops his water bottle. He picks it up, stands up, walks to the front of the room, gives Ricky hand shake, goes over to the recycling bin, throws his bottle into the bin, stops, does a little dance with Rosa, and then comes back to the desk, where Mr. Harris is still explaining the assignment to Tommy. Mr. Harris starts explaining to Reggie what he needs to do, and Reggie says, "I got the graphics."
> "What is the structure of water? Structure of water - you know that," Reggie says to Tommy.

"Yo, let's get to work," Tommy says. But he and Reggie continue to chat and joke with each other, instead of getting down to work. After a little while, Mr. Harris comes over and reprimands Reggie for not having done any work yet. Reggie objects, like it's not his fault. Tommy opens Pages on his laptop, and he and Reggie begin talking about their poster.

12:36pm. Tommy asks for permission to go to the bathroom. Reggie complains to Will and Natalie that they said he doesn't do any work. (They had just been joking about Reggie's lack of productivity.) Using Tommy's laptop, Reggie goes to Google and looks up "what is the structure of water". He clicks on the first result. He then goes back to Pages. He drags an image from the search results into Pages.

12:38pm. Tommy comes back to the classroom. Mr. Harris is floating around the room, Jake goes over to Tommy to show him his cell phone. Mr. Harris comes over, and Jake rolls back to his place next to Angelo. He puts his cell phone away. With Mr. Harris's back now to them, Jake rolls back over to Tommy and shows him a photo of something on his phone. Jake, Tommy, and Reggie start chatting and joking about cell phones.

Reggie launches iTunes, puts an earbud in his left ear, and give the other earbud to Tommy, who puts it in his right ear. This way, they can listen to the same piece of music at the same time. Reggie starts playing a song. Reggie then goes to a website, copies some text, goes back to Pages, and pastes the text into the poster. Reggie and Tommy then look at Reggie's album covers in iTunes.

Tommy asks Reggie how to drag a picture from the Firefox web browser into Pages. Reggie shows him, and then shows Tommy how to copy and paste text in, as well. Mr. Harris comes by, and noticing this technique of appropriating ("plagiarizing," according to Mr. Harris) content, tells them that copying and pasting doesn't teach them anything. Tommy tells Mr. Harris he just wants to get the project done. Mr. Harris asks the boys if they know what the phrase they just copied means, and neither can provide a satisfactory summary. Mr. Harris reiterates that he wants them to understand what the text means. Reggie reassures Mr. Harris, tell him he'll "make sure" Tommy knows what it means. "What does ionic mean?" Reggie asks Tommy. Realizing that they are somehow further behind, or have forgotten a part of the task, Reggie asks Mr. Harris, "Wait, we're supposed to do our own thing?" Will explains that they're supposed to make a poster AND a quiz for the assignment. Reggie is obviously confused. Tommy says, "Let's go," to prompt them into action. He tries to paste more text into the Pages poster, but he uses the wrong key commands (CMD+D instead of CMD+V). Confused, Tommy asks Reggie to copy and paste some text into Pages. Reggie switches from Firefox to Pages using Spaces, and Tommy asks, "How'd you do that? I barely use this laptop." Mr. Harris comes over and tells Reggie that he is "done talking to anyone else but Tommy." Tommy makes a joke that they have copied so much text onto the poster, that there's now "mad information there." In reality, their poster only has two lines of information on the structure of water.

Tommy tells Mr. Harris that he didn't know they had to create quiz, too. He tells Mr. Harris that Mr. Harris knows "there's no way we were going to be able to do both." Reggie jokes, "Is there anyone who can keep up with me?"

1:02pm. Mr. Harris tells the class to save their work. Tommy tells Reggie to save their work, "because if I save it, there's no way we're going to find it." He then tells Reggie that they'll do it on paper first, then bring it in and "finish that shit." They high five each other.

Where technology in this activity was meant to serve as a resource for enabling self-directed learning and engagement with the biology curriculum, in addition to mediating the creative expression of the content area knowledge, what emerged was, again, a tension surrounding two seemingly contradictory approaches to the activity. For Tommy and Reggie, having authority over the logistical and epistemic elements of their poster work meant free reign to use their time in a relaxed fashion, until they realized they had to also create the 5-4-3-2-1 assignment before the end of class. Though Tommy had originally attempted to prompt Reggie into action at the beginning of the period ("Yo, let's get to work"), only when it became clear that they were running out of time did Tommy again voice an interest in finishing the poster. Despite the authority to plan a logistical strategy for working on the project, as well as the power to decide what content would be important enough to include in the poster, the two seemed to "blow off" the intended purpose of the activity, which was to learn about the properties of water. Instead, the little productive work they did accomplish appeared oriented towards simply retrieving *any* chemical information about water, and pasting that into their document verbatim. Interestingly, Tommy also seemed to lack any understanding of how to copy and paste text and images into the document at all, highlighting a very significant tension in the teacher-defined division of labor - namely, that Tommy did not have the prior knowledge to fulfill his role as information gatherer.

The fact that Tommy seemed to lack any prior knowledge regarding efficient copy and paste techniques put him at an early disadvantage in terms of completing the task on time. It is possible to imagine a scenario in which Reggie could have assisted Tommy in learning these techniques of appropriation, yet taken that Reggie appeared even less inclined than Tommy to care about finishing the project, demonstrates that even when afforded opportunities to engage with curriculum on their own terms, using seemingly "motivating" tools (i.e., the laptops), some students still struggled to meet expectations, or accomplish what are sometimes considered "simple tasks." The outcome of their work appeared to further reinforce the low academic status that Tommy and Reggie withstood, hinting at some of the complex mechanisms of social reproduction that served to ascribe these boys such low status in the first place.

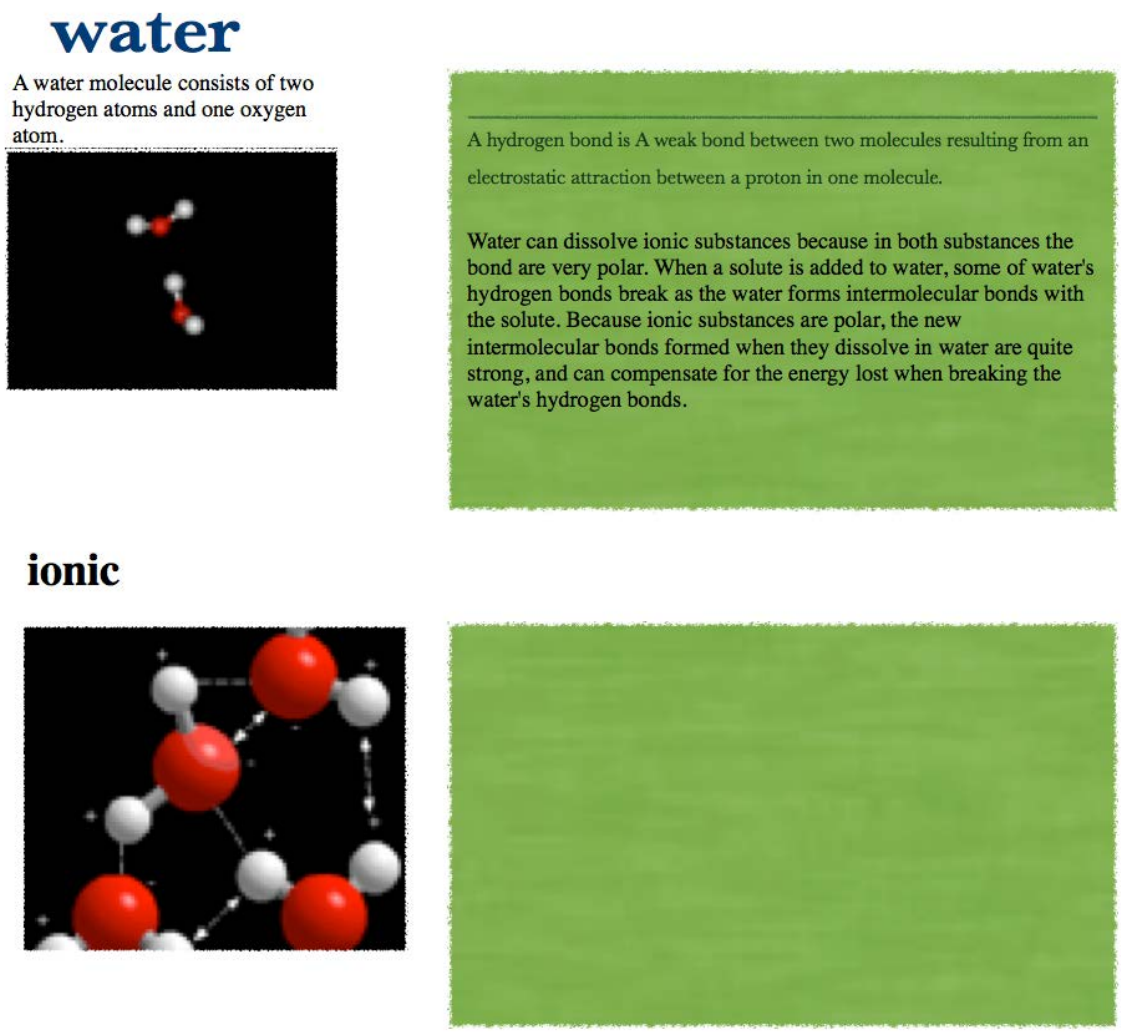

Figure 7: Reggie and Tommy's "finished" Properties of Water poster.

Resistance during the Evolution poster project. For one of the final "creativity" based projects of the year, Mr. Harris assigned the remaining students another poster project, this time on the topic of Evolution. What differentiated this poster project from the two others that were assigned earlier in the year was that for this project, students were encouraged to make their posters using traditional materials - poster board, construction paper, markers, tape, glue, etc. Another differentiating factor in this assignment was the expressed objective for student to "have fun" creating their artifacts. By emphasizing an element of fun in this project, Mr. Harris hoped to inspire the students to learn about the evolution of a personally interesting, human cultural artifact, such as "Corvettes, cars, cellphones, or Mickey Mouse." Students were required to include six stages of the cultural artifact's evolution, including images and a description of how its evolution led to certain advantages. Similar to the first poster project, creative design and decoration were included in the project's evaluation. The full assignment was posted to the Moodle course site.

EVOLUTION POSTER PROJECT
This is a project you should enjoy. Choose a topic you are interested in and would like to learn about.
Examples of projects include:

- Evolution of Corvettes
- Evolution of Cars
- Evolution of cellphones
- Evolution of Mickey Mouse

- Must be at least 11in. by 14in. minimum size and the largest it can be is the size of a poster board.
- Must have at least 6 changes
- For each change you must describe how the change gave a new advantage
- Must be creatively designed and decorated
- Must be neat
- Put your name and period on the back
- Must be a school appropriate topic
- Topic must be approved by me before you start on it

The students used their laptops for research, as usual, relying on typical sources such as Wikipedia and Google Image Search (mediating artifacts) to gather information on their topics. Students were then allowed to print out images to the printer in the library, which they could then cut out and affix to the poster paper Mr. Harris provided. Another similarity to the first poster project of the year was that, for the Evolution poster, students were instructed to work individually. Students also needed to seek Mr. Harris's approval of their topics, so that he could vet their appropriateness (rules). As was typical practice for assignments, Mr. Harris set class time aside for students to work on their projects. For the Evolution poster project, he provided several such opportunities, spread out over a number of class days. As with the Properties of Water poster, Mr. Harris also shifted logistical and epistemic authority over the content and layout of the posters over to the students.

Students made use of a number of strategies for completing their work, representing their chosen division of labor. Predominantly, they seemed to prefer to gather information first, collecting images and descriptions of their topics that they found on the Internet. Other students, however, did their work piecemeal, and upon finding a desirable description or image, set about printing, drawing, or handwriting the newly found information down on their posters. This was a strategy that Tommy appeared to employ, and though it did not seem at first to limit the pace of his progress, it did provide a certain strategy for being able to look on task, while distracting himself with other activities. Tommy's process, for example, resembled a cycle of using Google Image Search to find an image, printing it to the library printer down the hall, retrieving the printed image, cutting the image out with scissors, and then taping the printed image onto the piece of poster board Mr. Harris had provided.

Perhaps the combination of noticing Tommy's tendency to remove himself from the class (e.g., requesting to use the bathroom or get a drink from the water fountain down the hall), and his lack of productivity, Mr. Harris began to devote more individual attention to Tommy

during class work, often taking the seat next to him and scaffolding him through in-class work. This represented a shift towards greater management over Tommy's learning, as well as increased constraint over Tommy's mobility around the classroom. This kind of surveillance inherently diminished Tommy's teacher-sanctioned autonomy, as Mr. Harris defined more explicit pathways for Tommy to achieve the assigned objectives.

During the first and second days in which students were working on their Evolution posters, Tommy seemed to take an exceedingly long time finding information on his chosen topic - cell phones. Indeed, even as other students, such as Carmella, finished their projects, Tommy was still yet to begin putting any materials together on his poster. This presented somewhat of a paradox to me as an observer, as on paper, this constructivist activity not only provided Tommy with a great amount of autonomy and authority over his learning (both logistically, as well as epistemically), but Tommy also had selected a very fitting topic for his Evolution poster (cell phones). Tommy had demonstrated a great interest in cell phones over the course of the year, and Mr. Harris and I were both well aware of the surreptitious text messaging, Facebook checking, and internet surfing for which Tommy used his cell phone during class time. Indeed, Tommy enthused over the various exciting and fun features of his new cell phone earlier that spring when I interviewed him and Angelo. During our conversation, Tommy also alluded to his negative feelings towards the school's laptop program, and the inferior experience of using his laptop when to his phone.

Tommy was indeed quite knowledgeable about the various features of his phone, and they benefitted him both socially and personally. Education reformers have theorized that providing students with autonomy to engage in curriculum through personally meaningful channels enhances motivation and self-directed learning (Ito et al., 2010), yet, crucially, that deterministic approach to the inherently motivating nature of technology risks ignoring deeply ingrained mechanisms of social reproduction, which put the very same students who would benefit most from such reforms at risk of further marginalization (Sims, 2013). Tommy's enthusiasm for his cell phone stemmed from the intimate, personal experiences he initiated and participated in outside of the realm of schooling. Though the boundaries of this use crossed over into the school environment, Tommy's engagement with the Evolution poster project did not evidence the sort of motivated, self-directed learning that was expected from being granted both logistic and epistemic authority over his work. Tommy's productivity waned as usual, and his overdue poster demonstrated not the excited, creative expression of knowledge that had been the objective of the activity, but rather, incorporated a minimal number of black and white images, which he appropriated from various sources. The text on the poster included sparse details describing the successive generations of cell phone technology Tommy had found while searching the Internet.

Like with other course work, Tommy appeared resigned to simply handing in an assignment that exhibited minimal effort. Even despite Mr. Harris's attempts to provide Tommy with scaffolding and instructional support, Tommy seemed to flounder on his own, vacillating between distraction and sluggish attempts at making progress in his work. It is difficult to draw any causal relationships between the approach Tommy took towards his

course work (i.e., what his learning objectives actually were) and effectiveness of the mediating artifacts that were meant to help accomplish the goals Mr. Harris put forth, but the level of work Tommy's final product exhibited, especially when considering *how* he worked on the poster (often in fits and starts, showing very little focus on tasks), suggests that, when endowed with logistical and epistemic authority, Tommy resisted the teacher-defined division of labor, thereby derailing Mr. Harris's objectives for the Evolution poster project (e.g., demonstrate understanding of the theory of Evolution).

Tommy's work was ultimately sufficient to earn him a low passing grade on his poster project on the evolution of cell phones, but despite having the authority to complete the project on his own terms (again, a seemingly motivating and "fun" activity in which the laptop would mediate both creative expression and the learning of biology content), Tommy seemed reluctant to take up his division of labor - again, a node of activity that serves to mediate the accomplishment of activity objectives. I interpret this reluctance as representing a tension between Tommy's objective for participating in the Evolution poster project activity, and Mr. Harris's purpose for which Mr. Harris assigned the project.

Resisting the division of labor in the podcast project. Bayside High School's vision for 21st century learning sought to encourage the use of technology for production, especially digital media production, and through its Web 2.0 and Presentation course, invested instructional resources and curriculum development towards meeting its goals. Yet Tommy, who had enrolled in the Web 2.0 and Presentation course the previous year, still clearly struggled to demonstrate the competencies of technology production valued by the school. Subramony (2007) attributed students' difficulty in transitioning to technology producers to issues of a host of social factors, including cultural traditions, expectations of gendered behavior, and peer relationships, suggesting that regardless of their proficiencies for consuming technology, students had very little interest in performing or developing the productive competencies that were expected of them. It is therefore possible that Tommy's disposition towards the digital media production was such that he simply didn't care to perform what institutional powers expected of him - in essence, performing a form of resistance to schooling and institutional authority.

Tommy's resistance to (and struggles with) independent work spanned many activities, but were visible during the podcasting project, which Mr. Harris had assigned earlier in the spring semester. Podcasting was a component of the Web 2.0 and Presentation curriculum, and included not just technical instruction on audio recording and editing, but also on script writing. Mr. Harris emphasized the importance of script writing in the Introduction to Biology class, as well, and gave the students one class day to work in pairs, producing a script that narrated the solution to a Punnett Square genetics problem.

Although many of the students in the Introduction to Biology class had completed the Web 2.0 and Presentation course, not all had. Mr. Harris believed that there was an obvious difference in the quality of podcasts and scripts between students who had taken the course and those who had not. He attributed this to students' ability to provide relevant information and tailor their scripts towards an authentic audience. He concluded, as well,

that students who understood this aspect of podcasting production "do a better job" making use of the digital resources available to them, and were thusly more capable of fulfilling the division of labor assigned to them during podcasting projects.

Solving Punnett Squares (monohybrid genetic crosses) is a classic genetics activity, in which students diagram the possible genotypes of reproductive offspring and find the probabilities of dominant or recessive genes the offspring will express. Prior to the podcast assignment, Mr. Harris spent several days describing the theories of Mendelian genetics, and showing students how to solve Punnett Squares. He listed on the board the steps for solving a Punnett Square to scaffold the students in their script writing:

1. ID parents genotypes
2. Dominant/recessive
3. Make the Punnett square
4. Fill in square
5. Find geno-pheno types

For the podcasting assignment, each student pair was randomly assigned a Punnett Square to solve. Students were instructed to record themselves explaining how to solve the Punnett Square using the audio production tool GarageBand that came pre-packed with the operating system on their MacBook laptops. The objectives of this activity were for students to demonstrate their understanding of Punnett Squares, including their understanding of the terms "genotype" and "phenotype," and to demonstrate their understanding of podcasting "for an audience" (their classmates). As well, the project was meant to provide the opportunity for students to practice using technology (specifically digital media production), and to work on their writing skills. The mediating artifacts were the GarageBand audio production software, the script-writing tools students chose to use (pencil and paper, or word processing software), and students' prior knowledge of recording and editing audio. By assuming students had a familiarity with the podcasting procedure, Mr. Harris felt he did not have to spend an inordinate amount of time re-teaching the features of GarageBand, or reiterating the script-writing procedure (division of labor).

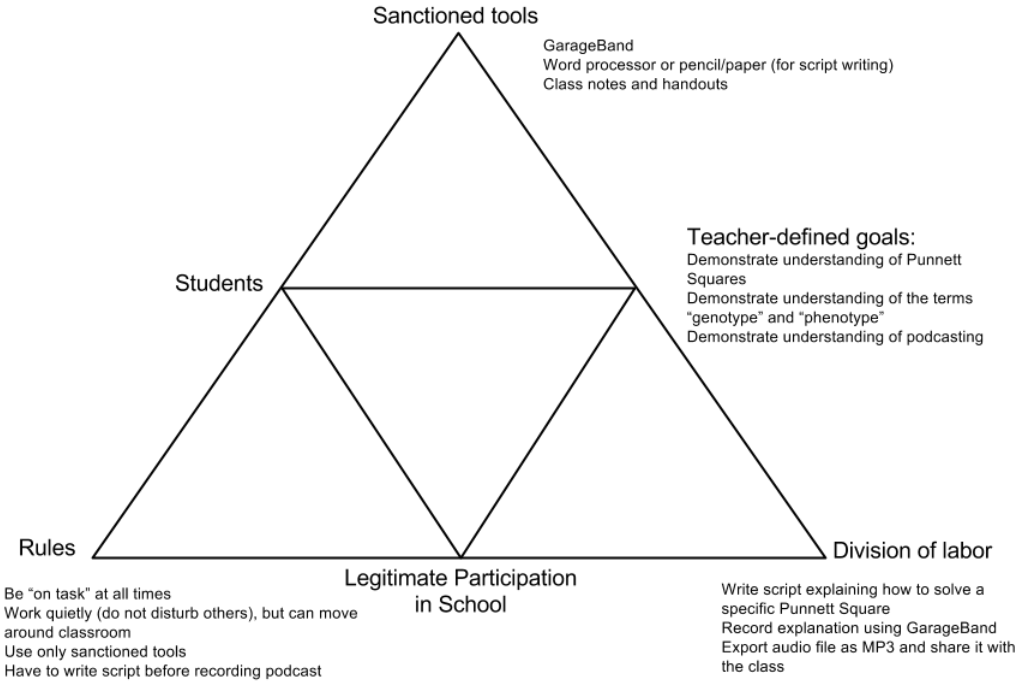

Figure 8: Activity system diagram of the podcasting project.

Mr. Harris modeled how to solve Punnett Squares, and then briefly went over the functions of the GarageBand software that the students would need to use for their recordings. During this review, I noticed Tommy and Angelo chatting quietly with each other, seeming to pay little attention to Mr. Harris. As the class assembled into pairs, I took a seat near Tommy and Angelo to follow their progress. Angelo retrieved the script he and Tommy had started writing on a piece of lined notebook paper during the last class meeting, and told me that he solved their assigned problem on his own, without Tommy's help. As they settled in to begin their work, Mr. Harris came by and quietly encouraged Angelo, "You can do this. You can get this done." He reiterated to the pair that they needed to complete their script first, and then would have to record the podcast. Tommy took control of Angelo's laptop as Angelo then left to use the bathroom.

Seemingly eager to commence with their project, Tommy awaited Angelo's return before continuing to edit their script. While waiting, Tommy seemed to play with some of the features of Google Presentations, particularly the templates. One template included a photograph of a bright red Ducati motorcycle, which seemed to capture Tommy's interest. We spoke briefly about motorcycles as Tommy continued to wait for Angelo to return for several more minutes.

During this time, I noticed that the students seemed to have more mobility, more flexibility to move around, than usual. Some were even allowed out into the hallway to record their narrations. Because of the communicative nature of the podcasting assignment, students were not expected to remain completely quiet during the period, and indeed, there was a good amount of chatter taking place in class. Mr. Harris went about his usual checking in on pairs of students, moving up and down the aisles of the classroom.

Tommy continued to wait for Angelo, and did not make any progress on the assignment. Mr. Harris was aware of Angelo's long absence, and prepared Tommy to finish their assignment on his own. This seemed to distress Tommy, who began to pace around the room, and ask for help.

> Mr. Harris tells Tommy that he needs to get going because "there's a chance Angelo won't be allowed back." Tommy appears to get distressed, and then stands up and peers out into the hallway to see if Angelo is coming. Mr. Harris stops Tommy from walking out into the hallway. Tommy then asks for the worksheet from the other day.

