

“That’s Bogus as Hell!”: Getting Under the Hood of Surveillance Technologies in an Out of School STEM Learning Environment

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Abstract. This study investigates how opportunities to learn about the ethics of advanced technologies emerged and were negotiated through interaction amongst students and instructors in YPRPT, an out of school STEM learning environment. We present a microethnographic analysis of a single pedagogical activity organized around *GeoMedia*, a tool we designed to mimic authentic surveillance technologies currently used by numerous law enforcement agencies. Our findings detail how the organization and unfolding of learning in the focal activity created opportunities for students to explore “under the hood” of advanced technologies, and to feel a sense of excitement and awe at the possibilities and perils of social media surveillance. Additionally, our findings show how opportunities to learn were not solely constructed through apriori pedagogical design, but also emerged through in-the-moment instructional decisions and sequences of activity. This study has implications for participatory design possibilities grounded in interdisciplinary collaboration between historically disparate disciplines like computer science and civics.

Introduction

In recent years, there has been much scholarly as well as public discussion regarding questions of ethics, race, power, and technology (Benjamin, 2019). How, what, and for whom technologies are designed are key considerations. Complex interactions between technology and society, including their disproportionate and/or inadvertent impact on marginalized communities are among the most pressing concerns of our current historical moment. Yet, despite the critical importance of these questions, they are largely absent from discussions of formal or informal education. This is due, in part, to the inevitable interdisciplinarity demanded by these issues, and the gap in our knowledge about the characteristics of learning about technology and ethics and how to best support it. To address this, we propose bringing together two disciplines that are rarely in conversation with one another - civics and computer science (CS) education. This paper explores such an effort. We investigate the social and interactional organization of learning in the Young People’s Race Power and Technology Project (YPRPT), a summer workshop and afterschool program for high school students co-designed by a team with deep expertise in both civics and computing.

A critical civics approach to technology

While mainstream advocates for civics education identify the interrogation of current and controversial issues as key for civic learning, there has been a lack of attention to questions of race and power that underlie the kinds of political issues young people are facing. We build on approaches that conceptualize authentic civic learning experiences as those that connect deeply to the identities and lived experiences of historically marginalized youth of color (e.g., Mirra & Garcia 2017). This includes leveraging young people’s engagement in participatory politics by recognizing the power and possibilities that new media and digital technologies play in the political lives of young people. These modalities for “doing politics” allow us to go beyond traditional forms of civic education that privilege direct engagement with formal institutions of government. In the YPRPT project, for instance, civic engagement entails creating learning opportunities for youth of color to interrogate the role of surveillance and other advanced technologies in their local communities. Who are these technologies for, and who designed them? How are they experienced by community members, and do they ultimately expand or restrict community prosperity? In this way, we build from critical civic approaches and extend these frames to domains of science and technology that are often missing from the purview of civics education.

A critical CS approach to studying power

Alongside exploring sociopolitical implications of advanced technologies, YPRPT simultaneously leverages CS education pedagogical approaches to support students in learning how the technologies under consideration operate “under the hood.” While CS education has made a comeback in recent years, and is often instrumentalized with a focus on coding, we locate our perspective within a longer tradition in the learning sciences that views

computing not as an end in itself but as a means towards empowerment and expressivity (e.g., Eisenberg, Rubin, & Chen, 1998; Papert, 1980). In particular, we align most closely with approaches to computing that draw on culturally relevant and critical pedagogies, conceptualizing access to computational technologies as a matter of power and justice for historically marginalized groups that have been systematically excluded from computing pathways and careers (Ashcraft, Eger, & Scott, 2017; Goode, Chapman, & Margolis; Vakil, 2018).

Theorizing hybridity and learning in YPRPT

Our approach to conjoining critical civics and CS education pedagogical approaches is anchored in a theory of hybridity. Hybridity is a construct employed in educational research, as in hybrid instructional environments, commonly used to frame discussions regarding bridging of school-based, out-of-school, and community funds of knowledge. Another way hybridity has entered educational discourse has been through the lens of identity, and traces back to postcolonial and critical theoretical traditions (e.g., Anzaldúa, 1987). Building from this work, our approach here draws from perspectives that theorize hybridity as deeply connected to epistemological diversity and heterogeneity in learning environments (