I was keenly aware of some of the struggles Tommy experienced using technology by this point, and decided to ask if he had recorded a podcast before. This prompted Mr. Harris to come join our conversation, and to scaffold Tommy through the process of writing his script. It was at this point that Tommy revealed to me that he did not remember how to create a podcast, despite having taken the Web 2.0 and Presentation course the previous year. While talking Tommy through the script writing requirements, Mr. Harris adjusted the assignment slightly for Tommy, telling Tommy that the script should now be written for Mr. Harris, and similar to an oral exam, should explain, using scientific language and terminology, how to solve the Punnett Square. This reaffirmed the "teacher-centeredness" of the project.

> As Tommy continues to sit by himself, not making any progress on the assignment, I ask him if he's made a podcast before. He tells me that he has, as a part of the Web 2.0 class - but that he doesn't remember how. He tells me that was a long time ago, during Freshman year. I ask what year he is, and he tells me "tenth," meaning it's been about a year and a half since his Web 2.0 class. Mr. Harris comes over to check in on Tommy, and offers to help him with the podcast. Mr. Harris takes a look at the worksheet in front of Tommy - it's Angelo's, and has Angelo's work on it. Mr. Harris tells Tommy that the goal of the assignment is to explain "to me" (Mr. Harris) everything he needs to know to solve the problem.

Mr. Harris then began to scaffold Tommy through the Punnett Square problem he had been assigned, probing Tommy at each step in the process. Shortly thereafter, Angelo returned from the bathroom. Mr. Harris did not wait to direct him down to the Vice Principal's office before continuing to help Tommy.

> "So these are the parents, right?" Mr. Harris asks Tommy, pointing to the description of the problem.

> "Right," Tommy responds. Mr. Harris then reads the problem aloud, and summarizes the main question for Tommy.
> Angelo comes back from the bathroom, and immediately, Mr. Harris tells him to go have a seat in the office. Angelo says, "That's dumb," but complies. He retrieves his backpack and leaves the room. Mr. Harris then continues to help Tommy through the Punnett square problem. "I know you know what you need to do in your head. Verbalize it," Mr. Harris tells him. He asks Tommy what a phenotype is, but Tommy struggles to answer. Mr. Harris explains, "It's what it looks like."
> "An albino?" Tommy answers. Mr. Harris confirms his response. Mr. Harris then writes the solution steps on Tommy's worksheet. He tells Tommy that he can either type the script, or handwrite it. Tommy replies that he'd prefer handwriting the script. He then tells Mr. Harris that he's going to get some pencils from the office, and attempts to leave the room.
> "No," Mr. Harris replies. A student tosses Tommy a pencil, and Tommy begins to write on a piece of lined paper.

I continued to observe Tommy as he began working on the script by himself. Shortly after organizing his desk with three documents - his working script, the assignment handout, and a blank piece of lined paper - he raised his hand and told Mr. Harris that he was done with his script. Mr. Harris came over and explained that Tommy needed to be "more descriptive," to which Tommy responded that he simply wanted to "get it done so [he] can chill."

> He tells Mr. Harris he just wants "to get it done so [he] can chill." While he waits for Mr. Harris to check his work, Tommy paces around the room, and chats with a student who is walking by outside. Mr. Harris tells Tommy that he needs to explain the specifics of his given problem, and that Tommy's script is "too general." "Your directions are great. Spot on," Mr. Harris tells Tommy, but they do not describe the solution to the problem. As Mr. Harris begins to float around the room some more, Tommy begins to pace. He picks up a latex glove that was left behind from the Forensics class and blows it up like a balloon. "Alright, I need to do this," he says to himself. He sits down and rocks back and forth in his chair.

Tommy continued to negotiate the status of his work with Mr. Harris. Each time Tommy would raise his hand and say "I'm done," Mr. Harris clarified that Tommy needed to do a little more work, to describe in more detail in the script how he solved the Punnett Square problem. In this way, Mr. Harris was both scaffolding Tommy, and defining the important elements of the script to include. Without direct instruction, Tommy worked in fits and starts, seemingly motivated at one moment to complete the assignment, and then distracting himself the next. This pattern of distraction, work, distraction, work continued throughout the period. Each time Tommy appeared motivated to "get it done," his attention would shift back to unsanctioned activities, such as socializing or listening to music. He continued to plead with Mr. Harris that his work was "done," only to be prompted again for more details. In the excerpt below, Mr. Harris attempts to further propel Tommy towards completing his script, but Tommy clearly resists doing the work he has been assigned.

> Tommy starts writing again. He copies the text from his first draft of the script. He writes five words down, then goes back to playing with iTunes. He gets up to sharpen his pencil, then has a brief conversation with Tony. He asks what Tony is up

to, then inquires about the girl now sitting in the front of the room, taking a test for Mr. Harris. He sits down next to Tony. Mr. Harris checks in again with Tommy. He tells Tommy that he needs to be done so that he and Angelo can record the podcast. Tommy asserts that he wasn't just copying his first draft onto another piece of paper (this is a lie). Mr. Harris reads the second draft and tells Tommy that he needs to write a couple more sentences. Tommy puts his head down. Mr. Harris grabs his hood and playfully lifts Tommy's head up. Tommy starts to write again, but only manages one more sentence before he pushes back away from the table and tells Mr. Harris, "I'm done."
"Alright, let's see what you did," Mr. Harris says. Tommy has written "A normal man marries an albino woman." Mr. Harris asks Tommy what the genotype is. Mr. Harris takes the pencil and writes on Tommy's script the genotypes of the parents. Mr. Harris starts to write a script for Tommy, explaining the problem.
"Can I go now?" Tommy asks.
"No," Mr. Harris replies.
"You just told me to make a Punnett square!" Tommy argues. Mr. Harris explains that he told Tommy to make a Punnett Square for the problem, and that Tommy has only made a generic one.
"Alright, I got it," Tommy replies. Mr. Harris starts to roll his chair away, and Tommy gets back to writing again. He writes one more sentence: "In this case, you would put the albino woman little "cc" on the top and the normal man on the side."
I ask Tommy if he's all done, and he replies, "I'm almost done. I'm just taking my time."
Another minute later, Tommy tells Mr. Harris that he's all done, but he hasn't done any more work since Mr. Harris last checked in with him.

Tommy's way of negotiating the status of his script evidenced his orientation towards the podcasting activity (resistance), yet what also became apparent is that by adopting this "just get it done" approach to the task, Tommy rejected the intended division of labor Mr. Harris had ascribed him, and thus undermined Mr. Harris's attempt to implement elements of student-centered pedagogy into the activity. Though Mr. Harris tried to shift logistic authority over to Tommy, Tommy resisted, and seemed only interested in performing the tasks that Mr. Harris explicitly demanded. As a result, Mr. Harris continued to scaffold Tommy through the assignment, first writing down the solution to the Punnett Square problem, and then drafting part of Tommy's script.

Getting answers and producing answers: tensions in the division of labor of structured activities. Instructional support was a substantial issue for Mr. Harris throughout the year. No in-class instructional support personnel were made available to assist with Mr. Harris's 28 students, even though many of the students held mandated individualized education programs (IEPs), each listing numerous instructional accommodations that Mr. Harris was expected to implement. This gap in classroom personnel represented a tension between the division of labor and object of many activities, which Mr. Harris felt, at times, incapable of bridging.

Mr. Harris broached this subject with me frequently throughout the year, and it became rather clear that he felt strongly that the lack of in-class support he received severely

limited his ability to create meaningful, higher-order learning activities that could engage all of his students. He told me that he felt he had to spend an inordinate amount of time managing classroom behavior, and attending to lower-achieving students' learning needs. At the end of the year, Mr. Harris again complained of the lack of instructional support, saying that he was severely limited in the activities he could assign in class. As a result, he omitted or withdrew some of his more advanced technology activities such as organelle commercials (multimedia production), a collaborative biome wiki site (digital publishing), and collaborative group work - examples of 21st century activities that evoked more progressive, student-centered pedagogies.

> MH: And conversely, I don't know if you noticed- like, the open-ended assignments that I could have done, were dr- dramatically limited.
> NW: Mm hmm.
> MH: Because I couldn't let Tommy, and Angelo, and Reggie on an open-end assignment, because Reggie would go all over, Tommy would get lost, and ask to go to the bathroom to, you know, go smoke, and Angelo would be hitting on all the girls.
> NW: Uh huh.
> MH: Um. So that negatively affected, like, Martin. That negatively affect Isaac and Mike.
> NW: Right.
> MH: You know? And those kids would check out.
> NW: Mm hmm.
> MH: Um. I-
> NW: So you think that- that, like, the fact that you had such a range, and-
> MH: Mm hmm.
> NW: - essentially no external support was-
> MH: Incredibly limiting… Um, but could I spend the time, with close to thirty people in the room, dealing with those individual strong needs, and coming up with assignments that would actually let me- let him express what [they know]?

As a result of the lack of in-class instructional support for students with more in-depth learning needs, Mr. Harris felt he had to constrain the learning activities - especially the technology activities - he assigned in class. Mr. Harris lamented the ways that project-based assignments (or "open-ended" assignments, as Mr. Harris called them) unfolded, stating that (in addition to the plethora of learning needs he felt obligated to accommodate) students' resistance to their division of labor made managing their learning more difficult. As a result, he adopted increasingly teacher-centered practices to structure students' engagement with the biology content. This manifested in the implementation of more activities that structured learning along narrow pathways, including lectures and "interactive," content-based technology exercises. These assignments constituted a very different genre of activity than project-based assignments, and entailed a far more restricted notion of learning (from creation and production to answering prefigured questions) and participation (from autonomous to dependent on teacher-defined pathways) than creative projects during which students held more authority. Mr. Harris explained that because of the ways students resisted accomplishing the objectives of

project-based activities, and the variety of orientations students took towards school, learning, and academic achievement, he was unable to effectively differentiate instruction, and thus needed to foreground content delivery at the expense of student autonomy and authority.

> MH: I'd love, love, love to be able to do something a little more open-ended with them.
> NW: Mm hmm.
> …
> MH: The problem is, you've seen that class. I put two or three of them in a group, I'm gonna have to spend time getting the groups back into the right groups. Because, Reggie's gonna go over and try to talk to Jake.
> NW: Mm hmm.
> MH: Tommy's gonna try to buy [drugs] from Jake, and- and all the other pieces that are there-
> NW: Mm hmm.
> MH: Plus the three school phobic kids. They're gonna be out. And I can't put them in the same group-
> NW: Yeah, right.
> MH: Because that's actually discriminating against them.
> NW: Mm hmm.
> MH: Um, so I have to mingle them into other groups. They're not gonna be there-
> NW: Mm hmm.
> MH: So those other groups...
> NW: So it's just the nature of the classroom that you think-
> MH: Yeah.
> NW: Is, like, a barrier to that?
> MH: The- the- the nature of this course is a hinderance to almost all the kids in it.
> NW: Mmm.
> MH: Because of the way- I'm all in favor of differentiated instruction.
> NW: Mm hmm.
> MH: And having classrooms that are unleveled.
> NW: Mm hmm.
> MH: If you have the same goal. This classroom in particular, they have kids with different goals.
> NW: Right. Right.
> MH: You know, which is- I can go so much more in depth-
> NW: Get into AP, pass the MCAS, pass the class-
> MH: Exactly. I mean, I could do so much more for the honors kids.
> NW: Mm hmm.
> MH: I mean, there's so much out there on how you actually perform a dehydration synthesis.
> NW: Mm hmm.
> MH: You know? That should be learning.
> NW: Mm hmm.
> MH: But if I tried, if I honestly tried, to do a lesson that goes into the nuts and bolts of that-
> NW: Mm hmm.
> MH: It'd explode the other half of class.

NW: [laughs]
MH: It- and if they were all freshmen, unleveled, and they had the same goal, it'd be a little easier.
NW: Sure.
MH: Because you're driving to the same spot.
NW: Right.
MH: We're trying to drive them to three different spots at the same time.
NW: Mm hmm.
MH: You know?
NW: Mm hmm.
MH: So there's my frustration.

Structured activities became increasingly common as the school year went on, and concomitantly, students' autonomy and authority over their learning experiences diminished. The purpose of implementing these activities was, as stated above, to enable Mr. Harris to more closely manage students' learning, particularly with regards to exposing students to the biology curriculum. A significant aspect of the approach structured assignments took towards learning was for students to answer questions Mr. Harris and other curriculum designers deemed were most important for biology students to understand (a decidedly teacher-centered pedagogy). Mr. Harris integrated online curriculum resources, such as virtual laboratory experiments, informational sites, and other content-driven digital media to meet these goals, and designed a series of constructivist learning activities to first develop students' foundational understanding of the content, and then guide students towards answering higher-order questions related to the material. As such, the division of labor assigned to students (follow instructions, use sanctioned tools to investigate scientific phenomena, and produce answers to teacher-generated questions) as well as the rules of activity (be on task, work quietly, use only sanctioned tools to complete an assignment) mediated a picture of legitimate participation that was arguably easier for Mr. Harris to manage (or enforce) than during activities in which students held more authority.

In my observations, students approached these activities in ways that resisted the teacher-defined division of labor, and subsequently, the teacher-defined goals. Instead of producing answers to questions through a process of knowledge construction, Tommy and Angelo (and Reggie and Wei at times) overwhelmingly sought to acquire answers, bypassing the knowledge construction process, suggesting that "getting it right," or "getting it done," rather than developing a rich understanding of biological phenomena or "21st century skills," motivated much of their participation. This represents a significant concern for institutions that structure and define the development "21st century skills," and the ways in which disenfranchised students view themselves as legitimate participants in that process. As the following section suggests, as a result of the tensions between the teacher-defined division of labor in structured activities and students' resistance to that division of labor, technology's role began to resemble a rule of activity, rather than a mediating artifact of the learning process.

Structured activity systems. The technology resources students used to participate in these activities were more "rigid" or "inflexible," and afforded limited pathways to learning the biology content. In this way, the purpose of technology use aligned more closely with learning the biology content, and less so with creative expression or developing critical technology literacies. Virtual laboratory experiments, online games (or "manipulatives" as Mr. Harris called them), and worksheet-guided online activities provided students with very little epistemic authority; "what" they were supposed to learn as an outcome of their participation in the activity was, as stated above, already preconfigured. The object of virtual laboratory experiments, online games, and worksheet-guided online activities was to engage students with various aspects of the biology curriculum through a constructivist pedagogy that guided students towards understanding specific concepts and terms, and then asked "higher order" questions that challenged students to reflect critically on what they had just read, viewed, or produced (i.e., the results of virtual experiments). As such, students were tasked with following the instructions listed on the worksheets, and answering the questions provided therein.

The mediating artifacts of these activities varied from task to task, but drew on a relatively narrow range of resources, including worksheets (for providing instructions and guided questions), Java- and Flash-based simulations (for conducting virtual experiments), the digital textbook, and class notes. Students were expected to be on task during these activities, and to keep any socializing or other perceived off-task behavior to a minimum, so as to accomplish the goals Mr. Harris set forth in his daily agenda, which was written on the board each morning. The instructions and directives outlined on worksheets served as the boundaries of students' logistical and epistemic authority (division of labor). However, students often eschewed these structures, and instead found answers by typically "clicking around," Googling answers, or copying answers from their classmates. In this way, students challenged the limited logistic and epistemic authority provided to them in their teacher-defined division of labor.

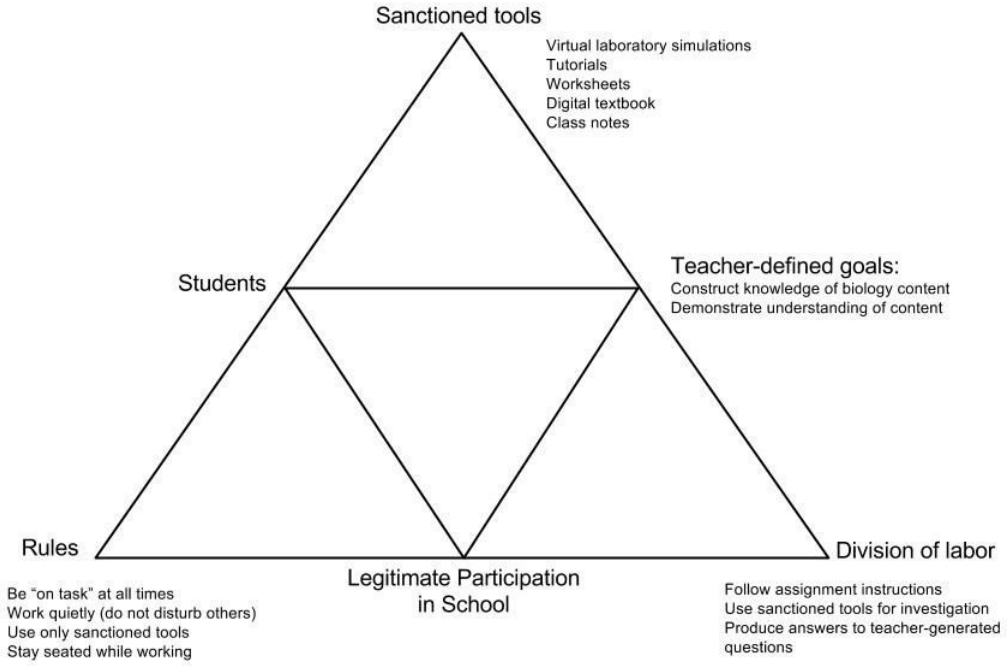

Figure 9: Teacher-defined activity system for structured activities.

In this section, I will discuss how students came to terms with the their limited authority during these preconfigured learning activities. Largely, the focal students adopted technology to create "epistemic short cuts," such as bypassing instructions (especially instructions that pointed students to reading passages or videos) and Googling questions verbatim in the hope to find a direct answer. This not only called into question the object of these structured activities (i.e., learn content or simply find answers), but the role technology served in mediating those goals. As a side note that I will discuss in the next section, the combination of narrowly-defined learning pathways (through rigid, content-based technology tools), and students' "get it done" approach to the tasks shifted technology's role from mediating artifact to rule of activity, and as such, represented an extension of institutional forces that constrained student autonomy and authority, rather than liberated and empowered students.

Tensions between the division of labor and the object of a virtual experiment activity. Though meant to mediate constructivist learning, the focal students typically used virtual laboratory tools and games in "linear" ways. If it was possible to do so in the software, students were sometimes prompted to reread content, or try alternative approaches to completing a task if they did not accomplish the goal or give a correct answer to a question on a first attempt. Yet I rarely observed students go back over content or instructions to

reflect on their work. Instead, I observed mostly "clicking around", a strategy that involved a seemingly random (or perhaps "best guess") selection of clicks that dismissed the requirement to read, reflect on, or think critically about the material - fundamental aspects of constructivist pedagogy. Another prominent strategy was simply to copy answers off of neighbors' worksheets. Both "clicking around" and copy answers served as forms of resistance in the teacher-defined division of labor of structured activities, and undermined the constructivist intent of the assignments. Both also called into question the value of learning outcomes that were achieved by simply getting the right answer (or sometimes, just simply *an* answer) without also engaging in other learning processes, such as reflection, self regulation, and critical thinking.

Compounding this tendency to bypass higher-order learning processes (e.g., reflection, critical thinking, etc.), Tommy suffered from a lack of instructional support, indicating the presence of another tension within the division of labor of structured activities. In the excerpt described below, Tommy appeared very confused as to how to conduct a virtual experiment, as well as how to produce the answers to the questions Mr. Harris provided. As Mr. Harris divided his attention among Tommy and Angelo (working seemingly as a pair on this day), and the rest of the class, Tommy's confusion, combined with an insufficient amount of direct instructional support, impaired his ability to complete the assignment. During the frequent moments in which Tommy appeared stuck, he, Angelo, and Reggie turned to socializing, exhibiting a resistance towards their division of labor (i.e., read instructions, conduct the experiment, and produce the answers listed on the worksheet) which ultimately left the three of them with incomplete work, and zeros on the assignment.

For the virtual experiment, students were tasked with performing a controlled experiment to test the rate of reaction of different amounts of substrate in solutions of variable pH. At the beginning of class, Mr. Harris modeled the virtual experiment for the students, reiterating instructions to underscore important aspects of the assignment, such as which content to pay careful attention to, and how to conduct the experiment. He also provided the students with a worksheet that listed each step, and asked pointed questions about the experiment along the way. Mr. Harris emphasized that in this assignment, students could not simply "click around" to answer the questions on the worksheet. Instead, he suggested, they would "actually have to read the directions." Yet, despite Mr. Harris's suggestion, and his attempts to scaffold Tommy, Angelo, and Reggie through the assignment, the three appeared to ignore one of the primary components of their division of labor for the activity: read the instructions. Despite some assistance from Mr. Harris, Tommy and Angelo ran the experiment haphazardly, producing disorganized results, and again, failing to answer the questions listed on the accompanying worksheet. Having chosen to not read the directions on the worksheet that accompanied the activity, Tommy and Angelo performed the experiment without any systematicity, producing data that was disorganized and difficult to decipher. This had no bearing on the actual results of the experiment (despite following an unorthodox procedure, the lab simulation produced accurate, but disorganized data) except that Angelo and Tommy were unable to explain the outcomes they produced, despite frequent attempts by Mr. Harris to explain the experimental procedure and encourage the

two to carefully read the instructions. Throughout the exercise, they chatted and played with the virtual lab interface, making little to no effort to read the instructions or answer the follow-up questions. At the end of the activity, Mr. Harris led the class in a discussion of the results that each group should have achieved. Tommy and Angelo continued to chat quietly, rather than participate in the discussion. Tommy and Angelo's socializing did not seem to serve any productive capacity in terms of task completion or engagement with the biology content.

> Mr. Harris tells the class where on the Moodle page they can find the lab simulation. He loads the simulation on the projector and describes the lab activity that the students are going to perform. It looks like the waiting room at a doctor's office. In the background, there is a television. A computer monitor sits in the foreground, next to five titrate vials. He clicks on the television, and a popup window appears. In the popup window, a video loads and plays a short tutorial on enzymes. 3-D shapes float across a black background. Mr. Harris tells the class that almost all of the answers to questions on the accompanying handout can be found in the video. He suggests they replay the video, "Play, and pause, and rewind as you need it." He models how to click to select certain items, how to change the pH, etc. The simulation makes a loud, harsh sound as he clicks different screen elements.
> The accompanying worksheet begins by asking 8 multiple choice questions, and one open response. After the multiple choice questions, there is a table that students are supposed to fill out with data from their virtual experiment. The axes are pH and amount of substrate. Students are supposed to record the number of molecules formed per minute obtained in the lab. Students must then answer 6 more questions based on their data. Mr. Harris says to the whole class, "This isn't the kind of activity where you just click to get the right answer. You actually have to read the directions." Despite this suggestion, however, the students seem to haphazardly click through the exercise.
> "Can you help me," asks Tommy. Mr. Harris goes over and explains the instructions again to Tommy. Tommy seems reluctant to read the instructions on his own. Mr. Harris describes the steps of the experiment, essentially telling Tommy the order as it is written in the instructions. Mr. Harris again urges Tommy to read the instructions.
> In the virtual lab, students are instructed to click on the television "monitor" and watch an informational video on enzymes. The video includes a voice-over narration. Student are then instructed to click the "Information" button, and read some text about enzymes.

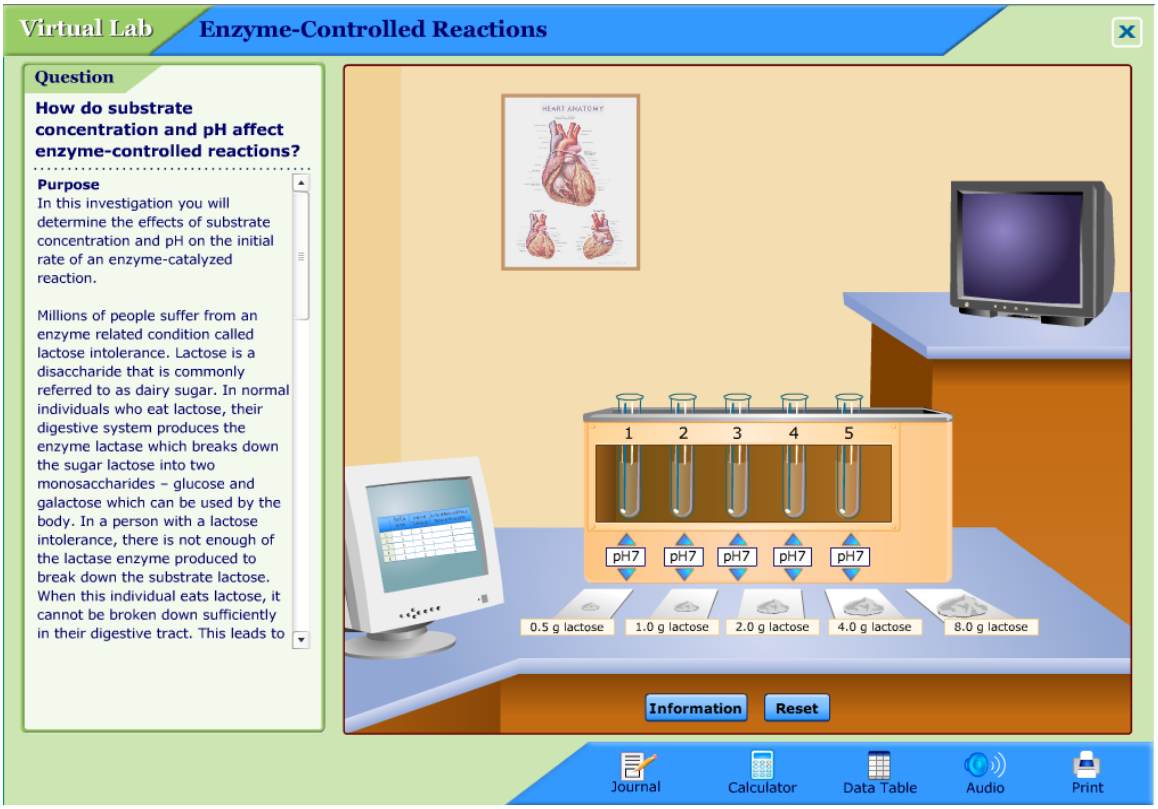

Figure 10: Virtual lab: Enzyme controlled reactions.

The lab instructions simply tell the students to "adjust the level of the pH tube… and then add lactose to each of the test tubes that already contain a lactose solution." It does not provide any information on how to systematize the experiment (i.e., holding one variable, such as pH, constant while testing the other variable, such as amount). Students are provided explicit instructions on the virtual lab to click and drag the icon of the lactose dosage onto one of the test tubes. After "adding" the lactose to the test tubes, students can then click on the computer monitor to find the number of molecules of product formed per minute.

Mr. Harris reads the instructions to Tommy and asks, "We are going to start with [a pH of] three and go all the way up to eleven. So where do you want to start?" Tommy says something and clicks on the laptop. "Yeah, so we're looking at how the amount is going to affect the product," Mr. Harris tells him.

Mr. Harris then turns to Reggie, explaining the procedure. Tommy and Angelo begin chatting, rather than beginning the assignment.

Mr. Harris turns back to Tommy, and tries to scaffold him into systematically testing the substrate amounts in the virtual lab. Tommy appears to be struggling with the concept of holding one variable constant while adjusting the other. As Mr. Harris leaves to go check in on other students, Tommy turns around and jokes with Reggie about another student. Reggie looks up from his work, and they continue to chat. Tommy then begins to click through the simulation and produces a data chart.

Mr. Harris comes back to Tommy and explains how he is going to generate the graph while Angelo is trying to catch up. He tells Tommy that when Angelo catches up, they're going to run the graph and look at it together. When Mr. Harris leaves,

> Angelo looks at Tommy's worksheet and begins entering the data into the table on the simulation. They continue to chat. Meanwhile, Reggie writes something on the worksheet of the girl sitting behind him. Minutes later, Mr. Harris asks Tommy and Angelo if they have caught up with their data table. They still have not.
> Finally, Tommy and Angelo finish entering the data and run their graph. They continue to chat. Mr. Harris tells Tommy, "No more warning. If you guys turn around and talk to each other again…" he trails off.

Reggie vacillated between on-task work and off-task socializing throughout the period, but unlike Tommy and Angelo appeared highly engaged in the large group discussion. This was typical of Reggie, who was always eager to ask broad questions and become an active participant in whole-class discussions. Reggie had failed to successfully answer roughly half of the questions included on the assignment, however, indicating that he did not accomplish the activity objectives. The contrast between Reggie's approach to completing the worksheet and participating in the group discussion, I believe, evidenced the tension between the division of labor intended for the virtual experiment (which Reggie resisted), and the object of the activity (learn about/construct knowledge of the nature of chemical reactions). Further, this served to reveal the limited nature of the learning pathways made available to Reggie in the virtual laboratory exercise. Ultimately, this also exposed the questionable role technology played in mediating Reggie's learning of the biology content, and rather, its position as a rule of activity.

> "Why can't we do this in real life?" Reggie asks.
> "Because I have no safety products," Mr. Harris explains. He tells Reggie that if something happened, he wouldn't have anywhere to take them. The students begin to protest, and complain that they don't do hands-on labs. Mr. Harris reiterates the problem is due to a lack of safety equipment. Reggie, drumming on his desk, asks Mr. Harris for another worksheet. "Mr. H., can I get a worksheet?" Mr. Harris hands him one, and then goes back to Tommy to continue helping him. Reggie begins joking again with the girl next to him. He looks at the girl's worksheet and copies down her data.
> Mr. Harris tells the class to look at question twelve. "Alright, this is a moment where, unless I ask you to talk, you don't talk." He shows the class what the graphs should look like. He draws two axes on the board, and then an s-curve. "What's going to happen to the graph if we keeping adding sugar?" he asks. Reggie says it will plateau. Mr. Harris explains to the class why the plateau shape is correct, saying that the enzymes are already busy, so they won't get any more done. He makes an analogy with an auto body shop. "Who takes their car to a shop?" he asks. Reggie raises his hand. "How many people work in the shop?" Reggie hesitates. "Eight?" Mr. Harris asks. Reggie affirms his guess. Mr. Harris then explains that no matter how many cars shop up at the garage, only eight cars can be worked on at a time. As he is explaining this, Jake types on his cell phone. Reggie then writes something on the worksheet of the girl sitting behind him.
> After a little while, Reggie has clicked through the experiment and generated some data. He runs his graph and looks around the room., then rolls his chair over to Will's desk, takes his worksheet without asking, and checks Will's answers against his own. Mr. Harris comes over and rolls Reggie and his chair back to his normal desk. Having copied his neighbors' answers, he fills in some of the follow-up

> questions on the worksheet. I ask Reggie if I can see his worksheet. The first page is blank, but on the last page, he has partially answered roughly half questions. Most are incorrect.

Shortly thereafter, Mr. Harris called the attention of the class and began to go through the answers with the group. Reggie, despite having not completed the worksheet, eagerly volunteered to read the questions. Yet, as Jake made an offensive comment, Reggie responded angrily, prompting Mr. Harris to kick him out of class.

> Mr. Harris convenes the class to go over the answers together. He asks for volunteers to read the questions, and Reggie eagerly offers to. "Reggie wants to read so he can prove he knows English," jokes Jake. Reggie says something in response, and Mr. Harris tells Reggie to "take a walk." "Go take a lap around the building, and then come back," Mr. Harris says. The class starts to go over the answers, and Reggie blurts something out. "Take a walk," Mr. Harris says to him again. Reggie stands up, grabs his cell phone, and leaves. He does not come back until the end of class.

Angelo and Tommy continued to chat and joke around with each other, and as the end of the period approached, Mr. Harris asked them to leave as well. Presumably, all three boys (Reggie, Angelo, and Tommy) were all asked to leave the room, in part, because of the behavior they demonstrated during the virtual lab simulation activity, which is to say largely off task, and only partially engaged with the virtual experiment. Tommy, Angelo, and Reggie resisted the division of labor by both not doing the work, and by taking epistemic short cuts - that is, not reading instructions, not watching the video content in the virtual laboratory, and copying worksheet answers off of neighbors. This not only disrupted the teacher-defined division of labor of the activity, but also subsequently offered a glimpse into how, by structuring the assignment with limited pathways and authority, the object of the activity appeared to shift away from achieving so-called "higher order" learning outcomes, to simply finding the answers on the worksheet - a very different kind of learning goal.

In another online activity, called "Cells Alive," Mr. Harris directed the students to a website that included a model of a cell and its constituent parts. Guided by a worksheet, students were instructed to click on the various parts of the cell, and record the properties of each part as listed on the website. They then had to answer a series of questions related to each property of the cell. Similar to the virtual lab activity, students overwhelming seemed to simply "click through" the exercise, shared work with each other, and collected answers in an unreflective, uncritical way. As such, many of the focal students went about their usual activity behavior, chatting and playing, as opposed to focusing on the task. Once again, the students' approach seemed to resist their assigned division of labor, and subsequently undermine the objective for the activity.

Getting answers from neighbors in the Cells Alive activity. On the day in which Mr. Harris assigned the "Cells Alive" activity, the focal students seemed more interested in socializing, and only appeared to work after Mr. Harris reprimanded them, or came by to check in on their progress. Moments of productive work were short-lived, as Tommy, Reggie, and Angelo returned to socializing or using personal technologies while he checked in on other

students around the room, evidencing more resistance to the teacher-defined division of labor of structured activities. The Cells Alive activity included a guided worksheet that listed various organelles of biological cells in a series of tables. Within each table, students were instructed to 1) indicate if the organelle was from a plant cell, animal cell, or both, 2) describe the function of the cell, and 3) answer a small number of questions related to the organelle function. The end of the worksheet included diagrams of both a plant cell and animal cell, with blank labels which the students were supposed to fill in.

Organelle	VACUOLE
(plant / animal / both)	
Function:	Vacuoles are small in _____cells and large in _____ cells. What things do vacuoles store? Describe what makes a plant wilt.

Figure 11: Sample question from the Cells Alive activity worksheet.

Similar to the virtual laboratory exercise, the Cells Alive software was content-driven, and by and large, the focal students went about their assigned tasks by simply "clicking around" the Cells Alive website interface, resisting the suggestion to critically read the biology content provided in the simulation. Throughout this activity, Mr. Harris moved from student to student in an effort to provide assistance to those who need clarification, but also to closely manage the behavior of Tommy, Angelo, and Reggie. Whereas Reggie, who worked on his own, eventually took up the task (after being on the wrong website) and began answering the questions, Angelo and Tommy seemed heavily invested in not doing the work. Despite this, they were able to convince Mr. Harris that they were "working hard," but just slowly. Because Mr. Harris could not attend solely to them for the entire period, Tommy and Angelo were able to continue chatting, socializing, and using their cell phones to send messages and check Twitter while Mr. Harris's attention was elsewhere. The little work that they did do was ultimately insufficient, as Mr. Harris instructed them to include more detail in their answers, and to be "more descriptive." Noticeably, Tommy and Angelo did not adhere to Mr. Harris's prompts, and chose not to revise their work. Reggie, as well, disengaged at times from working on the Cells Alive worksheet, and opted to rest his head, or to surf the internet.

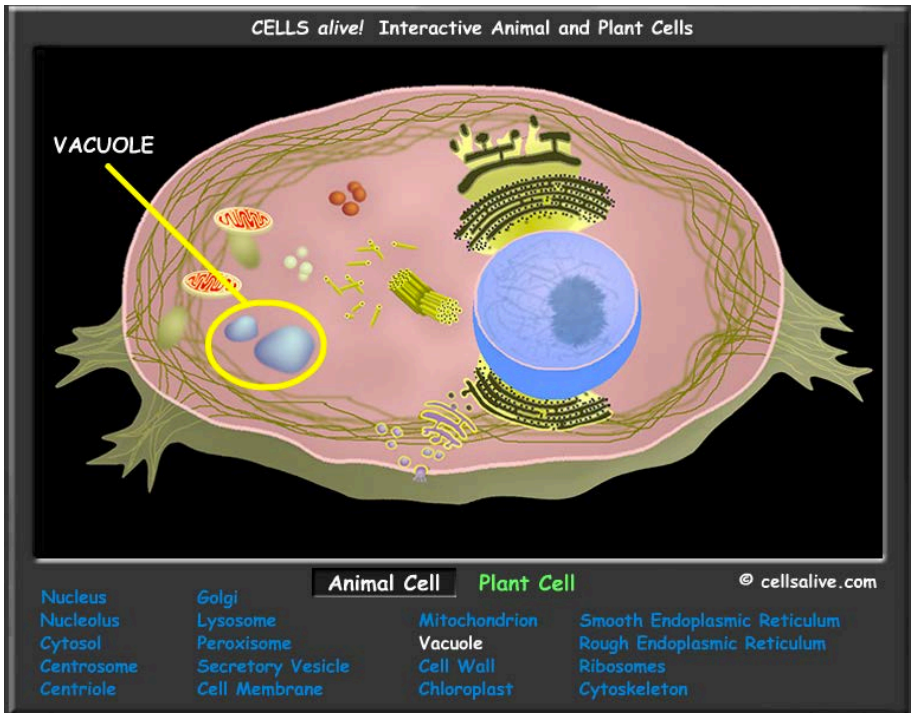

Figure 12: Sample diagram of an organelle from the Cells Alive website.

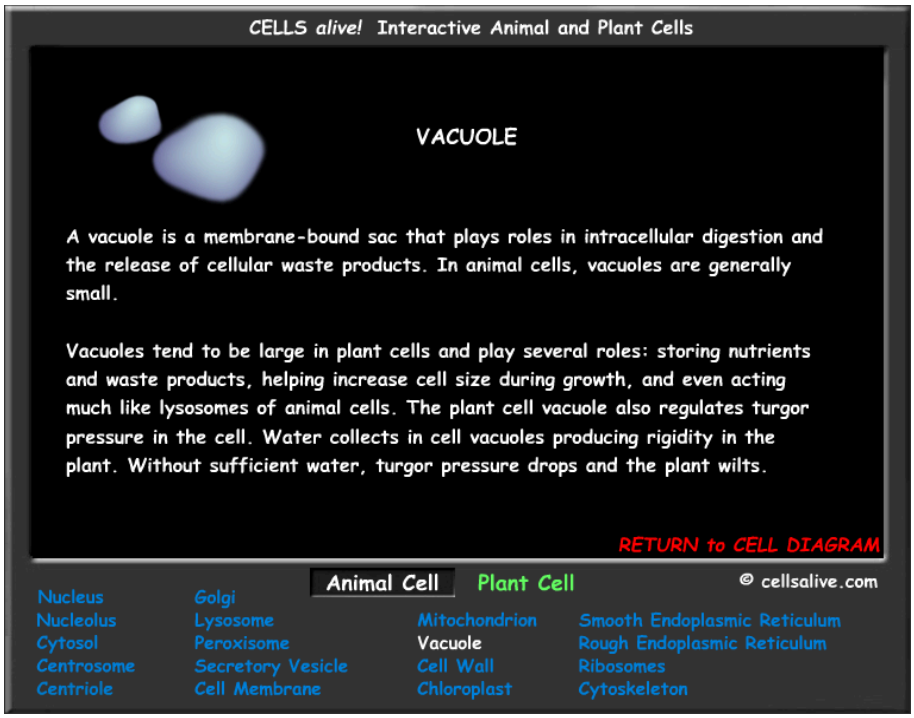

Figure 13: Sample definition of an organelle found wihin an animal cell.

Many of the answers to the Cells Alive worksheet could be found directly on the Cells Alive website, either by viewing the diagrams of the cell structures, or reading the descriptions of

the organelles, mimicking a sort of web-based scavenger hunt, where students were expected to find answers and recite them back. Despite what may have been considered to be a rather simple division of labor, and some scaffolding from Mr. Harris, Tommy, Reggie, and Angelo largely resisted completing the task on the teacher-defined terms, and instead opted to get answers from other students in between their moments of off task behavior.

> Tommy asks for a pencil, and Mr. Harris hands him one, reprimanding him, Angelo, and Tony for not paying attention to the instructions he's just laid out. "Angelo has a chronic chatter deficiency," Reggie jokes. Reggie begins to look tired, almost like he's asleep. Mr. Harris comes back to him and asks, "Reggie, where are we?" Mr. Harris tells Reggie that he's on the wrong site "because [he] didn't follow directions." Tommy asks if he can get a drink of water. Mr. Harris tells him that Reggie is next in line.
> "But he's going to the bathroom," Tommy protests. Mr. Harris reiterates that Reggie is next, and Tommy returns to his seat. His laptop remains closed as he begins chatting with Rosa. Mr. Harris floats around the room, checking in on students. "Where do I go to?" Tommy asks Mr. Harris. Mr. Harris tells him to read the instructions."W-W-W dot cells alive?" he asks. Rosa tells him which site to go to. He seems confused.
> A couple of minutes later, Reggie comes back from the bathroom. He does a little dance, chats with Angelo, and raps a couple of lines before sitting down. He puts his headphones in. Mr. Harris comes and sits next to Reggie. He asks Reggie to read one of the questions to him. Reggie reads it aloud. "Alright, what is the first organelle you need to look for?" Mr. Harris asks. Reggie reads the text on the page, and Mr. Harris asks some follow up questions. "Yeah, it has DNA to control what?" Mr. Harris reads a passage on the screen about DNA. "I want you to keep working," he tells Reggie. "I'll probably be done when you get back," Reggie replies.
> "I would be ecstatic if you were done, but for now I just want you to keep working," Mr. Harris tells him. Reggie goes back to reading the text. He fills in some responses on the paper worksheet. Tommy comes back from the bathroom, typing something on his cell phone as he enters the classroom. He chats with Angelo, laughs, and walks slowly over to his seat. He continues standing for a moment, typing on his phone. Mr. Harris walks over to him. "Sup?" Tommy asks.
> "Pull up your website," Mr. Harris says. "I'll help you with it."
> "She's (Rosa) gonna help me with it." Mr. Harris sits down next to Tommy and takes control of his laptop. "Do you see a nucleus in the plant cell?" he asks. Tommy says that he does. "You can click back and forth," Mr. Harris explains, showing Tommy how to navigate the site. Tommy makes like he understands and is good to go on his own. "Okay, this is what I challenge," Mr. Harris continues. "I challenge you to commit this to memory." They chat a little more, and then Mr. Harris leaves, wheeling his chair around the room. Tommy looks at his worksheet and talks to Rosa. Meanwhile, Reggie is working on his own, clicking through the items on the website. He writes something down on his paper. He appears to be on task. Mr. Harris wheels his chair back over to Angelo and Tony. He tells them, "Be more specific." Angelo says that he doesn't know what's going on. Angelo turns back to Tony and continues to chat with him. Tommy, meanwhile, is showing something on Twitter to Rosa. Mr. Harris goes back over to Reggie and answers a quick question. Reggie returns to his work.

> Tony turns around and says something to Rosa and Tommy. Tommy switches back from the Cells Alive page to Twitter. He then goes a Google search for "Cells Alive" and goes back to the assignment page. Mr. Harris comes back over to Reggie, who is doing a Google Image search for something unrelated to the Cells Alive activity - perhaps a music artist. Reggie flips quickly back to the Cells Alive site, but not before Mr. Harris notices. "Reggie, what other web site were you on, Reggie?" Mr. Harris asks.
> "Nothing. I was just looking for help," Reggie deflects Mr. Harris's question.
> "Reggie, another website won't help orange hair," Mr. Harris tells him, referring again to the bet made earlier in the year, that it Reggie earns an "A" average for the year, Mr. Harris will dye his hair orange. As Mr. Harris walks away, Reggie goes back to the Cells Alive page. He turns up the volume on his headphones, then reads some more text on the page and fills out something on his worksheet.
> Tommy looks over at Rosa and says, "You're getting ahead of me." He looks at her answers, and copies them down on his worksheet. His laptop is dim from not being used. As Mr. Harris helps Natalie with the assignment, Tommy turns around and asks Mr. Harris how to do the screenshot for the puzzle extension activity. Mr. Harris reminds Tommy that he's not done with the tutorial yet. Tommy tells Mr. Harris that he's working hard."I know you're working hard," Mr. Harris replies. He encourages Tommy to finish the assignment, and promises that he'll show him how to do the screenshot after. He gives Tommy a Lifesaver to get him to stop talking with his neighbors.

As the passage above indicates, Tommy attempted to negotiate logistic authority (division of labor) with Mr. Harris, suggesting that Rosa would help him with the assignment. Instead, Mr. Harris took control of Tommy's laptop and tried to scaffold him through the directions. Although Tommy tried to convince Mr. Harris that he then understood, it is questionable whether or not Tommy felt comfortable completing the assignment on his own, or if he simply wanted Mr. Harris to leave so that he could check his Twitter account. I interpret this and many of the other interactions on this day between Mr. Harris and Tommy, Angelo, and Reggie as evidencing some of the resistance these students displayed against completing the Cells Alive activity *on Mr. Harris's terms.* It is interesting to note that, despite what appeared initially like resistance to completing the assignment at all, Tommy was then eager to copy down Rosa's answers onto his own worksheet, complaining "You're getting ahead of me." I believe this also evidenced Tommy's orientation to the activity, which was to "get" answers, rather than produce them on his own through reading the content exploring or the Cells Alive website. By copying answers from Rosa, Tommy was able to get some answers to the worksheet questions without using technology at all.

The examples presented above illustrate much of the approach the focal students took towards the structured activities Mr. Harris implemented over the year, again, many of which served as coping strategies for dilemmas caused by the intersection of institutional structures (including pressure to implement the entire biology curriculum) and tensions in the division of labor evidenced during project-based activities. By and large, the focal students adopted an orientation towards structured (or content-driven) activities that foregrounded the acquisition of answers to teacher-generated questions over the higher order learning processes Mr. Harris intended for the activities to motivate. As such, this

resistance to the teacher-assigned division of labor (critically reflect on the biology content and produce answers to higher-order questions), students also undermined the objective of these exercises, which, as Mr. Harris described, were created in the spirit of Constructivism.

During the instances in which the object of the activity shifted away from learning biology content to simply getting answers, technology *necessarily* shifted from mediating knowledge construction processes to mediating the acquisition of answers. In the activity just described the Cells Alive website was constructed to serve a single purpose - content delivery. Similarly, although the virtual laboratory experiment was on one level more interactive (i.e., students could adjust the pH level of the solution) than the Cells Alive site, it served a single primary function: simulating a controlled experiment. As such, if the primary factor motivating students' participation in the activity was to simply find the answers to the preconfigured questions, rather than critically reflect on one's understanding of the underlying concepts of chemical reactions, the tool held little purpose other than to 1) undermine the teacher-defined division of labor, or 2) serve as a rule of activity. In this latter condition, technology use signified compliance with the teacher's expectations for behavior, and thus served to legitimize the acting student's position as a member of the greater classroom and school communities. Notably, these conditions contrasted significantly with students' attitudes towards their personal technology devices, and even some of the (unsanctioned) functionalities of the school-issued laptops, which could be used for myriad purposes, including finding solutions to personally-relevant problems, social networking, playing videos games, sharing work with peers, and creating digital media artifacts.

As a result of the tensions in the division of labor of in-class activities, the constituent elements of the activity system also necessarily shifted, especially with regards to the role of technology. Again, Mr. Harris (as well as the Bayside High School administration) saw the laptops as mediating a reformed approach to teaching and learning - one that was more student-centered, and bridged the division between students' use of technology outside of school and technology use in the classroom. While the purpose of technology use in these activities was therefore to mediate constructivist learning of biology concepts, that use became a rule of activity, and arguably did not contribute to students' technology literacy skills, or their ability to use technology in empowering ways. In the following section, I will examine how resistance in the forms of satisficing and not doing work had the effect of shifting technology's role as a mediator of 21st century skills and "higher order" learning, to that of a rule of activity. I argue that, as a result of this shift, technology became an extension of institutional forces that still supported the hegemony of assessment culture and knowledge acquisition, rather than becoming a tool of empowerment.

Finding 3: Serving Multiple Roles During In Class Activities, Technology Became an Extension of Institutional Forces

The first digital media activity I observed during the year was entitled "Visual Vocab." For this project, Mr. Harris led students to a template of a Google Presentation, which he had created and posted to the school website. He demonstrated for the students how to access and download the template file, which they were to then use to create their Visual Vocab projects. The file included several slides, with a series of blank slides followed by slides that displayed biology terms. The intended result of the activity was to have students develop a game-like slideshow that used images and text as hints for the various biology terms. Students were instructed to post three images onto a slide, then to write brief hints in text on the following slide. The figure below is an example from the template.

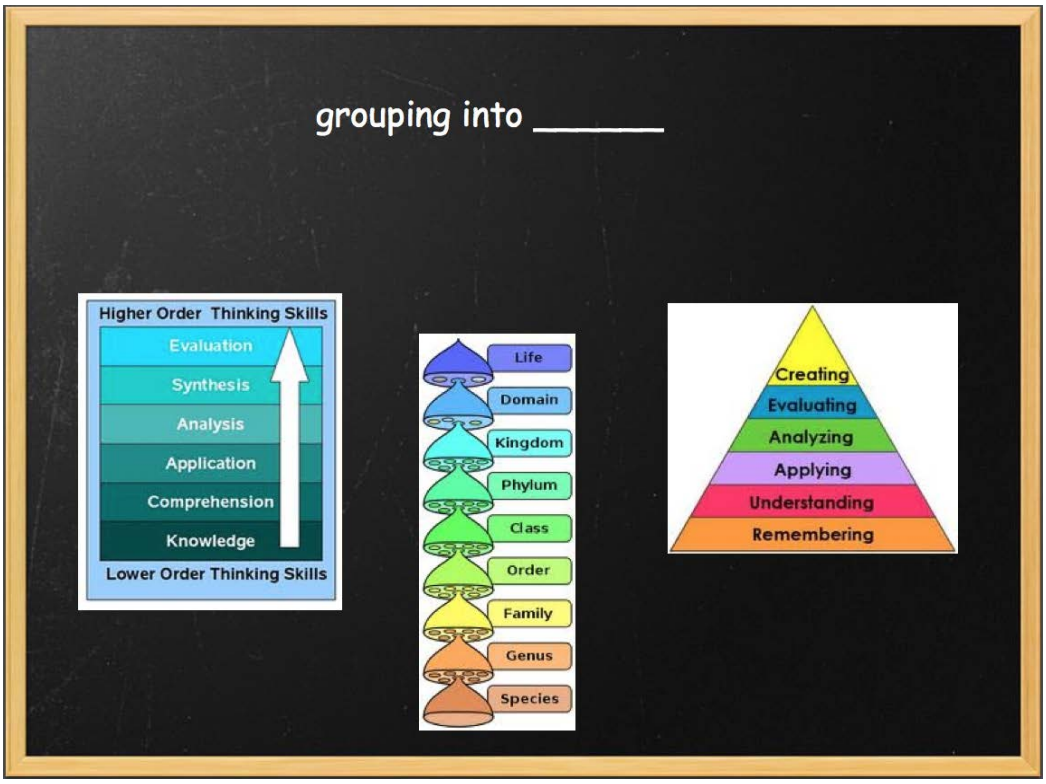

Figure 14: Side 1 of the sample Visual Vocab project.

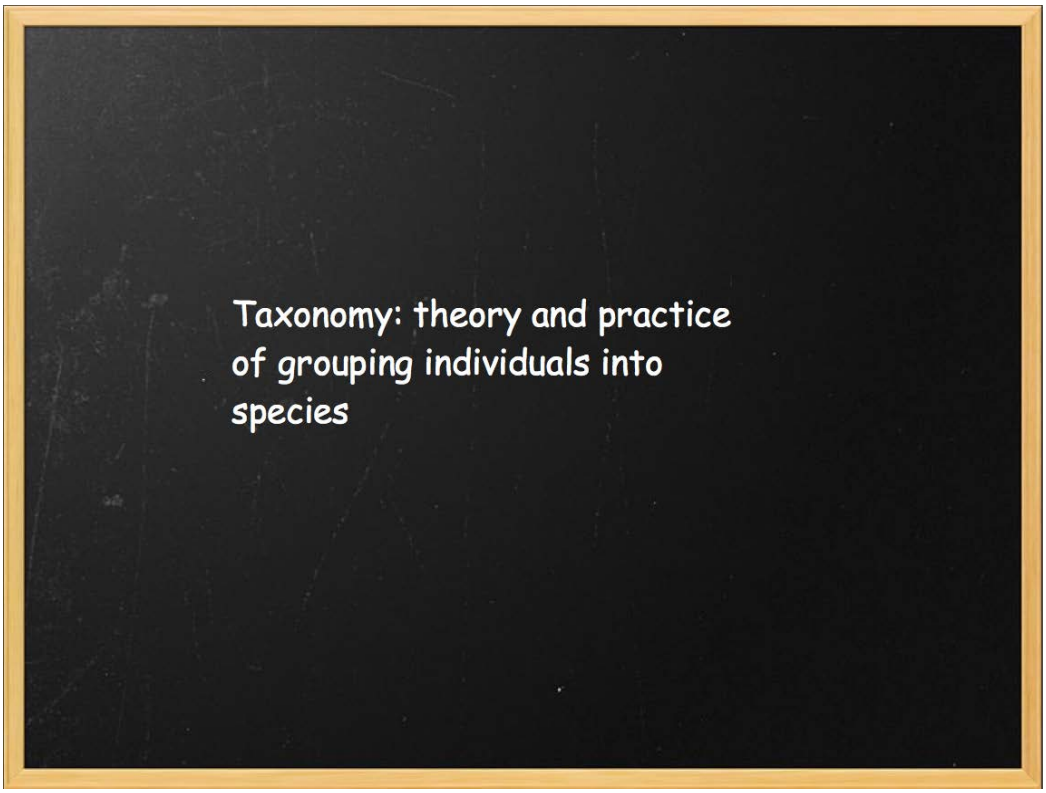

Figure 15: Side 2 of the same sample Visual Vocab project.

Mr. Harris explained the instructions to class aloud on the morning that the project was assigned.

> "The first slide for the vocabulary, you are going to find three pictures – pictures from the internet – that will make people guess what you're looking for. DON'T PUT THE WORD. You can do a search on Google... One the second slide, I want you to put a hint… On the third slide, you're going to put your pictures together on the slide…"
> A couple of students interrupt Mr. Harris, asking for clarification on what they are supposed to do. "The directions are right there, I'll explain in a second… Do you see what we're trying to do?"
> "There's going to be a ton of slides," says a student.
> "You're going to have a ton of slides," Mr. Harris agrees. He speaks loudly, and asks, "Why am I trying to get you to place pictures to words? Because your brain works in pictures," he explains. He tells them that visual representation will help them memorize the vocabulary.

As was typical during in-class activities, Mr. Harris walked around the room while students did their work. He checked in on students, inquiring about their progress or if they needed assistance. Students sometimes needed clarification from Mr. Harris on the technical steps. During these moments, he often took control of the student's laptop, and performed any necessary troubleshooting steps then modeled how to complete the technical steps while the student looked on. This tactic gave Mr. Harris the opportunity to not only demonstrate to individual students how to utilize various functions of the technology they were

supposed to use for the assignment, but to check in on students' understanding of the task. It also enabled Mr. Harris to move among the students, maintaining an authoritative presence that suggested that his watchful eye was always within view. Indeed, several times, I observed the mere act of Mr. Harris walking by perk students up, suggesting they were well aware of the expectation that they be using the class time to work productively.

Students still found ways to socialize and play, however. For instance, during class I observed two boys taking playful photos of themselves using the built in camera on one of their laptops. Two other boys joked about the results of one of their image searches to each other, chuckling quietly. Still others checked their cell phones, or whispered to each other in tones low enough to mask the content of their conversation from Mr. Harris. These behaviors seemed more playful than disruptive, and while they temporarily distracted students from the assigned task, seemed to provide relief from the long task they had been assigned. Indeed, as I observed the students over the next sixty minutes, many of them appeared to work very mechanically, searching for images and copying text into a Google Presentation in a rote, time-efficient manner. I honed in on Wei, whose work appeared to typify the mechanics of this activity. During her internet searching, Wei relied on Wikipedia to find definitions to the terms that Mr. Harris had provided in the assignment.

> Wei navigates to Google Image Search. She drags the thumbnail of one of the images to the lower right corner of her desktop, which is cluttered with image icons that she has saved to her computer from the Internet. She switches tabs in her browser over to Google Presentations, and under the Insert menu, selects "Image". The content browser opens, and she navigates to a file on her desktop. She loads the image onto the slide, and grabs one of the corner handles to expand the image, so that it covers most of the entire slide. When she does this, she seems to do it without preserving the aspect ratio, producing a "smooshed" effect. I cannot see her laptop screen clearly enough, but I wonder if the image is grainy, since she technically only copied the thumbnail image, which has a lower resolution, rather than selecting the "view image" option in the Google Image Search results.
> In a new tab, she goes to Wikipedia, and does a search for "Binomial distribution." She swaps tabs again and creates a new slide in Google Presentations with a text box. She swaps back and forth between the Wikipedia tab and the Presentations tab, entering text into the text box until she has written, "One sentence hint: discrete distribution of the number of success in the sequence independent experiment, each of which yields success with probability" - a definition straight from the Wikipedia page on binomial distributions.

To the naked eye, the classroom mirrored what many educators have come to expect as exemplary productive learning; the class was relatively quiet, students appeared mostly on task, and Mr. Harris, floating around the room, providing individual attention to students who needed assistance at that moment. Indeed, arguably, the very activity students were performing on this day seemed to comply with technology integration studies' recommendations that 1) students need opportunities to rehearse technology skills, and 2) they benefit from opportunities to use technology for creative production. Yet, weeks later, when I asked the focal students how they felt about technology, how they used it for personal interests, and how they used it academically, with the exception of Wei (and

Carmella, who did not arrive in Bayside until later in the year), none of the focal students studied for exams. Though the gestures the students performed during the Visual Vocab activity, including the tasks of finding information online, grouping that information into appropriate categories, and creating a multimedia artifact to represent that understanding, appeal to the prescribed set of "skills" the Bayside High School administration had published in their technology rubric and public relations material, the objective undergirding the activity was to aid students in memorization and test preparation - two canons of schooling and institutionalized education that have been systematically used in the past to separate students into the various tracks of academic privilege. This fact remains crucial for examining student engagement in academic work, especially when that work is mediated by the seemingly powerful tools (such as laptops) to which many have attributed lofty notions of empowerment, opportunity, and motivation. These two factors call into question the nature of student engagement with the Visual Vocab activity, as well as what exactly the learning outcomes are for these students.

Mr. Harris agreed with administrators' notion that technology should not be "taught", but rather embedded into the everyday discourse of learning at Bayside High School, and that technology would thus serve the role of mediating students' engagement with curriculum. In many instances over the course of this study, however, the approach students took towards particular academic uses of technology appeared to conflict with this notion of technology serving as a mediating tool, which created a number of dilemmas with which Mr. Harris had to contend. These dilemmas seemed to stem from both tensions regarding differing epistemic approaches to learning, as well as students' attempts to undermine the intended (read: institutional) purpose of technology use. While at times, this appeared to resemble overt resistance to schooling in general, in other cases, students more subtly undermined technology activities by masking their resistance in what appeared outwardly as compliance, but called into question the purpose of their engagement in certain tasks, like the Visual Vocab assignment just described.

Though they resisted the teacher-defined division of labor during assigned technology activities, it is impossible to say precisely what motivated Tommy's, Reggie's, and Angelo's participation in the Introduction to Biology class. Their behavior suggests, however, that developing a thorough understanding the state-mandated biology content was not their primary goal. As was evidenced in the project-based activities, as well as the structured activities examined earlier, satisficing assignments, not doing work, and getting answers from peers and resources that did not fit under the list of sanctioned research or informational tools (e.g., the Google search engine [at times, but not always] or Yahoo! Answers) suggests that a possible objective of activity from these students' perspective was simply to acquire answers in the most effort-efficient means possible, and look relatively compliant doing it. Indeed, the fact that despite resisting the assigned division of labor, these students participated in classroom activities at all suggests that they did have at least some level of interest in complying with school rules and expectations for behavior. While technology could mediate some of these possible objectives (again, Googling answers or appropriating technology to mimic compliant behavior), understanding the nature of digital

education inequities in formal learning environments such as classrooms necessitates examining the role of technology plays in mediating students' participation in activities. In many of the instances of technology use that I observed, students approached technology as a rule of activity, rather than as a tool to mediate the higher forms of learning Mr. Harris and the Bayside High School intended the laptops to serve. In such instances, technology mediated the relationship between the subjects (students) and the community (legitimate participation in school). Thus by performing certain teacher-sanctioned activities (i.e., "doing school"), such as taking notes on their laptops, students could demonstrate their compliance with institutional expectations regarding behavior and learning. Interestingly, many of the focal students preferred to take notes on paper, or not at all, evidencing the rule-based nature of technology use in the class. Indeed, this was further evidenced when resistance to taking notes earned students disciplinary action. This arguably cost them a level of cultural capital among their peers and Mr. Harris, again reflecting a sense of what constituted legitimate participation in class.

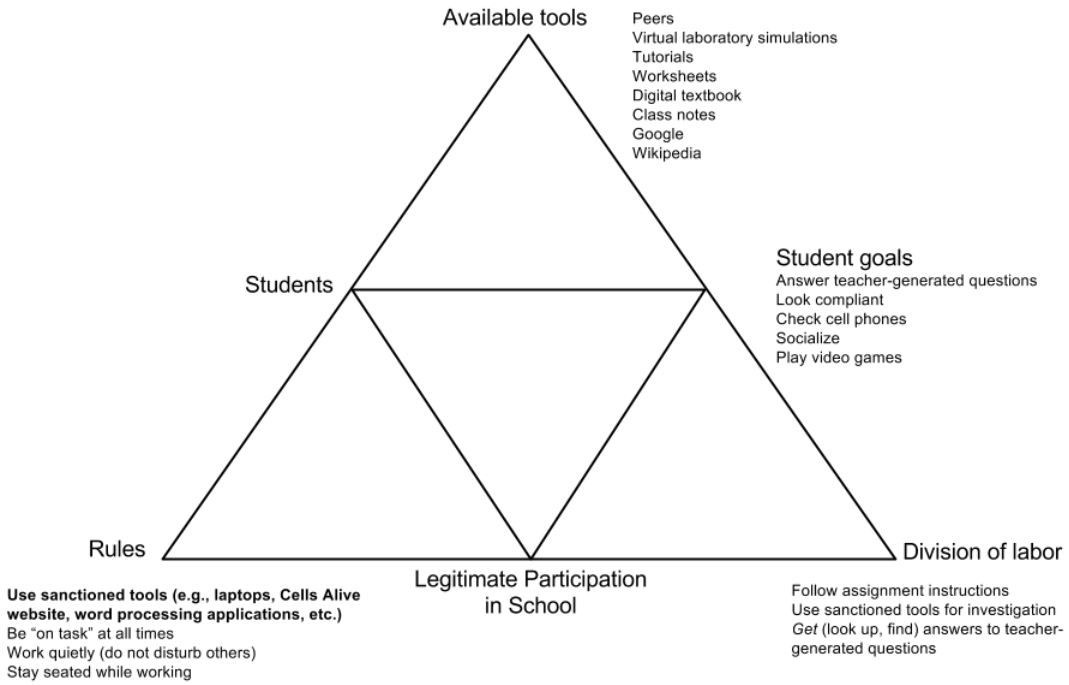

Figure 16: Structured activity systems from the focal students' perspective.

Even during some of these activities, technology did, however, also serve to mediate productive learning goals. Practice tests in particular represented highly structured activities oriented towards preparing students for upcoming assessments. Though not all of the students took advantage of the opportunity to rehearse their understanding of biology

terms and concepts through the use of these practice tests, both Carmella and Wei (on numerous occasions) did. While taking practice tests at home or outside of class fulfilled institutional objectives related to self-regulated learning and reflection, I found that this use of technology contracted many of the aforementioned objectives of the laptop program itself, and rather than empowered students to "show what they know" in multiple formats, reified a hegemony of testing culture and knowledge acquisition.

Technology as a rule of activity. Technology use was, by and large, a requirement of student work throughout the year. Only when interruptions in Internet service, or when students forgot to bring their laptops to class, were other "analog" tools sanctioned for use in the Introduction to Biology class. As a mandated tool for note taking, technology use was very much a rule of activity. In my observations, technology use was also closely associated with social capital, and as I argue further in the pages below, the negotiation of identities in practice[7]. This was particularly salient during note-taking activities, when technology simultaneously mediated a process of content delivery, as well as a process of showing one's compliance with institutional expectations. Note taking and lecture activities garnered my attention early on, as it was one of the first activities in which I could easily observe and document patterns of behavior that centered around the use of technology.

Lectures served as a platform for introducing biology concepts, in a way laying a foundation of content knowledge upon which subsequent unit activities could build. They also provided Mr. Harris the opportunity to integrate technology with a relative frequency and purpose of use that, at least on paper, could *later* (in the form of open-ended assignments and test preparation activities) be used to serve some of Mr. Harris's own, as well as the district's, goals for "21st century learning and instruction" - namely the organization analysis of information, and self-regulated learning. Finally, as an "efficient" means of mitigating student behavior and progressing through the curriculum, the lecture format entailed very clearly understood rules for participation, and an activity in which Mr. Harris could easily discern who was on task, and who was not[8].

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[7] On the occasion that students forgot their laptops at home, could not use their own laptop due to a dead battery, or experienced some other technical issue, students were expected to handwrite their notes. As an example, when some students, particularly Reggie, Tommy, and Angelo, failed to take out their laptops and begin taking notes during lectures, Mr. Harris would often unceremoniously hand them a pen and a few sheets of paper, indicating they should be recording the content of the lecture in text. Other times, especially if students were caught talking to their neighbors, checking their cell phones, or paying attention to something other than Mr. Harris, he would call them out, scolding them, "You're not taking notes." Such actions seemed to reinforce both Mr. Harris's authority in the classroom, and strongly suggest that the "right" thing for students to be doing, was taking notes.

[8]For a study on digital education inequity, a focus on lecture/note taking activities might appear biased towards a critique of teacher-centered learning activities. After all, the

Note taking was the most common technology activity students participated in over the year. Lectures lasted anywhere from twenty minutes to over an hour, and invariably involved the use of the large projector screen at the front of the room, onto which Mr. Harris presented a PowerPoint slide show of the topic at hand. On most occasions, lectures were sandwiched between a brief review of the previous class meeting's topic on one end, and a worksheet activity on the other. Lectures were occasionally interrupted by whole-class discussions, which followed a typical question and response format. Students were allowed to ask questions, as long as they raised their hands, and Mr. Harris at times elaborated for several minutes on his responses.

While Mr. Harris used lectures to deliver a significant portion of course content, he saw technology as a way for students to keep a record of the "condensed" version of the "most important" information covered in the course. Note taking on the laptops thusly served two important pedagogical goals for Mr. Harris: 1) the efficient delivery of course content, 2) the development of information finding-, organizing-, and filtering skills. By delivering the biology curriculum in a lecture format, Mr. Harris could ensure uniformity in how his students received course content (i.e., didactically, rather than in the less predictable, and harder to enforce, format of assigning readings from the electronic textbook). The structure of note taking activities also meant that Mr. Harris could highlight what he considered the most important elements of the curriculum, and keep relatively close tabs on classroom behavior (more on this later). Finally, by taking their notes on the laptop, the students could easily maintain an archive of course material, using a tool which afforded advanced searching and filtering capabilities, which might become useful for test preparation, or project assignments that asked for a condensed display of information. Mr. Harris expressed to me that students being able to organize and filter information was a large goal of his, one which he felt technology could easily mediate[9].

The role of technology in the ritual of note taking was central in the Introduction to Biology class. Again, from Mr. Harris's perspective, technology mediated the process of learning and engagement with the Biology subject matter. Many studies have linked the process of taking

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literature cited in the previous sections indicates that teacher-centered instruction does little to promote student agency and empowerment for historically marginalized populations of students. My contention here is that digital education inequity is a representation, however, of the disparity in opportunities for agency and empowerment that are offered to students within different educational settings. In this regard, the frequency of lecturing/note taking activities that the students in the Introduction to Biology class experienced is an appropriate area for investigation. This approach is consistent with the central questions guiding this research, as it involves understanding how and when students from non-dominant backgrounds engaged with learning processes, *including note taking*, through the use of technology.

[9] It is worth noting here, again, that Mr. Harris expressly did not teach certain technology skills to students. He did, however, complain that he thought the school should do a better job of teaching students how to use applications such as Evernote for note taking.

notes to cognition and memory, and as such, the exercise of taking notes is sometimes seen as a way to rehearse those cognitive processes (Piolat, Olive, & Kellogg, 2005). As a self-described constructivist, Mr. Harris was also concerned with providing a foundation of knowledge upon which students could construct a more in-depth understanding of biological phenomena. The benefits of note taking with digital tools, in Mr. Harris's opinion, was that it could mediate efficient searching, organizing, and sharing of information. As such, the intent and format of Mr. Harris's didactic instruction was to both deliver important content to the students, as well as to provide students opportunities to rehearse the note taking skills afforded by digital technologies.

Mr. Harris often began his lectures by unceremoniously drawing the projector screen, connecting his laptop to the tethered projector cable on his desk, and turning off the overhead lights. While doing this, students often took a moment of downtime to chat with neighbors, check cell phones, or surf the Internet, creating a mild commotion, which Mr. Harris would hush and try to direct towards the front of the room. The students became rather rehearsed in this ritual, and would often take their laptops or launch their preferred note taking application automatically, though Mr. Harris occasionally reminded the students that he was about to begin a lecture, which meant they should be preparing to begin taking notes.

Using a USB remote and laser pointer, Mr. Harris delivered his lectures while walking up and down the aisles between the students' desks. Occasionally, he would stop next to or behind a student who appeared to be off task, imposing his presence in an effort to turn the students' attention back to the lecture slides. During this time, students were expected to sit quietly, facing the front of the room, dutifully recording notes - an act, which consisted almost entirely of simply copying down the text that appeared on the screen. As Mr. Harris advanced through the slides, students often requested that he move back one, or pause, as they finished recording the text onto their laptops.

The majority of lecture time consisted of the standard one-way didacticism, but Mr. Harris also interrupted the flow of content to pose questions to the group, sometimes leading to tangential discussions. Though students were expected to remain silent most of the time, Mr. Harris did entertain questions that pertained to the content material, only seldom indulging students whose questions were indirectly related to the topic of the lecture. This provided an opportunity for students to participate in larger discussions, which sometimes grew to involve multiple interlocutors.

During some of these "whole class" discussions, students strayed from the topic, at times for several minutes. Certain discussions, particularly those involving bizarre phenomena or grotesque animals, seemed to whip the group into animation, and found them talking over each other, raising the volume of the room to a very loud level. Angelo and other students often navigated the web browser on their laptops to Google, to find images of these captivating themes, which had momentarily stirred their curiosity. Swiveling around in their chairs, they showed their classmates the images that they had found.

Such instances were short lived, however, and came to abrupt endings when Mr. Harris decided that the class was spending too much time on tangential themes. Redirecting the class's attention back to the screen and the lecture material, Mr. Harris thus reserved the floor for himself and the curriculum.

Along with daily questions, lectures were also one of the most obviously routinized aspects of the course. This allowed me to compare multiple episodes of similarly arranged technology activities after only a relatively short period of observation (i.e., a few weeks), and to test the hunches that I recorded in my field notes with a regular consistency. During lectures, I typically sat at the back of the room, propping myself up against one of the radiators with my computer on my lap. From this vantage point, I could see over the shoulders of every student in the classroom. As my notes began to focus more closely on the group of focal participants, I would shift my spot in the back from one side of the room to the other, so as to get a better view of focal participants' individual laptop screens. This also allowed me to see what the students were typing as they took notes, and to compare their notes with the slides being projected at the front of the room.

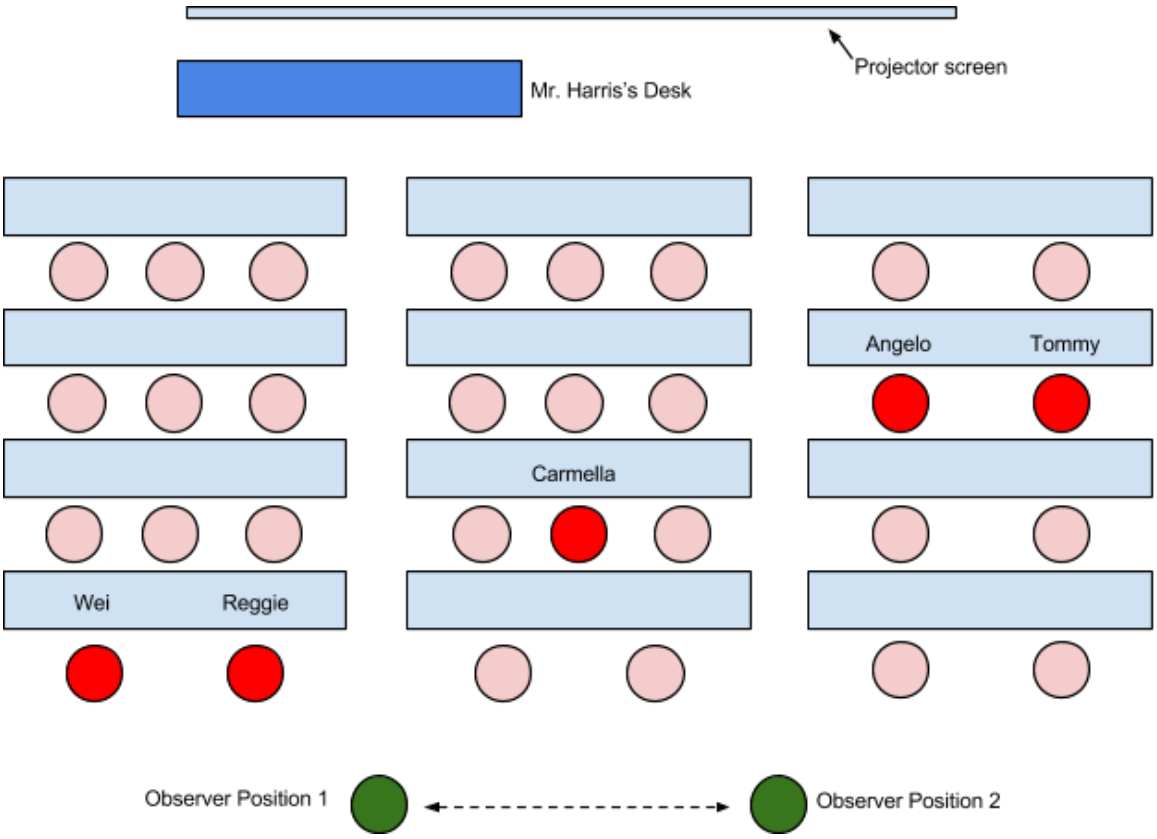

Figure 17: Classroom seating arrangement during note taking activities.

As I paid closer attention to note taking activities in class, I began to observe certain patterns of behavior around the students' use of technology that made me question their orientation to the activity. For instance, students' note taking behavior tended to include a

limited range of information. While content varied from lecture to lecture, students overwhelmingly recorded only the text that appeared on the lecture slides. This sort of heuristic, almost rote exercise, was so unvarying, that it appeared to resemble other behavioral norms that emerged during note taking. The students had quickly developed an understanding of the unwritten rules of the lecture environment (facing forward, not talking, and taking notes), and compliance with these expectations indicated a student's recognition of Mr. Harris's authority, and of the standard schooling practices they were expected to respect and take part in. Just as dimming the house lights in a theatre signifies to the audience that the performance is about to begin (Goffman, 1974), so did the displaying a PowerPoint presentation on the large screen at the front of the room signify that it was time for students to take out their laptops, face forward, sit quietly, and record notes on the content that Mr. Harris was delivering. In this sense, the students seemed to view their laptops as a rule of activity. To illustrate this, I will offer two examples of student notes that I recorded in my field notes: one from my observations of Carmella, and the other of Tommy - two students who ended the year on practically opposite ends of the achievement spectrum.

As a student whom Mr. Harris considered to understand the rules of "playing school", Carmella was a shy, high achieving, compliant student who never failed to turn her work in on time, or complete, often going above and beyond the requirements of assignments. Tommy, on the other hand, was routinely defiant and off task in class. When he did turn in his work, it was often late and incomplete. Meeting the requirements of assignments was a rare experience for Tommy. I use these two examples to highlight the similarity in their orientation to note taking, and to call into question the objects motivating their participation in the activity.

Example 1: Carmella's Note Taking Habits. Carmella usually copied text as it appeared on the screen, mimicking the same formatting and stylistic features of the slide text, such as bullet points, indentations, and bold and italicized fonts. For instance, if the slide projected to the class looked like this:

Figure 18: Lecture slide used to deliver content related to cell division.

Carmella recorded in OpenOffice (her note taking tool of choice) the following:

> Prophase I
> - Chromosomes are shorter and thicker
> - Nuclear membrane & nucleoli disappear
> - Centrioles move to opposite sides of the cell
> - Spindle fibers are formed

At the end of the lecture, Carmella's notes were thus an almost exact replicate of the text as it appeared on the screen to the class.

Carmella admitted to occasionally reviewing these notes when studying for assessments, but also stated that she preferred to review handwritten notes when possible.

> NW: You said in- in- um, on the [attitudes towards technology] survey, I noticed when I went through the results, that something about, like, taking notes, is maybe, like, fast you- you can- you can type them faster than you can write them. But you don't refer back to your notes on the computer when you're studying for a test?
> C: Yeah. Because, um, when I get home, and then my computer's away then if I'm doing a worksheet, or something, and then I have to look back to the notes, I find

that I don't really look back when it's on the computer, 'cause I don't want to go through the trouble and get it out, and then... yeah.
NW: Sure, sure. So is it- is it, like, laziness? [Laughs]
C: Yeah.
NW: Do you feel like it- it's helpful to take notes in class?..
C: Yeah.
NW: Yeah? Can you explain why? Why you think that is?
C: Uh... In case I forget, I guess. And just to go over the information again.
NW: Okay.
C: To make it sink in.
NW: Right on.
C: Yeah.
NW: Right on. So do you- like, so when you're- when you're paying attention in class, and you're typing in the notes, do you feel like it's -it's difficult, or is it easy, to- to hear what Mr. Harris is saying, and see what the text on the screen is that you're copying down, and be able to type it? Do you feel like you can sort of attend to all that information that's coming in?
C: Yeah, it's sort of difficult when he's explaining *while* we're typing.
NW: Mm hmm.
C: 'Cause you can't really, like-
NW: Right.
C: - absorb it.
NW: Yep.
C: Yeah… And then I feel, like, I have to go, like, I have to type this fast so I can go ahead and listen.
NW: Mm hmm.
C: Yeah...
NW: Do you- do you ever take notes, um, when you're- when you're typing stuff on the computer, do you ever type down- down, some of the stuff that Mr. Harris is saying, and not what's just on the screen, or do- or are you notes just pretty much just the text from the slides that he puts up?
C: Mostly just from- directly from the slides.
NW: Yeah.
C: Yeah. Sometimes I-
NW: Do you- do you ever add stuff?
C: Yeeee- not necessarily in biology, but in history.
NW: Yeah?
C: Yeah.

For Carmella, though taking notes was seen as useful for helping "information sink in," taking notes electronically served little intrinsic function other than to provide an seldom-utilized archive of material. Indeed, later in the interview, Carmella admitted that she held negative feelings towards the use of laptops in school. Before transferring to Bayside High School, she had attended a school in the Midwest with a one-to-one laptop program, and reported that many she of her peers preferred to use traditional paper and pencil tools rather than digital ones for note taking.

Example 2: Tommy's Note Taking Habits. Tommy, on the other hand, routinely copied the text of slide, but in a seemingly haphazard way. During the evolution unit, for example, Mr.

Harris produced a slide, which included text listing two main ideas under the subject of fossils: the study of heredity, and comparative anatomy. As such, they appeared like so on the screen:

> Fossils
> - Study of Heredity
> - Comparative Anatomy

As was typical of Tommy during lectures, he sat somewhat distracted next to Angelo, occasionally taking out his cell phone to look at it, looking around the room or at Angelo's laptop. When he did record notes, they resembled a string of text without punctuation, formatting, or even spaces between words. As such, the same slide above appeared in Tommy's notes (taken in Pages on this day) as so:

> *Fossils studyofheredity comparative anatomy*

At the end of the period Tommy's notes were cryptic and incomplete.

Tommy's confessed to me that he did not study for assessments, and presumably, therefore, he did not review these notes at any point after the lecture. It is thus unclear what, if any, academic goal note taking served for Tommy.

Note taking as compliance. In the two cases just described, copying the projected text from lecture slides into Pages or OpenOffice did not appear to mediate any obvious learning function, other than perhaps allowing some rehearsal in transcribing text. Yet in terms of navigating the classroom culture, taking notes on the laptop allowed both Carmella and Tommy to appear compliant, and actively conforming to the rules of the note taking activity. In this way, compliance represented a vehicle for students to remain, at least momentarily, in Mr. Harris's good favor, and out of the spotlight. Thus, technology served as a rule of note taking, mediated their students' relationship with the school (i.e., institutional) community.

Different classroom activities called upon students to properly interpret different pictures of "good" behavior. During group activities, for instance, Mr. Harris occasionally had to plead with the students for more active talking (discussing). Silence, individual work, or technology use during these moments was considered improper behavior, and worthy of reprimand. Students who learned the rules of behavior expected of them in these settings, more quickly accrued the cultural capital typical of "good students". In each instance, staying out of the spotlight remained a top priority.

When I asked Carmella and Tommy about their interest in using the laptops, both students cited negative views of the laptops as a learning tool. As Tommy stated in one of our interviews, "I don't see what the point is of using them." When I asked students to describe to me their thoughts of using the laptops to take notes versus handwriting their notes, Carmella responded in greater detail,

> "I haven't really noticed a difference between the two, but sometimes I'm too lazy to get out my laptop. Although, I do take notes on the laptop much faster than when I

> handwrite my notes. When I need to look back at my notes, I've noticed that if my notes are on the computer, I don't want to get out my computer to look at the notes; I am more likely to look back at my notes if they are handwritten because to me they're more accessible."

While technology may have served as a rule in the note taking activity, it is interesting to note that both Carmella and Tommy used their laptops for non-academic work rather frequently. Indeed, Carmella navigated online discussion to learn various functions in the Mac operating system, and to keep tabs on conversations taking place in Minecraft user forums. Thus, while as a note taking tool, the laptops may have held little academic value to Carmella and Tommy, it is significant that their negative opinions of the laptops did not extend to personal activities. I will return to this point later, as it implicates notions of legitimate technology use, and participation in the schooling community - two notions that other researchers have pointed to as important factors in the production of digital education inequity (Ito et al., 2011; Sims, 2013).

Resistance and agency in note taking activities. As just described, technology use became a way for students to indicate their compliance with, or defiance of, the discourse of schooling, even while undermining the purpose of the activity. Students bring with them a whole range of experiences, backgrounds, and dispositions towards schooling into the classroom. As such, the temptation to expect that students would share the exact same learning objectives and attitudes towards classroom technology use as Mr. Harris deserves some interrogation. Indeed, throughout my observations, note taking seemed to reflect a level of discord between teacher and students, rather than assimilation. In this way, the use of the laptops for taking notes seemed to undermine Mr. Harris's primary objectives for lecturing and integration the laptops into activity.

For students who did not wish to draw unwanted attention to themselves, but whom had little interest in note taking for their academic growth, going through the motions of note taking was in itself an object of activity, the rule of which was using technology. Not only was this evidenced by Mr. Harris's reprimands of non-compliant students, but in the content of students' notes. As shown earlier, students' notes invariably consisted of only the text that appeared on lecture slides. Though Tommy occasionally went through the motions of note taking to exhibit his compliance with Mr. Harris's rules, Reggie did not take notes - an act of conscientious resistance. Though he was a frequent and engaged participant in whole-class discussions and lectures, for Reggie, note taking presented a self-described cognitive challenge, one that conflicted with his passion for active learning engagement.

Resistance to note taking as a form of agency. During one of our interviews, I asked Reggie to reflect on why he did not take notes during class. His response revealed an insightful rationale, one that may have even deserved some form of instructional accommodation.

> NW: So I noticed that, right, so Mr. Harris does a lot of note-taking stuff, right? In class, he like, puts up a PowerPoint, does a lecture, shows like a video, and sort of expects you guys to take notes. And I noticed that you rarely do.
> R: Take notes?

NW: Yeah.
R: Yeah, I'm not- I'm not like a note guy.
NW: How come?
R: I feel like it's… it doesn't help me at all. I used to always take a lot of notes, and if anything, it made it worse for me, because when I- when I take notes, the way- the way like I… I am… I'm sure not all kids are like this, but when I'm copying something, either- anything, I don't see words, I see letters.
NW: Mmm.
R: I see letters and shapes, like, you- oh- you ask me to copy something and write it and tell me what I just wrote, I won't know.
NW: Mmhmm.
R: Like, oh… It's… It might work for, like - the only thing it might help for is to remember certain spellings or words or something like that, so I can remember how it looks like.
NW: Mmhmm.
R: But that's about it. I- I have no… It- It doesn't come it me. It doesn't come to my brain, like make a sentence for me. I just see words, like letters. Random stuff.
NW: So do you feel like, like taking notes in class during lectures is, like, distracting? 'Cause I notice you-
R: Yeah!
NW: -You, you definitely pay attention-
R: That's-
NW: You're listening to what Mr. Harris is saying-
R: That's how I catch stuff.
NW: -And what's on the video.
R: That's how I catch that. I wish it was more of talking, and like, just talking, just talk to students, inspire the students. And so, like, just take notes, take notes, take notes, because not all students work like that.
NW: Right. Right.
R: And, it's, um, it really bothers me, especially when, like, maths -actually, um, yeah. Math, math sometimes you have to take the notes because that's more like you have to remember the steps-
NW: Yeah, you like have to practice and stuff, right?
R: Yeah, but like, let's say history… History a little bit more, you have to remember things [inaudible], but don't write every single thing. You might, you might write like, like, like a few words to remember, so I can be, like atoms this- this deflections, but need to write all of the, like, everything he says, or everything you see on the board, because, he just, sidetracks me into- all I focus on when I'm taking notes-
NW: Mmhmm.
R: All I foc- I start focusing on is what I'm writing, trying to keep up, and I completely don't hear him at all.
NW: Yeah.
R: And I- I have to block him out so I can write what's happening.
NW: Yeah yeah, right.
R: So, I don't catch anything. It completely messes me up.

Reggie's lack of compliance to the rules of note taking became emblematic of what was perceived as a general level of insubordination, or defiance, in Mr. Harris's eyes. In fact,

when Reggie attempted to explain his reasoning for not taking notes, Mr. Harris's quickly dismissed Reggie:

> "When I take notes I can't understand anything," says Reggie. "I'm serious," he adds. "I'm not gonna buy it," Mr. Harris tells him. Reggie tries to explain, but Mr. Harris cuts him off, saying, "ReggieReggieReggie- I'm not gonna buy it." He tells Reggie and Tommy how they are going to do the two-column notes. "Anything that's details, etc., you're going to copy down…"

In this excerpt from my field notes, Reggie attempted to explain his rationale for not taking notes to Mr. Harris. In addition to publicly discrediting Reggie in front of his classmates, Mr. Harris's reaction in this excerpt arguably cost Reggie a good deal of social capital among his peers (such negative, public responses from an authority figure arguably provided a model for interpreting and delegitimizing Reggie's contributions to the class). Interestingly, though, Mr. Harris and Reggie seemed to share the same overall objective in the lecturing activity: to learn the major topics presented in the Introduction to Biology class. Yet the imposition of technology to mediate that process, especially in the form of note taking, deserves mention, as it seemed to create a great tension between Mr. Harris and Reggie, as technology's role blurred the lines of mediating artifact and rule of activity. One outcome of this tension was for Mr. Harris to enforce his authority, and to discredit Reggie - an outcome that speaks to long-standing issues of power and privilege in schooling, and the reproduction of the conditions under which students like Reggie, whose orientation towards learning is considered illegitimate, are therefore marginalized by dominant discourses. As this process of marginalization was on public display for the class to witness, these events reified the rules of activity, and the consequences of resistance.

Arguably, restricting students to only a few degrees of freedom in their class work, as well as limiting the kinds of interactions they could have with peers, produced a workable environment in which Mr. Harris could keep members of the class on task, and distribute his attention more evenly among the students who needed more one-on-one instruction. As such, taking notes on the laptop represented a rule, which students seemed to understand both when they wished to exhibit compliance with Mr. Harris's objectives, and when students wished to express some form of resistance. By refusing to take notes, students could demonstrate to Mr. Harris, and to their classmates, a willing defiance. Some students, such as Reggie, were willing to risk their standing with Mr. Harris, and their peers, because of deeply held beliefs about learning and engagement. Other students, such as Tommy, and Angelo, however, seemed to risk their standing with Mr. Harris and classmates in order to maintain a level of social capital among their own identity group, which included students with histories of disciplinary action and a low-level of academic achievement, i.e., the "bad students". As the imposition of technology represented a rule of Mr. Harris's authority, and by extension, the Bayside High School institution, refusing to use technology was therefore one method to show resistance to institutional forces. Resistance to schooling is a well documented phenomena, and students' reasons for such resistance have been attributed to the value of maintaining social capital among one's affinity groups over the value of social capital in the classroom (Willis, 1977; Eckert, 1989).

Reinforcing hegemonic and canonical structures of schooling at Bayside. Some in class activities centered on the memorization of vocabulary and of biological concepts, usually through rehearsal or self-assessment. In the process of participating in these activities, Mr. Harris hoped students would pick up on terms and ideas, either through practicing tests, or grouping, sorting, and filtering information that pertained directly to the content of upcoming assessments. Practice assessments were designed to encourage students to reflect on their understanding of Biology concepts, and thereby serve to motivate deeper, self-regulated learning practices. Students could also use the artifacts they created for grouping, sorting, and filtering to prepare for future, higher priority assessments down the road, such as for the MCAS or mid-term and final exams.

Study aid activities were somewhat teacher-centered, in that they revolved around canonical forms of instruction (tests, quizzes, and other assessments), and memorizing the "correct" answer. As such, they supported a "knowledge acquisition" orientation towards learning. These activities typically encouraged students to appropriate content from the Internet or the digital biology textbook, especially for definitions of terms, or concise descriptions of biological phenomena. As with all of his project assignments, Mr. Harris also liked to encourage students to use images and other visuals in their work, which they had access to through resources such as Google Image Search, Wikipedia, and other Internet sites, such as Big Huge Labs (www.bighugelabs.com). Mr. Harris often provided students with written instructions for each assignment, as well, which included step-by-step directions describing how to copy and paste materials from the web into students' projects, and how to export the final products into PDF format.

Surprisingly, despite the nature of study aid activities and their emphasis on test preparation, the focal students did not use either the practice tests or the study aid artifacts they created for classwork. As such, study aid artifacts lost their relevance upon completion of the assignment. The exceptions to this were Wei, who logged numerous attempts on practice tests outside of classroom hours, and Carmella, who attempted the practice final exam twice. Practice tests, therefore, did serve to support a level of reflection and self-regulated learning practices, yet as I discuss later, as these behaviors focused on achieving high assessment scores, seemed to mediate the reproduction of testing culture more so than serving to empower these two students through a process of creative production or collaborative participation - two central goals of the Bayside High School laptop program.

Practice tests. Mr. Harris created five practice tests over the course of the year, and assigned two of these as in-class activities. Both of these instances came during the first three months of school, before the Thanksgiving break. The first of these occurred before I was able to begin data collection, thus I cannot provide a rich description of the context of that activity. Practice tests covered three units in the curriculum (classification, cell function and cell structures, and biochemistry), the midterm exam (a cumulative examination of the first half of the year's content), and the final exam (content from the second half of the year). The second practice test activity (described below) was part of a metacognitive, self-regulation assignment, meant to make students' understanding of concepts and terms

explicit to themselves and their classmates. Other times, practice tests were used as "add-on" activities. After students completed in-class work, Mr. Harris occasionally encouraged students to use the remaining class time to attempt practice tests. With the exception of Wei and the "good students", however, this suggestion was rarely taken up.

After generating the other practice tests, Mr. Harris referred students to them for individual preparation, or at the end of the period, as an add-on activity to do in class. Practice tests were structured similarly to typical assessments. Students accessed and took the practice tests through the Moodle platform, which provided automated feedback on the roughly 25 multiple-choice questions Mr. Harris included. Actual tests typically included more multiple-choice questions (30 for unit tests, and 50 for mid-term and final exams). Regular tests also included short essay questions, but these were never structured into practices tests.

The object of practice tests. The Massachusetts Department of Education issues a yearly examination (the Massachusetts Comprehensive Assessment System or "MCAS") to assess districts' effectiveness in teaching various learning standards. The exams are typically held in May, towards the end of the school year. High school students in the state are required to achieve a score of "proficient" in three major areas (English Language Arts, Mathematics, and Science) in order to graduate, and districts are thusly expected to continuously improve test scores year after year, resulting in a quantifiable measure of yearly progress. Schools that fail to meet the state mandated Adequate Yearly Progress (AYP) face limited funding and resources provided by the state. Districts such as Bayside, which serve diverse socioeconomic and ethnic populations of students, feel pressure to demonstrate AYP within certain demographics of students (i.e., students from low-income families, students who are minority or non-white, English language learners, and students with special learning needs) which are historically "under-performing". Often, these pressures are felt at the instructional level, creating a heightened sense of accountability for teachers to raise test scores.

Students at Bayside High School had the option of taking the MCAS science exam in one of four fields: biology, chemistry, physics, and technology and engineering. The most common field for students at Bayside High School to take for the MCAS was biology. Biology was often taken during the ninth or tenth grade at the school, early in the students' academic career. Taking the MCAS in the lower high school grades is recommended, as it provides students the opportunity to take "retake" exams, should a student receive a score below proficiency. Several of the students in Mr. Harris's classes had scored below proficiency in previous attempts on the biology MCAS exam, and thus needed to prepare for "retake" exams taking place in January, halfway through the school year.

Mr. Harris was keenly aware of the institutional pressure to help his students pass the MCAS exam, and tailored much of his instruction to provide opportunities for students to rehearse practice exam questions, and to regulate their understanding of the biology standards. During our first interview together, roughly four weeks into the study, I asked Mr. Harris to explain the impact that preparing for standardized tests had on his instruction.

He replied that he felt obliged to prepare students for the exams, but he wanted to do so without "teaching the test". In my experience, Mr. Harris's sentiment is common among progressive education reformers who question the value and impact of high stakes assessment, and thus make attempts to lessen that impact by indirectly introducing the subject matter on which students are assessed.

On its website, the state's Department of Education provides sample questions from previous years' MCAS exams, which teachers and students can freely access. Mr. Harris explained that he would use these questions to create "practice tests", which the students could take self-paced, on their own throughout the year. He created these un-graded practice tests on the course website in Moodle, and provided students open access to them. Students could attempt the practice tests ad nauseam, from home, or at school, and after each attempt, could review their scores and the correct answers. By encouraging his students to take the practice tests, Mr. Harris planned to "expose" the students to the types of questions they would encounter on the exam, but in a way that avoided the need for direct, rote instruction of assessment questions or subject matter. This would enable him, he hoped, to still "teach biology", but without overemphasizing the MCAS exam.

> NW: ...so how much of it is an obstacle for you, um, not having enough time to integrate technology because of the time it takes to prepare students for high stakes tests?
> MH: Hmm. Well let's see. Most of my classes don't have a high stakes test. 'Cause I- I've taught chemistry, forensics. Now biology-
> NW: So just for the bio one then.
> MH: For the biology kids, right now is where I'm just starting to worry.
> NW: Yeah?
> MH: 'Cause the retake's actually in January for some of them.
> NW: For MCAS?
> MH: For MCAS. Some of them.
> NW: Mm hmm.
> MH: Some of them, it's at the end of the year, depending on what age their in, whether they're taking retakes.
> NW: Mm hmm.
> MH: Um, I'm starting to get worried. I- I do- what I'm gonna do to address that, is getting all the MCAS questions- I have all the MCAS questions for biology [inaudible].
> NW: Right.
> MH: We're gonna start actually giving them MCAS questions in their practice tests.
> NW: Mm hmm.
> MH: You know the practice tests?
> NW: Mm hmm.
> MH: We're gonna start power loading them with MCAS from those standards.
> NW: Mm hmm.
> MH: So it won't be just a generalized MCAS remediation, but I will start exposing them to the questions.
> NW: Mm hmm.
> MH: 'Cause I don't want to actually teach MCAS biology. I want to teach biology, giving them an idea of what MCAS is gonna be like.

Practice tests thus served to expose students to MCAS style questions and topics. Mr. Harris also embedded the questions (sometimes verbatim) into the quizzes and tests that made up a large portion of students' course grades.

The structure of practice test activities. The objective of practice tests was to prepare students for upcoming assessments by providing similar questions and question types that the students would encounter on both regular Introduction to Biology tests, as well as the biology MCAS exam. No new content was delivered through the use of practice tests, except on one occasion. In this instance, Mr. Harris assigned an in-class activity wherein students were to view a practice test at the beginning of a new unit, and make a list of terms and concepts with which they were not familiar. This activity, however, was dissimilar to actual practice test activities, in that its purpose was to foreshadow for the students the various biology content that they would learn about over the course of the unit. Then, having seen the questions up front, students would have a better understanding of what they needed to know to pass the assessment at the end of the unit.

During typical practice test activities, the class simply mimicked a test environment, and answered questions as they would on a regular exam. The practice exams were thus meant to provide a form of rehearsal for the students, and to foster self-regulated learning strategies that might help them prepare for actual tests. Mr. Harris also encouraged the students to take the practice tests after school hours, during the lead up to unit tests.

In terms of the community node of activity, Mr. Harris and his class constituted the makeup of individuals taking part in the practice tests. Mr. Harris designed and created the practice tests (division of labor), while the student were expected to approach the practice exams as serious test preparation tools. Though not an explicit rule of activity, Mr. Harris did strongly encourage the students to take the practice tests at home. He configured the practice tests to enable multiple attempts, so students could take and retake the practice tests as many times as they wanted. After the practice tests were posted to the Moodle course site, students could access them at any point during the school year, which was valuable for mid-term and final exam preparation.

For Wei and Carmella, the only two focal students who attempted practice tests outside of class hours, practice tests served as preparation tools. Wei, in particular, accessed practice tests regularly as high-stakes assessments, such as the mid-term and final exams, approached. Looking through the activity logs from the Moodle course site, Wei typically began accessing practice tests a couple of days before the date of the assessment, and conducted numerous attempts - sometimes as many as eight in a single session. The Moodle assessment tool keeps track of the amount of time students spend on each assessment, and even each question. Looking closely at Wei's activity logs, the data showed that with each attempt, Wei's overall time went down, and her score improved. Wei continued to make attempts on the practice tests until she achieved a perfect score. Carmella only made two outside-of-class attempts on practice tests, and these both occurred at the end of the year, as students prepared to take the final exam. Upon her first attempt, Carmella scored above 95% on the practice test. Her second attempt fared even better.

For these two students, practice tests fulfilled the very objective Mr. Harris had intended - the practice tests mediated a process of test preparation, which at least for Wei, included reflection and rehearsal - two characteristics of self-regulated learning. This is significant in that it implies a level of self-directed agency on the parts of these two, and the initiative to utilize the available technologies (i.e., the laptops and the Moodle assessment tool) to achieve personal goals. Indeed, at no other time during the year did Wei exhibit the same level of self-directed behavior, or persistence, with an activity as she did for practice tests. This observation strongly supports the notion that laptop learning environments can enable students to develop self-directed learning skills, and can provide anytime/anywhere access to curriculum. In this regard, practice tests were a successful example of technology integration, and fostered a level of agency and empowerment.

Though paradoxically, while both girls demonstrated the capacity to make use of digital technologies for such agency and self-directed learning, they also reported feelings that the laptops did not contribute significantly to their learning experience. Carmella expressed to me that she typically did not use her laptop for studying, preferring instead to make use of her paper notebook, and Wei suggested that the only benefit of using her laptop for academic work was that it allowed her to record notes faster than doing it by hand (she considered herself a quick typist). “Taking notes on the laptop is somewhat helpful, but I don’t see a big difference [between taking notes on the laptop and] hand writing notes,” she wrote in response to a brief survey I conducted at the end of the year to garner students’ attitudes towards technology.

Though Wei showed a great amount of self-directed behavior in accessing the practice tests multiple times, her participation in the Introduction to Biology course, and her course grade, took a significant dive in the second half of the year. Mr. Harris believed this was because of her access into new social circles, which he saw as a negative influence on her academic work. Wei was also under the care of a legal guardian, despite her mother living nearby. Mr. Harris also speculated that issues at home may have impacted her emotional well being, causing her school work to suffer as a result. Unfortunately, I did not have the opportunity to interview Wei about what may have impacted her academic achievement in the class. The fact that Wei rehearsed the practice final exam four times, however, suggests that despite a downturn in her grades during the second semester, she was directed and motivated to achieve a good score on the final exam.

I interpreted the evidence presented above as somewhat revealing of the hegemony of canonical models of education at Bayside High School, specifically assessments. This is significant, given that school mentioned strongly in their rationale for implementing the one-to-one laptop program was that digital technologies provide students the ability to “show what they know” in multiple, non-traditional formats. Indeed, the school believed one of the primary benefits of a one-to-one laptop environment would be a movement from canonical forms of instruction towards student-centered learning.

For the three other focal participants - Reggie, Angelo, and Tommy - the role of the practice tests, and exactly what objective they served, remained in question throughout the study.

These three students only accessed practice tests during assigned in-class activities, and again, the first such activity took place before my data collection began. The nature of this second in-class practice test activity was non-standard, in that Mr. Harris provided access to this practice test at the beginning of the corresponding unit. His intent in designing this activity was to have students generate a list of unfamiliar terms and concepts, which they would then share with the class through a PollEverywhere survey. Tommy, Angelo, and Reggie's participation in this activity was paradoxical, however, and seemed to contradict the assumption that students would be motivated to learn the unit content if they were able to preview what would be on the unit test. Of the three, only Tommy and Angelo took the actual test at the end of the unit. Reggie was absent on the day of the exam, and did not make up the test.

On his first attempt at the practice exam, roughly 25 minutes elapsed between when Tommy began the first question, and when he submitted his final response. At first glance, it would appear that perhaps Tommy had taken the activity seriously, and used his time to investigate terms and concepts that he would learn over the course of the next few weeks. Interestingly, however, the majority of this time was spend on only three questions, in intervals of five minutes, eight minutes, and ten minutes, making up 23 of the 25 overall minutes he used to look over the entire practice test. This means that, on average, Tommy spent only five and a half seconds on each of the remaining 22 questions. Indeed, the large segments of time Tommy did spend on the three questions mentioned above, coincided with time when he left the room (10 minutes), when he retrieved his headphones from his bag, connected them to his laptop, and selected some music to listen to while he took the remaining questions (8 minutes), and a brief interruption by Mr. Harris, who related a personal story to the class about his high school experiences (5 minutes). Mr. Harris did not collect a final list of terms from Tommy at the end of this activity, and as such, it is difficult to conjecture exactly if Tommy did make any mental note of questions or terms that he needed to learn. Weeks later, when the students took the actual unit assessment, however, Tommy scored worse on the multiple choice portion of the exam. His practice test score had been 11 correct answers out of 25. On the actual exam, he answered only 8 out of 25 questions correctly. Angelo fared better, improving from 7 correct answers to 14, but this still resulted in a failing grade on the exam.

CHAPTER 5

DISCUSSION

To implement its one-to-one laptop learning initiative, Bayside Public Schools and the Bayside High School administration sought to establish an infrastructural foundation upon which "21st century teaching and learning" could take place. With a new, high-tech building to house this ambitious program, the school made serious attempts to prepare its community for the struggles and opportunities such a large endeavor would inevitably entail. With a particular focus on integrating technology into the curriculum, the district sought to implement systems that they envisioned would support a digital, 21st century learning environment.

Following, administrators went to great lengths to put forth to the community a message of one-to-one learning that portrayed students from all backgrounds being able to take advantage of computing and Internet technologies to receive a highly engaging, equitable education that made learning a rich and relevant experience. The school provided its faculty with a guidepost, a school-wide technology rubric, for integrating technology into the curriculum, focusing on the areas of digital publishing, data analysis and organization, and multimedia production. With these supports in place, and the incorporation of the Moodle learning management system, the school embarked on its journey into "21st century teaching and learning."

Similar to many institutions that have adopted one-to-one computing programs, Bayside High School grappled with an inevitable culture change; administrators attempted to shift the prevailing orientation of teacher-centered instruction towards pedagogies that were more student-centered, emphasizing the ability for its now technology-equipped students to "show what they know" in a variety of creative and "authentic" formats. One area in which the difficulty of this transition was particularly salient was the management and distribution of power and authority. As with most institutions that must simultaneously grapple with state-mandated assessments, curriculum standards, a diverse student body, and a changing culture, authority at Bayside High School modeled a top-down hierarchy, with administrators acting as the chief arbiters of decision-making, planning, and discipline at the school. Administration tasked the faculty with implementing the state-mandated curriculum into their subject areas, and meeting the school's expectations for integrating technology "into all areas of curriculum, instruction, and administration". As organizers of classroom-based learning activities (including those that would provide students with chances to develop and demonstrate the competencies outlined in the technology rubric) teachers were thusly entrusted to manage their classrooms, and students' learning opportunities, in ways that aligned with the administration's vision, and the mission of the school, "to provide a safe, respectful environment in which all students are challenged to reach their academic and social potential."

While it is possible to imagine a scenario in which the focal instructor of this study, Mr. Harris, was able to leverage his classroom authority to reform teaching practice, and to re-

conceptualize what learning would look like in a student-centered, digitally enhanced environment, this study found myriad structural and social influences impacted his ability to do so. While it may be tempting in this regard to focus attention on teacher perspectives, and the responsibility Mr. Harris carried for reforming classroom culture, providing meaningful and relevant technology integration activities for students, and adapting curriculum to empower students, doing so would formulate a deterministic attribution of digital education inequities to Mr. Harris's own skills and comfort with technology, and with simultaneously managing curriculum and student behavior. Such a formulation would largely ignore the depth of resistance I observed at the student level, both towards the tasks they were instructed to perform on a daily basis, as well as towards the rooted schooling structures that perpetuated a tradition of teacher authority, limited student autonomy, and administrative power to manage student learning.

Early on in the year, a clear struggle began to form between Mr. Harris, the students, and the technology activities he implemented into the Introduction to Biology curriculum. I interpreted this struggle as taking shape predominantly along the lines of authority, autonomy, and power. As Reggie, Tommy, Angelo, Wei, and Carmella seemed to take little interest in participating in the project-based activities Mr. Harris assigned, and approached their work with an eye towards satisficing and "getting it done", a stark tension emerged around the role of technology in supporting student learning, and legitimate participation in classroom. Indeed, the institutionalizing forces that authority and curriculum had on shaping the purpose of using technology for learning were vast, and difficult to confront.

Yet, while it is hard to disassociate Mr. Harris from the technology activities he assigned, and the ways that these activities seemed to reproduce inequities rather than ameliorate them, it is critical to understand the context in which Mr. Harris was authorized to simultaneously carry out the vision of the Bayside High School administration, meet state-mandated curriculum standards, and foster students' science and technology literacy development. For it is these structures, and the privileged practices of teacher-centered instruction that formed much of the historical setting in which student resistance, and learning, took place in this study.

As noted in Chapter 4, with the exception of a few project-based technology activities, class time predominantly centered on standardized curriculum and assessment. In contrast to the Bayside High School administration's prediction that implementing its laptop program would enable students to "show what they know" in multiple, differentiated ways, as well as in contrast to Mr. Harris's own attempts to integrate "fun" and "creative" projects into the course, the students in this study overwhelmingly resisted completing their assigned work with the attention to detail and inclusion of digital "enhancements" that the use of technology was supposedly going to motivate. As the school year began, some of the limitations of this hopeful vision revealed themselves. Amongst institutional pressure to progress through the multiple curriculum frameworks on time, Mr. Harris struggled to meet the individual learning needs of his 28 students, and to ensure that they each learned the biology content that was "most important." To cope with these dilemmas, Mr. Harris

incorporated canonical methods of instruction and assessment into his teaching practice, heavily regulating institutionally- and teacher-defined rules regarding classroom technology use, and as noted earlier, sanctioning fewer action possibilities for students. This had the effect of reinforcing structures of schooling that foregrounded control, power, and discipline, and concomitantly marginalized students' personal feelings about learning and technology. As such, this study found that through a complex intersection of resistance, authority, and control, the laptops served as extensions of institutionalized authority, and of social structures that delegitimized students' interest-driven technology practices.

Again, it is critical to examine canonical teaching practices within the context of institutional structures, rather than as stand-alone attempts at controlling student learning. Technology may afford greater access to learning resources and authentic learning experiences, but as the findings reported in the previous chapter show, the combination of curriculum and scheduling constraints greatly influenced how Mr. Harris distributed authority in the classroom, and his decisions regarding classroom management. This study revealed several examples of how structural elements of schooling and instruction foreclosed such opportunities (e.g., by adopting increasingly teacher-centered instructional practices), and provides a glimpse into why such practices are enacted (i.e., institutional pressures, scheduling, and the insufficient access to support resources).

Following the rules. Rule enforcement, including managing behavior and student interaction, inherently implicates issues of power and authority, and arguably, may foreground control at the risk of marginalizing students' attitudes and beliefs about schooling, especially when those attitudes and beliefs are unorthodox, or challenge established norms of "schooling" culture. Some of the rules Mr. Harris enforced summarily foreclosed opportunities for students to occupy positions of authority over their learning experiences, such as rules forbidding communication between peers and the use of only sanctioned tools. Arguably, these rules inculcate in students a sense of what schooling "looks like" in relation to their cultural selves, and may or may not provide visible roles for them to occupy with regards to interaction or authority in the schooling environment. For example, by regularly reprimanding Reggie for asking questions that were tangentially related to the topic under discussion, and by de-legitimizing his belief that recording notes negatively affected his ability to learn biology content, Mr. Harris effectively established the notion that such behaviors violated the "rules" of participation in classroom activities.

In this way, the enforcement of certain institutionally- or teacher-defined rules also creates opportunities for resistance and opposition, such as the surreptitious use of technologies I observed throughout the year. Rules served as a way to make salient for students what types of technology (and ways of using technology) were "appropriate" within the school context, and those that carried the risk of disciplinary action. It is therefore not surprising that students such as Tommy, who adopted a somewhat anti-authoritative disposition in the class, would come to reject the very technologies that the school institution sanctioned for student learning.

It is no doubt tempting for teachers to adopt more canonical (i.e., teacher-centered) instructional practices that may limit distractions related to unregulated technology use. This has the potential to limit the frequency with, and purposes for, which students use technology, and by extension, opportunities for students to occupy agentive and empowered roles in the classroom. This is especially important with regards to the use of technology in a one-to-one learning environment, where issues of control and monitoring students' actions are increasingly complicated, and potentially serve to institutionalize technologies, rather than treat them as emancipatory or empowering. As such, by enforcing rules that regulated student participation in activities, students experienced fewer opportunities to occupy agentive or empowered positions in the class.

Being on task. When I asked Mr. Harris 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 "open-ended" assignments without greater instructional support to both keep students on task, and attend to the range of students' individual learning needs. Mr. Harris spent a great deal of time giving students individual attention, and scaffolding them through assignments (sometimes because students had forgotten how to use certain technologies, or had no familiarity with the tools at all). This was exacerbated by students' tendency to ask Mr. Harris for help before thoroughly reading the instructions he had prepared ahead of time. All of this is to say nothing of the disciplinary measures Mr. Harris frequently enacted to maintain a type of productive learning environment he felt was necessary for his students.

A common instructional method (and perhaps classroom management strategy) was for Mr. Harris to check in with individual students throughout the entire duration of in-class activities. His method of floating around the room arguably created opportunities for some students to socialize, play video games, and surf the Internet as his back was often turned, and his attention occupied with answering questions. Sometimes, students would seemingly push the boundaries of Mr. Harris's patience, talking too loudly, or being conspicuously off task, which compelled him to respond, and reprimand the offending student(s). Thus, Mr. Harris spent a significant amount of time and energy managing the classroom, in terms of both learning and behavior, throughout the year. According to Mr. Harris, the combined lack of planning time, and the effort required to control student behavior, diminished his ability to design or implement more "open-ended" activities. As the Spring semester unfolded, Mr. Harris took on a sixth class (a section of Web 2.0 and Presentation), increasing is teaching load further, and subsequently further reducing his lesson planning time. His assignments became noticeably more structured during this semester. To deliver content, he used lectures and note taking activities more frequently. More online activities were used, guided by recipe-like worksheet guides, which asked students to locate and answer specific, pre-configured questions about the content. Mr. Harris himself lamented these practices, which, again, were ways of coping with time constraints and student behavior.

The fact that classroom activities increasingly incorporated canonical pedagogic practices made it tempting to draw causal lines between teacher centered practices and students'

technology use. Yet doing so would have overlooked the very strong influence students' themselves had on how learning activities played out.

An integral aspect of student-centered learning is a shared autonomy among teachers and students to create and engage with subject matter on negotiated terms. While many of these opportunities were systematically foreclosed due to the effects of institutional structures (i.e., curriculum and schedule) on instruction, Mr. Harris did attempt to integrate student-centered learning activities into the course, primarily in the form of production-oriented- and multi-media projects - areas that the school presumed captured some of students' interest-driven technology practices (Ito, 2010). Yet, as Larson, et al. (2013) propose, simply creating assignments or "pointing to" opportunities to make use of digital media do little to motivate students who have little access to either mentors or other networked resources, or to structures that support their *own* interest-driven activities:

> When young people lack local social networks and institutional support for the learning they care about, they rarely take full advantage of the learning opportunities afforded by today's online information or social and interactive media. Research has demonstrated that it is only exceptionally motivated and resourceful young people who are able to pursue self-directed and interest-driven learning without the support of adult mentors and learning institutions (Ito et al. 2009, 2013). (p.8)

The fact that the focal students themselves seemed to hold little interest in participating in school-managed activities supports Larson et al.'s findings.

Authority and rule enforcement. The frequency and purpose of technology use form the foundation upon which digital empowerment is built (Hohlfeld et al., 2008). By resisting the division of labor ascribed to them during in-class technology activities, the focal students in this study disrupted not only the aforementioned hopeful vision of one-to-one learning that the laptops were meant to produce, but the purpose of many of the activities Mr. Harris assigned, which were often geared towards learning biology content through the use of supposedly "fun" and "creative" digital media. Through two primary forms of resistance (not doing the work, and satisficing assignments), students avoided engaging with course content on Mr. Harris's terms (chiefly by "Googling" answers and copying each other's work), and neglected to plan out effective ways of distributing labor amongst themselves. Rather, students often chose to socialize, check their cells phones, and play video games – demonstrating a resistance to the teacher-defined division of labor in these activities, and cultivating practices of their own which would become unsanctioned, and worthy of disciplinary action.

While students' attitudes towards using the laptops suggested a level of disinterest in following the prescribed ways of engaging with the biology subject matter that Mr. Harris intended, their "just get it done" approach to much of the assigned work, toiling to simply meet assignment requirements despite encouragement to be creative and to "have fun" with the production process, simultaneously demonstrated an acknowledgement of the

privileged practices of schooling that they were expected to perform, and a passive form of resistance to those practices. Indeed, during activities in which students satisficed assignments, an analysis of activity systems revealed tensions between students' situated actions, and those envisioned by Mr. Harris. In particular, students negotiated (or "bridged") the mediating artifacts of activities; rather than using the most *effective* tools to accomplish the goal of learning biology content, students adopted the most *efficient* tools to mediate their ability to satisfice assigned work, such as Google, WikiAnswers, AirDrop, Siri, etc. By adopting these tools to achieve teacher-defined learning goals, but through processes that shortcut the intended trajectories of discovery and knowledge construction, the focal students destabilized the vision of one-to-one learning that Mr. Harris and his superiors tried to realize. By satisficing assignments, students undermined the student-centered division of labor Mr. Harris hoped to achieve - a shared, distributed authority that would motivate students to "own" their learning, and the biology content. Recognizing this, Mr. Harris felt compelled to implement measures that *assured* students engaged with the content in specific, directed ways.

From the perspective of the Bayside High School administration, these outcomes may have seemed surprising, or to even contradict predictions that allowing students to "show what they know" in a variety of formats would somehow motivate *all* students to engage in classroom learning exercises. Indeed, the picture that was painted in many of the public relations materials leading up to the one-to-one laptop learning initiative rollout portrayed an image of a school that was ready, even eager, to embrace computing as tool for learning. But this orientation calls into question the assumptions school administrators and teachers make about integrating technology, even supposedly "fun" and "motivating" technologies, into the classroom.

Whether students actively rejected taking up roles of authority, or simply were not equipped to, leads to two very different implications for teachers. The first suggests the possibility that long-standing cultural attitudes and beliefs about schooling and social class may affect students' engagement in formal learning environments, while the second suggests that teachers may need to scaffold students into roles of authority. Both suggest that technology-mediated student-centered learning environments are more difficult to achieve than simply by providing access to knowledgeable teachers, laptops, and Internet resources.

Despite access to rich technology resources, Mr. Harris was left feeling that he needed to dictate many of the terms of technology use (including which tools, websites, and activities would be sanctioned), and suppress students' ability to challenge or undermine those terms. These actions had the result of foreclosing opportunities for students to negotiate their schooling experiences. For students such as Reggie, who are compelled by their own curiosity and passion for learning to engage with school-based subject matter, but whose ways of engaging endanger teacher authority and control, foreclosing opportunities for the negotiation of epistemic and logistic authority risks overlooking student skills and literacies

that may not appear on assessment scores. Such cases are prime examples of social reproduction, and unfortunately, of digital education inequities.

The intersection of competing objectives seemed to cause Mr. Harris to manage the arrangement of classroom, especially technology-based activities, in a way that limited student control. Indeed, the overwhelming sense that he could not provide enough direct instructional support on his own and simultaneously progress through the entire state-mandated biology curriculum greatly impeded Mr. Harris's willingness to assign open-ended activities in which he and his students shared epistemic and logistic authority. As a result, Mr. Harris searched for ways to retain control over student behavior and learning, which had the effect of turning activities that were originally intended to motivate students to take on creative, self-directed positions, into activities that closely resembled canonical models of instruction - teacher-generated tasks that required students to produce artifacts for an audience of one: the teacher. Student's orientation towards satisficing compounded the issue, and served to produce a dilemma for Mr. Harris, which he by and large selected to cope with by implementing greater control over the learning environment. In this way, Mr. Harris began a process of institutionalizing authority in the classroom.

Institutionalizing authority. Almost inevitably, the distribution of power and authority in school systems tends to intersect with teaching and learning in ways that position individuals in multiple (and sometimes conflicting) roles (Giroux, 1988). Despite an obviously knowledgeable background in technology, and a capacity to make use of a wide range of learning technologies for instruction (e.g., CAD, Google Docs, Moodle, PowerPoint, GarageBand, in addition to a number of online resources), Mr. Harris, as noted earlier, experienced significant dilemmas of practice at both the institutional level and in the classroom. These dilemmas had the effect of influencing Mr. Harris's teaching, and subsequently affected both the frequency and purpose with which students used technology, and the opportunities students experienced to hold authority over their learning. The demands of the rotating daily schedule left little time for Mr. Harris to experiment with various models of instruction, or to edit or create teaching materials that might have better suited the learning needs of his students, and an attempt to cope with the dilemma that a lack of time and an overwhelming workload created for him, Mr. Harris turned to appropriating teaching materials from colleagues and the Internet (such as lecture slides and worksheets) that he lamented were either too text-heavy, and did not lend themselves to constructivist pedagogies. In this way, institutional structures had the effect of influencing Mr. Harris to not only compromise learning materials in favor of creating a more manageable workload for himself, but of managing what content students would access and engage with for learning the biology curriculum.

As mentioned earlier, student resistance to fulfilling the teacher-defined division of labor (again, in lieu of the institutional dilemmas just described) further complicated things, placing Mr. Harris in an arguably difficult situation to manage. Whereas Mr. Harris could do little to control the curriculum he was supposed to implement (or the tools with which he was endowed to implement them) the traditional structuring of classroom relations at

Bayside High School privileged Mr. Harris to (at least attempt to) control how students engaged with the biology content. Without institutional restrictions or guidelines mandating either specific pedagogies or student-centered classroom activities, perhaps the best option that appeared to Mr. Harris was to use his power to manage student authority and autonomy.

Indeed, neither topic of student authority nor autonomy received very much attention in the school's official one-to-one policy documentation or its public relations materials. Though presumably sanctioned for instruction, the apparent lack of discussion of these topics calls into question just what roles the administration envisioned for students to take up in the one-to-one laptop initiative. By extension, a lack of discourse around the function or practice of authority and autonomy in student learning did little to suggest to Mr. Harris and his colleagues what roles teachers should make available to students, and instead, left such decisions up to the teachers themselves. As such, learning, and the activities surrounding technology use in the classroom, were predominantly "adult-managed" – both arranged and integrated according to teacher beliefs. Hence, the business of effective technology integration primarily implicated school leadership, administration, and faculty – *not* students. Though perhaps a minor concern, I interpreted the lack of institutional discourse, as well as the lack of instructional support directed at implementing authoritative and autonomous roles for students into classroom activities as compounded the pressures Mr. Harris felt to manage both the biology curriculum, and as the year progressed, student learning.

Student-centered- and other reformist pedagogies propose that students and teachers should share authority in educational settings, making the process of learning relevant to the students' lived experiences. In turn, these pedagogies argue for a shift in the role of the classroom teacher from one that is traditionally didactic, to one that more closely resembles mentoring or facilitating student learning. **"**Connected Learning," (Ito, et al., 2013) a growing movement of progressive reformists who focus primarily on using the power of Internet technologies to mediate learner-centered, interest-driven activities, further argue that "environments [that] draw together youth and adult participants in *joint* activities that have defined purpose, goals, and collaborative production" (Martin, 2014, p.18) (emphasis added) promote higher-order learning outcomes, such as those outlined by the Bayside district administration, and even larger organizations such as the Partnership for 21st Century Skills (e.g., critical thinking). Yet, as the integration of technology unfolded in the Introduction to Biology class over the course of the year, it became apparent that despite attempts to introduce student-centered learning practices to the class, Mr. Harris ended up relying on canonical practices of teaching that emphasized individuation and control over collaboration and shared authority. These practices included assigning individuated tasks, using lecturing/note taking as the primary vehicle for students to learn biology subject matter, and distributing recipe-like assignments that directed students towards what was "most important" to learn.

This was influenced in part by institutional pressures geared towards the implementation of state-mandated curriculum, on one hand, and on the other, tensions in the classroom involving student behavior, multiple learning needs (and a lack of instructional support to meet those needs), and a seeming unwillingness on the part of students to take seriously several opportunities to hold or share authority over their learning. The persistence of these issues inevitably served to influence Mr. Harris's decision to enact canonical practices (e.g., students seated in rows, facing forwards, paying attention, and following directions) in order to manage student learning, at the expense of doing "open-ended," project based assignments. In other words, as the focal students (and others in the class) resisted taking on their teacher-defined division of labor, Mr. Harris responded defensively, in ways that reserved authority for himself and his agenda.

The events I observed during project-based assignments (distracted and resistant students, socializing and "off task" behavior), are not uncommon aspects of classroom life, and for education reformers whose attempts to provide opportunities for autonomy and student-centered learning environments are met with questionably "productive" student behavior, the examples presented in Chapter 4 represent a larger question about the arrangement of classroom activities, and the privileged discourses of schooling (i.e., teacher authority, individuated class work, and individual achievement). Indeed, the tensions that resulted around student resistance to logistic and epistemic authority incite deeper questions around how students interpret authority as "naturally" teacher-centered, and how and when students take up opportunities to occupy authoritative positions in school. Other research has suggested that students from non-dominant backgrounds are enculturated into certain practices and power relationships in school that reproduce the centrality of teacher authority, such as sitting quietly out of respect (Ito, 2010). In this regard, it begs examination what barriers students experience when they are expected to occupy authoritative positions and to carry out their own learning, and how they resist *opportunities to challenge* these barriers.

Resisting opportunities to hold authority. The fact that student resistance seemed to pervade project-based activities, and that Mr. Harris in turn selected coping strategies that essentially revoked student authority (as opposed to scaffolding students into authoritative roles) suggests, I believe, the possibility that "authority" and "learning" may have been disconnected pedagogical concepts for both Mr. Harris and his students. This in turn, I believe, also suggests the possibility that authority was largely seen as a social practice that was reserved for teachers to wield, and could only to be shared with those students who attained great amounts of cultural (i.e., academic) capital.

Tommy's seeming disinterest in working on the Evolution poster project (for which he selected to research the topic of cell phones), for instance, was somewhat paradoxical in light of theories that suggest students are both inherently motivated by, and experience higher-order learning outcomes by having the authority to autonomously explore topics of personal interest in classroom activities. In this way, Tommy's resistance to the division of labor (i.e., authority) in the Evolution project was arguably similar to cases of observed

resistance to the privileged practices of schooling discussed by cultural anthropologists that found resistance to institutional structures represented acts of individual agency, and a way of identifying oneself with underrepresented, marginalized, or disenfranchised cultural communities (Eckert, 1989; Willis 1977).

Likewise, Angelo and Reggie seemed to approach opportunities for holding authority with a level of disinterest, laissez faire, or resistance to, "playing the game" of schooling (i.e., producing culturally irrelevant artifacts, conducting research on topics related to top-down curriculum, and making use of only sanctioned resources). Indeed, perhaps because Mr. Harris defined logistic and epistemic authority still within the bounds of sanctioned topics, a narrow set of mediating artifacts (e.g., social networking sites were largely unsanctioned, and even forbidden at Bayside High School), and enforceable rules (e.g., working quietly), the relative "openness" of project-based activities to structured activities still failed to disassociate these activities from the canonical activities (e.g., assessment and individuated tasks) with which these students had possibly difficult historical relationships (i.e., failing grades, disruptive behavior, marginalized perspectives, etc.). In other words, despite being given a greater amount of authority to conduct learning in more flexible ways, project-based activities still represented aspects of institutionalized education - arguably the same system that created the opportunity for these students to be made to feel academically and intellectually inferior on a regular basis. In this sense, rather than seeing their division of labor as "ownership," Tommy, Angelo, and Reggie arguably still perceived epistemic and logistic authority as "institutionalized."

Institutionalizing the laptops. While there is nothing inherently inequitable, faulty, or corrupt with teacher authority (arguably, scaffolding students into roles of autonomy and in the development of self-regulated learning practices requires a bit of teacher-centered authority in terms of facilitation and mentoring), it became apparent that Mr. Harris tended to use his authority to manage students' learning, especially their *productivity*. This speaks volumes to assumptions about what constitutes productive learning, and which practices (i.e., goal-directed activity or "messing around") are privileged in the classroom. Indeed, "productivity" (as opposed to "production") itself connotes certain cultural ideals, especially with regards to formal education settings, where "messing around," "frivolous searching" (Ito, 2010), and "off task" may be seen as distracted behaviors, and antithetical to the learning process.

As such, though the intent of the laptops was to mediate higher-order learning goals, it became clear that the laptops were used to mediate student productivity, especially when used for taking notes or finding and organizing information. By using authority to manage student productivity, Mr. Harris arguably evoked practices that aligned closely with privileged institutional perspectives of schooling. As such, I see Mr. Harris's attempts to manage student productivity, as largely "institutionalizing" the laptops to support teacher-defined objectives.

It is significant to note that such examples of productivity contrasted with students' own tendencies to use technology to "mess around" (Ito, 2010) in class. Messing around is

defined as "…a genre of participation that is driven by young people's own interests and motivations" (Ito, p.62), and incorporates practices that would typically resemble notions of unproductive classwork *if unrelated to course content*: finding information on a topic of personal interest, learning how various media and tools related to those interests work, and seeking out resources to learn more about those interests. All of the focal students, at one time or another, and often frequently, participated in "messing around" in this way, yet students often tried to hide these practices from the view of Mr. Harris. This suggests that the students perceived that the laptops as closely tied to institutional structures and were only to be used for approved academic purposes.

Yet, using the Google search engine to find information related (and unrelated) to biology content, copying and pasting text and images into their poster projects, and appropriating and modifying other digital resources all constitute technology practices that have aspects of self-directed learning and "[provide] young people with a sense of agency, often exhibited in a discourse that they are 'self-taught' as a result of engaging in these strategies" (Ito, p.57). As low barriers to entry, these practices thus also constitute legitimate participation in social spheres that may exist outside of school, such as was evidenced by Carmella's interest in perusing Minecraft forums for gaming strategies. That such practices were largely considered "unsanctioned" and "off task," and typically earned students more in the way of disciplinary action and public humiliation than agency and empowerment, further suggests that the laptop use was reserved for only sanctioned, and thus institutionalized, practices.

As Ito (2010) notes, "messing around" resembles more "open-ended," rather than goal-directed activities. In perhaps the most telling evidence of how the laptops came to represent institutionalized devices, Mr. Harris reported that he could not allow for students to engage in such open-ended activities, because of Tommy's, Angelo's, and Reggie's unproductive habits and tendencies to "get lost" in the assignment. Opportunities to mess around, and participate in other open-ended genres of activity, were thus explicitly foreclosed.

Technology as a rule of activity. By shifting the division of labor from one that resembled student-centered activity to that of more teacher-centered arrangements concomitantly altered the location of technology in the activity system from mediating artifact to rule. This was evidenced in several ways, but perhaps most saliently by students' approaches to note taking. As noted in Chapter 4, Carmella, expressed disbelief that the laptops actually provided much of an advantage over handwriting notes, Reggie simply did not take notes at all. For both students, using the laptops for note taking served more as an institutional mandate than any emancipatory or agentive function. That fact that the laptops served as a rule of activity reified the notion certain technology practices were "highly valued," while others, such as messing around, were not. As such, taking notes with the laptops came to represent a form of compliance with institutional expectations.

Conversely, because technology use was an *institutionally defined* rule of activity, questioning the usefulness of technology to support the learning of content therefore

represented a form of *resistance*. The marginalization of this resistance was evidenced strongly, and in two ways. First by Mr. Harris's overt denial of Reggie's attempts to explain why note taking did not support his own learning, and second, by Carmella's demonstrated *compliance* with note taking in spite of admissions that using the laptops provided few advantages over taking notes by hand. These findings complicate the assumption that providing students with one-to-one access to computing technologies and the Internet inherently motivates them for academic achievement, especially when "learning" is seen as something akin to producing artifacts for teacher-defined goals. As such, if students interpreted the role of technology as largely serving institutional interests, it may have been difficult to imagine how school-related technologies could be used agentively, or to serve their own academic interests.

For Tommy, who was reluctant to engage with curriculum independently, technology arguably acted as an obstacle to learning rather than a tool for productive agency and empowerment. As I observed Tommy's seemingly negative approach to schooling and academic technology use throughout the year, I grew increasingly wary of the possibility that the repetitive nature with which the laptop occupied the rule node of activity, might have served to inculcate a sense that academic technology represented an extension of institutional forces, rather than an emancipator from them. Though Tommy admitted to having negative opinions about using the laptop, he paradoxically enthused at the same time when talking about his cell phone. This negated the potential that Tommy was simply "technophobic," and unwilling to see the benefits of using technology for personal interests. This is not to say that, had the school not implemented a laptop learning program, Tommy would have excelled in his coursework - his academic history suggests that he would have still required much instructional support and many learning accommodations. But whereas the intent of the laptops was to make learning more accessible to all students at Bayside High School, its implementation seemed to cause more challenges for Tommy that it alleviated. I believe these challenges served to further marginalize Tommy, as his inability to accomplish the majority of classroom activities - especially those in which technology played the primary mediating role - led to poorer academic performance, and thus, an even lower amount of cultural capital in the eyes of the Bayside educational institution.

In all of the cases just mentioned, technology use was employed as a means of enforcing an institutionally-defined agenda to deliver curriculum, as well as for managing student learning. Though the laptops were not always used to mediate such teacher-driven goals, the pervasiveness of technology use for assessments, note taking, and structured activities suggests that the laptops served as tools to support canonical structures of schooling *the majority of the time.* Not only did the focal students have arguably tenuous historical relationships with these structures, but the fact that the laptops served predominantly to support canonical modes of teaching suggests the possibility that the laptops came to be seen as instruments of institutional goals, and not personal learning devices. This further complicated what I saw as a dichotomy in students' interpretations of what "counted" as learning in the classroom – namely, either following the teacher's instructions, or pursuing one's personal interests.

Institutionalizing what "counts" as learning. From an ideological standpoint, student-centered instruction implies that teachers and students must be willing and equipped to 1) share similar goals for participating in the activity, and 2) share the division of labor. As noted above, students' orientation towards many of the activities Mr. Harris assigned pointed towards either "getting it done" (e.g., satisficing assignments), or demonstrating one's compliance with institutional expectations. Though Mr. Harris explicitly endorsed neither of these objectives, certain instructional practices may have contributed to students' perceptions that testing and assessment (both canonical modes of schooling) counted as the most highly valued examples of "learning," with satisfying assignment requirements (i.e., "getting it done") following closely behind. The practices that I saw as contributing to these perceptions include providing and repeatedly encouraging students to make use of practice tests, frequent formative assessments, lecturing, and lastly, multiple-day long project work.

As systems of activity, lecturing and testing held many similarities. Both foregrounded individuation, both gave primacy to the memorization of content (e.g., definitions of terms), and both reinforced the idea that for each science question, there existed a single "right" answer. Further, both activities provided very few roles for students to occupy, or to engage with the subject matter. Both were also highly structured, encompassing, often strict, rules regarding appropriate behavior. For instance, interacting with peers or even using the computer (or worse, cell phones) to look up relevant information was discouraged, if not forbidden, as such things were considered "cheating" during tests, and "off task" during note taking. Finally, both assessment and lecturing are hallmarks of canonical pedagogies that have been shown in the past to systematically marginalize non-dominant students and their lived experiences. In this sense, the prevalence of assessment-oriented activities (as well as activities that emphasized individuation) structured student learning in ways that suggested what was most valuable with regards to their time and experience in the classroom. Students may therefore have seen open-ended, unstructured, and multi-media production activities that emphasized creativity in addition to content as less important (with regards to achieving academic success) than passing a test. It is therefore worthwhile to consider the potential effects of these canonical modes of schooling on students' classroom dispositions, in particular on their readiness, and on their willingness, to share epistemic and logistic authority with teachers. For example, Reggie and Angelo both demonstrated a level of disinterest in fulfilling the divisions of labor they were ascribed during project-based work, as socializing and the use of "epistemic shortcuts" undermined the (teacher-defined) purpose of distributing authority among students. Yet, the fact that they foregrounded "getting" answers over knowledge production seems to support the notion that both saw testing and assessment as more highly valued in terms of passing the class (which they both reported was a goal of their enrollment in the course).

Reggie, Angelo, and Tommy mostly turned in incomplete assignments, and made little use of the technical "enhancements" that would have earned them high marks on the school-wide technology rubric. Indeed, as I observed the rest of the students in the Introduction to Biology class over the year, I became well aware of how little they, too, used resources to "enhance" their learning artifacts. Instead, most student work tended to exhibit an

orientation towards doing the minimum amount required to achieve a passing grade or a 3-rating (passing) on the technology rubric. This suggests that it was not only the focal students who may have perceived project work and in-class assignments as less valued than tests. Thus, a paradoxical theme emerged in my observations: that even well-meaning, progressive, attempts at implementing a curriculum that would prepare the children of Bayside for civic engagement and participation in a global economy, did not necessarily disrupt for students the notion that incorporating "technical enhancements" into one's work "counted" as learning as much as "getting the right answer," and that both were meant to serve as outcomes of higher-order learning processes, not ends unto themselves. Technology thus served as a means for shortcutting teacher-defined processes rather than "learning", and essentially allowed students to "skip to the end" without engaging with the biology content. Many times, students congratulated themselves and each other by simply producing answers (even sometimes when they were incorrect), or finishing an assignment in class while there was still time left in the period. These self-congratulations often preceded socializing, the checking of one's cell phone, or other "off task" activities, which were unsanctioned in the class. In this sense, "learning" for many of the students, equated to accomplishing teacher-defined goals, *by any means*, and not necessarily through self-directed research, creative production, or reflection.

Doing the work faster meant more time to socialize, "mess around," or play - activities in which the students appeared highly interested in participating. Technology could mediate that process, and many times, students found ways to shortcut the intended learning process by Googling answers, or as Tommy and Angelo reported, using unsanctioned features of the laptops and their cell phones to share work and cheat on tests. Though Tommy and Angelo seemed to pay little attention to their assignments, and often resisted working when Mr. Harris granted them authority during projects, when they did appear motivated to participate in class, the object motivating their participation was often to "get it done" - a stark contrast to the higher-order objectives Mr. Harris and the Bayside High School administration promoted at the beginning of the year. As such, despite access to the laptops, and opportunities to hold authority, Tommy and Angelo appeared somewhat content to participate in schooling in traditional ways, rather than disrupt the paradigm of teacher-centered, teacher-directed, teacher-controlled learning.

That the focal students in this study did not respond to the laptops in the motivated, excited, engaged ways the school administration predicted (in spite of their apparent interest in personal technology devices and the use of Internet resources to participate in personally-relevant activities) suggests that the arrangement of school-based technology activities, the flexibility of technology resources (e.g., level of interaction), and students' own long-held conceptions of what "schooling" and "learning" look like, all conspired to create a situation in which the academic use of technology arguably represented an extension of school structures, and at times, something to be resisted rather than embraced. As such, by seeing the laptops as institutionalized tools of learning, the focal students would have experienced a great level of difficulty seeing themselves as newly empowered members of a knowledge-building community, or that school-based "learning" equated to something resembling the

construction of knowledge, and not the recitation of facts. The sole exception to this was Reggie, whose insistence that teachers should "inspire learning", and attempts to engage in group discussions without having to take notes, represented potential challenges to the status-quo (these attempts, again, were publicly de-legitimized).

Paradoxes such as these are difficult enough to theorize, but developing pedagogical strategies to overcome the challenges that confronted students' participation in schoolwork was far more daunting a task. During our end-of-the-year interview, Mr. Harris lamented that his ability to implement more "open-ended" or constructivist activities was limited because of the personal attention Tommy, Angelo, and Reggie each required because of their reluctance to engage with activities in prescribed ways.

> MH: And conversely, I don't know if you noticed- like, the open-ended assignments that I could have done, were dr- dramatically limited.
> N: Mm hmm.
> MH: Because I couldn't let Tommy, and Angelo, and Reggie on an open-end assignment, because Reggie would go all over, Tommy would get lost, and ask to go to the bathroom to, you know, go smoke, and Angelo would be hitting on all the girls.

As noted earlier, these sentiments influenced Mr. Harris's decision to enact tighter control over student learning. As such, authority over the learning environment remained reserved for Mr. Harris and the institutional agenda of curriculum implementation. By reserving the classroom for only teacher-sanctioned learning activities and tools, little was done to destabilize traditional notions of "what counts" in the classroom. As such, students' non-school ways of learning, and the tools they used for active participation in non-school communities, were arguably overlooked, as there existed few (if any) points at which students' non-school learning practices could enter into the teacher-sanctioned realm of the classroom.

What "counts" as legitimate participation. The "community" node of activity includes all the subjects who share *the same* goal for participating in an activity, as regulated by the rules and division of labor. As mentioned earlier, community is closely associated with Lave and Wenger's (1991) notion of the "community of practice." As communities of practice unto themselves, formal learning environments such as classrooms adopt and develop ways of "doing school" that entail the construction of particular social structures that influence the establishment of behavioral rules, as well as how commonly shared goals are accomplished (the division of labor). Legitimate participation in such a community thus entails both recognizing (and adhering to) rules and expectations, as well as performing the duties necessary to achieve those goals. In the Introduction to Biology classroom, students had arguably few points of entry to negotiate either the rules of behavior or the division of labor in legitimate (i.e., non-resistant) ways. As such, legitimate participation was predominantly influenced by institutionally-mandated, as well as historically-defined, ways of "doing school" that preceded the implementation of the still-young Bayside High School one-to-one laptop program. Despite the administration's interest in using technology as a

lever for developing what it considered critical 21st century competencies, and for having students "show what they know" through multiple formats, that data presented in Chapter 4 suggests that issues related to curriculum, authority, and students' dispositions towards learning (as well as towards use technology for academic work) clouded this path. Indeed, as evidenced above, Mr. Harris felt compelled to manage student learning in ways that foregrounded progressing through the curriculum over the implementation of "open-ended" project-based activities, which the focal students seemed to resist completing despite having access to more autonomous participation.

As the scope of student autonomy and authority narrowed, the picture of legitimate participation in classroom activities arguably grew increasingly constrained. Mr. Harris seemed to rely on creating standard pathways for student learning; content was delivered through the use of lectures and worksheets, students received the same assignments and were expected to engage in the same activities, and all students took the same assessments, which involved a mixture of multiple-choice and short open response questions. By standardizing the learning experience in this way, Mr. Harris arguably provided students with a very narrow spectrum of roles to occupy in the class. And as such, the rules and division of labor that regulated a specific image of what constituted being a "student". By extension, this also regulated the proximity of students' actions and behavior to a constructed view of legitimate participation, or in other words, the arrangement of moments for children to be recognized as legitimate "students". If "learning" is what students do, then, "what counts" as learning in the Introduction to Biology class constituted the goal-directed tasks Mr. Harris ascribed during various assignments and activities. This supports the notion that the arrangement of many in-class activities privileged teacher-centered, canonical schooling practices (e.g., assessment, getting the "right" answer, working quietly, always being on task, etc.), and arguably marginalized practices that either contradicted, or did not align with, teacher-centered or canonical ways of doing school. As such, opportunities for students to be empowered through the use of technology were limited at best, as such opportunities were systematically foreclosed by institutionalized social structures.

Interestingly, despite the implementation of teacher-centered activities, and a limited amount of epistemic and logistic authority, students at times used the organization of rules, division of labor, and mediating artifacts to carve new ways for themselves to participate in *interest-driven* activities that, though predominantly hidden from view, contested privileged assumptions about learning and being "on task".

Students' hidden literacies. Examples of students performing interest-driven learning 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. Tommy and Angelo were especially interested in finding ways to "play" the system to their advantage, and to find answers, share work, or otherwise "cheat" without engaging with the biology content (at least they content Mr. Harris approved).

Carmella, on the other hand, was typically "on task," but on occasion, I observed her browsing Minecraft fan forums. To my knowledge, she did not at any point make it known to Mr. Harris (or her peers, for that matter) that she took an interest in online gaming. Thus, when browsing the Minecraft forums, Carmella's actions resembled "hiding in plain sight," (Ives, 2011) - a mean of hiding one's actions against the backdrop of the classroom. By surfing the Internet during individuated, computer-mediating tasks, Carmella could appear "on task," and thus avoid reprimand. Several of Mr. Harris's students displayed a similar pattern of behavior, using the "spaces" feature to swap applications between sanctioned resources and unsanctioned websites or games. The ability to quickly transition between the two (especially by appropriating novel technologies) suggests in itself that Carmella and others were in fact performing rather literate technology practices. The fact that students performed these activities surreptitiously only underscores the notion that such practices were essentially forbidden, and constituted breaking the rules. By extension, this left institutional support for such literacies very much limited, or even absent from the focal students' learning experiences.

Summary. The purpose of this study was to examine the activities that students engaged in with technology, with a specific focus towards tensions that may have afforded or inhibited learning and empowerment through technology use. Yet, despite demonstrating great interests in using technology outside of the purview of the classroom, the focal students reported seeing little educational value in using the laptops for learning the biology curriculum, effectively destabilizing mythologized assumptions about the inherently positive aspects of schooling technologies. On its face, satisficing assignments and surreptitious technology use appeared similar actions that others have described as "resistance". Yet, qualifying students' shortcutting of research processes, their willingness to share work with each other in unauthorized ways, the Googling of answers (as opposed to more rigorous research methods), "just getting it done," and appropriating tools for unsanctioned uses as resistance is perhaps a contentious use of a term that has come to imply a range of dispositions towards authority. "Resistance" in education research typically connotes *oppositional* attitudes. Satisficing was not overtly oppositional in that, in a way, students clearly understood (and to a degree, observed) the institutionally-defined rules and expectations for behavior, as well as the roles they were meant to occupy as students in the classroom. Just as well, the surreptitious use of technology was not inherently oppositional towards teaching practices, or classroom activities. Rather, students seemed eager to incorporate their personal interests and lives into the classroom experience. Perhaps the understanding that doing so would earn them disciplinary action suggested that such actions needed to be hidden from the teacher's view.

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 "schooling". 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 - not incorporating their personal lives into the classroom context. This seems to expose a dichotomy in the beliefs of students that their classroom lives and their non-school lives are separate, and valued differently in the classroom. The assumption that students would take up the use of the laptops to bridge their personal lives and school did not appear to take into account that such dichotomies would exist, or would be difficult to deconstruct.

Canonical teaching practices such as note taking and assessment represent easily-seen examples of practices that serve as entry into the schooling community. Rules mediate the relationship between activity subjects and the activity community, so it is therefore important to interrogate what rules and expectations serve as disenfranchised students' entry points into the schooling community of practice. As stated above, during lectures and assessments, the rules and expectations for student behavior were easily observable: sitting quietly, using appropriate tools, and staying on task. Pulling back a bit from this perspective, however, it becomes more clear that these behaviors are privileged ways of "doing school" that are, in fact, continually enforced, as they were in the Introduction to Biology class. It is also important to note that these rules are institutionally defined, rather than emergent norms of social behavior that take into account students' cultural experiences and dispositions. As such, rules represent privileged standards to hold student behavior against. As these rules become part of the fabric of schooling, they also become excuses for marginalizing (or punishing) "anti-normative" behaviors. Thus, students must adhere to the defined rules of behavior to gain legitimate entry into the larger community of practice.

Conclusions

This study yielded two systemic tensions affecting the frequency and purpose of students' technology use throughout the year. The first tension regarded the role of technology itself. Whereas the institutionally defined role of technology (a vision of technology use which Mr. Harris shared with administrators) identified technology as a tool to mediate students' engagement with curriculum, the focal students approached the academic use of technology as a rule of activity. This was most apparent during lectures and note taking activities, but was also demonstrated during open-ended, creativity-based activities, such as poster projects and the one audio podcast project assigned to students during the year. Notably, this "rule-based" approach to use of technology for academic work strongly contrasted other students' (i.e., those from culturally-dominant backgrounds) views of the laptops as integral to the development of self-expression and organizational skills.

The second systemic tension revolved around conflicting epistemic orientations towards the activities themselves, and the completion of assigned work. Despite clearly defined objects for various activities, typically involving the learning of biology content, the focal students routinely approached in-class work as an object unto itself. Hence, "getting it done," or satisficing assignment requirements, became a way for students to undermine the purpose of certain activities, while still "doing work." As Mr. Harris grew increasingly aware of his students' tendencies to shortcut assignments, and to utilize their autonomy during less-structured activities to socialize, play video games, and listen to music, he implemented greater control measures to enable closer management of student learning. 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.

Technology determinism. The Bayside High School administration forecasted that the laptops would act as a bridge to authentic learning experiences, enabling students to "show what they know" in ways that mirrored their lived experiences. Not only did translating this image of technology use into classroom practice entail the coordination of infrastructural supports to maintain ubiquitous access to functional equipment and the Internet, but it also meant that teachers would have to interpret the utopian messages of education reform delivered by the administration, and figure out how to incorporate technology into a new vision of learning. The somewhat deterministic assumption that students would easily, and eagerly, take up these technologies, use them to appropriate cultural texts, and produce personally meaningful knowledge artifacts, arguably set up an unproblematic, and perhaps unrealistic, expectation of how technology use at the school would unfold. Despite teacher training and professional development, a high-tech infrastructure designed to support anytime, on-demand access to the Internet, and well-meaning instructors who sought to make learning at Bayside High School more relevant to the lives of their "digital generation" students, administrators did not seem to take into account the complexities of student resistance and the deeply ingrained beliefs students brought with them regarding education, schooling, and authority.

Though many students did indeed seem to enjoy using their laptops for learning activities, the findings presented in the previous sections suggests that effectively implementing one-to-one computing to support the growth of disenfranchised students' agency and empowerment is a far more complicated endeavor than simply providing access to technology, or even to well-trained, technology-competent teachers. Even the robust technology infrastructure that was integrated into the planning and design of the new Bayside High School building itself did not mean that students and teachers would realize progressive, 21st century learning opportunities.

A critical project of digital education inequity studies has been to uncover how technology determinism and lack of access to the privileged discourses of schooling reproduce the conditions by which students and their personal uses of technology are marginalized by educational institutions (Sims, 2013; others). To that end, the current study sought to understand how disenfranchised students come to terms with institutionally-derived rules regarding technology use, and how those rules affect students' learning with, and attitudes towards, technology.

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.

Future Research

According to Ito (2013), though increasing numbers of children and adolescents are taking up digital technologies to achieve their own interest-driven goals (both in- and out of school), only a minority of children from non-dominant communities have either the agency or opportunity to turn those interests into the kind of cultural capital that is needed to succeed in today's economy. While it is clear that children of all backgrounds have many deeply held interests across a landscape of domains, a question remains as to how students from non-dominant backgrounds are provided access to the expert communities and resources that might connect them to opportunities to acquire such capital. A significant number of recent studies have focused attention on how non-dominant students take up digital technologies to expand upon their personal interests (in the process cultivating skills and literacies that would empower those students for life beyond school) (Ito, 2009; Ito, 2013; Larson, 2013; Martin, 2014), yet many of these studies focus on children's interest-driven pursuits outside of the classroom. As education still stands as one of the greatest gatekeepers to cultural capital in our society, it begs the question what role schools have in bridging non-dominant students and their interests to privileged forms of capital.

The fact that many of the focal students in this study exhibited keen interest in using digital media to connect with friends, knowledgeable peers, and interest-based communities, yet

resisted opportunities to occupy authoritative roles while participating in technology-based activities in class, suggests that several, perhaps deeply-rooted barriers exist to privileged forms of cultural capital for non-dominant students. Indeed, one area for future research to explore is the nature of such barriers, especially those that stand between non-dominant students and student-centered authority. The results of this study indicate that authority and what "counts" as legitimate participation in schools may be disconnected notions for students, and that their conceptions of who succeeds in schools, and what success "looks like," may be deeply ingrained and far more challenging to disrupt than many digital education reformists would predict. Indeed, while much of the recent research around digital education inequity and participation in interest-driven communities provides a strong foundation for understanding how students develop digital identities and are thusly empowered to learn within these non-academic structures (Ito, 2013; Martin, 2014), these studies tend to focus on students who voluntary participate in such communities. As digital education inequities affect a wide range of youth and adolescents with equally ranging orientations towards new media and formal learning environments, it is crucial to consider how these orientations are legitimized in the process of learning with technology in school, and how technology can be used to empower students to try on various identities, rather than reifying existing social structures and privileged discourses that promote a narrow picture of what "counts" as learning. A research agenda that examines the nature of these barriers must include an expanded view of student identities and technology practices beyond what this study has encompassed, and as such, should look to examine these issues across learning settings in school (i.e., multiple classes), as well as in less formal environments (after-school programs and activities, home life, etc.).

Digital media scholars have begun to explore the nature of inclusion and social relationships within interest-driven communities, and provide some insight into how further research can theorize how school-based structures can create opportunities for legitimate participation through mentorship, and the provision of authentic, key roles for more experienced learners. This research will be invaluable for an agenda that seeks to deconstruct barriers to voluntary participation in interest-driven learning communities, as well as in formalized learning environments.

The ethnographic methods employed in this study provided a rich analysis of the contextual conditions that influenced the ways the five focal students made use of technology, but future research should more deeply consider the artifacts students created, and how these artifacts connected with students' non-school technology practices. Understanding how students are drawn towards certain resources and online behaviors may provide researchers with some insight into how teachers may bridge school and outside-of-school practices in more authentic ways, yet still within the typical school structures. With that in mind, future research in the area of digital education inequities are tied to negotiations of legitimate participation in school-based activities (in addition to non-school ones), and how such negotiations relate to how youth position themselves and each other socially. Doing so may provide further insight into how students' technology practices contribute to the reproduction of privileged social mores, and of marginalization.

APPENDIX A

INITIAL TEACHER INTERVIEW PROTOCOL

1. During the previous school year, about how often did you use technology as part of instruction? (e.g., the internet, creating multimedia presentations, sending email, etc.)

2. During the previous school year, about how often did your students use technology as a part of instruction? (e.g., the internet, creating multimedia presentations, sending email, etc.)

3. To what extent do you present students in your typical class with online work that involves using computers or the Internet in the following ways?

a. Creating a Word document?

b. Sending email

c. Playing educational games on a CD-ROM

d. Playing educational games online

e. Gathering pictures online

f. Reading a book or story online

g. Creating a multimedia presentation (e.g., PowerPoint)

h. Using reference sites online (e.g., dictionary.com)

i. Publishing information on a wiki or blog

j. Publishing information on a website

k. Communicating using Instant Messenger (IM) or other chat tools

l. Formulating questions to research online

m. Locating information online

n. Synthesizing information online

o. Searing for information online

p. Using specific search strategies to search for information online

q. Collaborating online with students from other classes

4. To what extent do you feel the following activities would be IMPORTANT to your instruction, assuming they were available?

a. Creating a Word document?

b. Sending email

c. Playing educational games on a CD-ROM

d. Playing educational games online

e. Gathering pictures online

f. Reading a book or story online

g. Creating a multimedia presentation (e.g., PowerPoint)

h. Using reference sites online (e.g., dictionary.com)

i. Publishing information on a wiki or blog

j. Publishing information on a website

k. Communicating using Instant Messenger (IM) or other chat tools

l. Formulating questions to research online

m. Locating information online

n. Synthesizing information online

o. Searing for information online

p. Using specific search strategies to search for information online

q. Collaborating online with students from other classes

5. To what extent to which you feel prepared to teach students the skills they need for learning online?

6. To what extent are you skilled at using digital technology for instruction?

7. To what extent are you skilled at using digital technology in general (computes, cell phones, iPods, etc.)?

8. To what extent would you like to increase your integration of technology into your instruction?

9. What do you feel would help you INCREASE your integration of technology into your literacy/language arts instruction?

10. To what extent do you believe the following are OBSTACLES to integrating technology into your instruction?

a. Reliability of technology

b. Not knowing how to incorporate technology and still teach content standards

c. Not knowing how to use technology

d. Not understanding how to integration technology into instruction

e. The fit of technology to your beliefs about learning

f. Not having enough time to prepare to use technology

g. Not having enough time to integrate technology because of the time it takes to prepare students for high stakes tests

h. Not believing technology integration is useful

i. Difficulty of reading internet text

j. Not understanding copyright issues

k. Having difficulty controlling what information students access online

l. Not knowing how to evaluate or assess students when they work online

m. Not having time to teach students the basic computer skills needed for more complex tasks

n. Difficulty managing the classroom when students are working on computers

o. Not knowing how skilled your students are at using technology

p. Lack of access to technology

q. Lack of incentives to use technology

r. Lack of time during a class period

s. Lack of technical support

t. Lack of professional development on how to integrate technology

u. Lack of funding

v. Lack of support from administrators

11. What types of technology are available to you at school?

a. Internet-connected classroom computer(s)

b. Internet-connected computer(s) elsewhere in the school

c. A laptop computer for personal use

d. Laptop computers for each student

e. A digital projector

f. An interactive whiteboard

g. Student email

h. Digital video recording equipment

i. Digital camera

j. A document camera

k. An iPod

l. PDA (e.g., Palm Pilot)

m. Any additional technology

12. What kind of technology support is available to you?

a. In-school technology coordinator (for instructional support)

b. In-school technology coordinator (for technical support)

c. District technology coordinator (for instructional support)

d. District technology coordinator (for technical support)

e. Administrative support (for obtaining resources, professional development, etc.)

f. Library/media specialist

g. Another teacher who assists with technology

h. No assistance is provided

13. How would you describe how you view technology as it relates to [subject area] instruction?

a. Technology should not be used in instruction

b. Technology is important to instruction

c. Technology is supplemental to instruction

d. Technology is central to instruction

e. I don't know

14. To what extent to you feel that students benefit when they use digital technologies such as the Internet to learn in your classroom?

a. Not at all

b. Small extent

c. Moderate extent

d. Large extent

e. Not sure

15. What do you think it looks like to integrate technology into instruction?

16. How many years have you been a teacher?

17. What grade do you teach?

18. What subject area do you teach?

19. What is your age?

20. Do you have children?

21. How old are your children?

22. Has your child ever helped you learn how to use a new form of technology?

23. Has any child ever helped you learn how to use a new form of technology?

24. Do you feel that you have received adequate professional development on how to use technology?

25. Do you feel that you have received adequate professional development on the integration of digital technology into your curriculum?

26. To what extent do your feel prepared to teach skills for learning in online environments?

27. In the last academic year, have you had any professional development related to technology use?

28. Did the professional development you received focus on how to use technology?

29. Did the professional development you received focus on how to integrate technology into instruction?

30. What would make the professional development you received more effective?

31. How would you rate your stance towards technology in the classroom?

a. Prefer to live without it

b. Can't live without it

32. To what extent did you use technology while you were in college?

a. Not at all

b. Small extent

c. Moderate extent

d. Large extent

e. Not sure

APPENDIX B

INFORMED CONSENT

University of Massachusetts, Amherst

School of Education

Informed Consent Protocol

Study Title: Student Technology use in a One-to-One Laptop School

Description of Study: The purpose of this study is to investigate the ways students use technology for classroom instruction within a one-to-one laptop environment. It is the intent of this study that this knowledge will contribute to improved teaching of students in technology-based classrooms.

Researcher: I, Nicholas Wilson, will carry out this study under the supervision of Dr. Florence Sullivan, Associate Professor of Learning Technology at the School of Education at the University of Massachusetts, Amherst. I am a doctoral student in Learning Technologies at the University.

Data: The data collected in this study will come in the form of fieldnotes taken during class meeting sessions. Students may be asked if they would like to participate in an interview with the researcher, and if they may be observed during class sessions. Interviews will be recorded and transcriptions will be made available upon request of the interviewee. Observations may occasionally be video recorded, if the student agrees. Some classroom materials may be collected (only with student consent) for purposes of the study.

Time Commitment: The majority of your participation will occur during classroom sessions. In addition, you may be asked to participate in interviews and classroom observations. Interviews may require approximately 1 hour of outside-class time, if you are willing to participate. Classroom observations will last the duration of a classroom session, and continue over multiple sessions. More or less time commitment is possible given individual circumstances and your consent.

Use of Results: The results of this study will be used to complete the doctoral requirements set by the Mathematics, Science, and Learning Technologies program at the University of Massachusetts, Amherst. Also, the results may be used in articles on education and/or in presentations on learning and technology. In these cases, pseudonyms will be

used to replace any proper names, to ensure the no individual will be identified as a participant in the study.

Privacy: Every effort will be made possible to protect your privacy. All data containing confidential information will be kept in a safe place in the possession of the researcher. Your name will not be used in any research reports of the information from this study. Your anonymity will be protected through the use of pseudonyms. No personal or confidential information will be included in any subsequent publication or presentation of the data resulting from this study.

Risks and Benefits: There is no personal risk associated with participating in this study. The possible benefit is that you gain insight into your own learning related to social interaction and computer-based project activities.

Your Rights: You should decide on your own whether or not you want to participate in this study. You will not be treated differently should you decide not to participate. If you do decide to participate, you have the right to withdraw from the study at any time.

Questions: Should you have any questions or concerns about this study, please contact Nicholas Wilson at nwilson@educ.umass.edu or 978.886.3605. Or, you can reach Dr. Sullivan at fsullivan@educ.umass.edu or 413.577.1950.

Please read the following statement and sign below if you agree.

I have read the information in this consent form and agree to participate in this study. I have been given the opportunity to ask any questions regarding this study, and my questions have been satisfactorily answered. I understand that, at any time, I my refuse to continue participation in the study and that my identity will be kept confidential.

_____ _____ _____

Participant's Name Signature Date

APPENDIX C

THE BAYSIDE HIGH SCHOOL TECHNOLOGY RUBRIC

Digital Publishing

To exceed expectations on digital publishing assignment, a student had to utilize multiple applications and images to create a "very complex" word processing document. The document must be published using "Web 2.0" technologies, such as cloud computing, or be published on the web via a blog or wiki. Meeting expectations required the creation of a "complex" word processing document that incorporates graphics to convey information visually. The student's work had to be adaptable for web publishing, and in the proper file format to upload the document to a blog or wiki. Working towards expectations implied that a student requires assistance to incorporate digital images into his or her work, as well as support in publishing the document to the web. The student also had to demonstrate the ability to properly format the document and properly cite references, as well as exhibit some knowledge of file formatting and management.

Work that qualified as below expectations indicated that a student could, at minimum, produce a word processing document, but required assistance to properly format the document and citations, manage file formats and attachments, and was unable to utilize Web 2.0 (i.e., cloud computing or web publishing) tools.

Data organization and analysis

To exceed expectations in the area of data organization and analysis, a student had to demonstrate the ability to "[use] an extensive set of statistical tools" to conduct a "complex analysis of information". Further, the student had to be able to utilize graphs to "tell a story," use "sophisticated filtering" to create "complex reports," and exhibit an understanding of implications of the data. Meeting expectations entailed independently being able to create spreadsheets and databases, adjust graphs and charts to display information, and produce "easily [readable] and [interpretable] data and graphs." In other words, to receive a passing grade on a data-based activity, a student had to be able to create a spreadsheet or database on his/her own, and properly display relevant information. A student was "working towards expectations" if he or she could create a spreadsheet "with simple formulas but require[d] guidance" to do so. A student also had to exhibit "limited skills using data inquiry tools", and could create, but "need[ed] support customizing and interpreting" graphs. A student's data organization and analysis skills were "below expectations" if he or she had difficulty entering information into a spreadsheet, "need[ed] support" using formulas to calculate results, and could "only prepare the most basic graphs."

Multimedia presentations

A multimedia presentation exceeded expectations if a student was able to clearly and easily convey the message of his or her presentation, integrate various modes of "enhancements"

(audio and visual) “exceptionally”, and do so “free of technical flaws”. To meet expectations, a multimedia presentation had to have only a few technical flaws, although “none of them [may] seriously impair the presentation.” A student also had to be able make “good use” of audio and visual “enhancements”, and the message of one’s presentation could only require some “additional explanation to be understood”. Working towards expectations indicated that a student’s multimedia presentation was “somewhat vague” or “puzzling” to the audience in its message, and that audio and visual information “need[ed] more integration”. A presentation that was working towards expectations also exhibited “some technical flaws which limit[ed] the presentation”. Presentations were below expectations if the message was “unclear,” a student made little or no use of audio and visual information, and the presentation was interrupted by technical flaws.

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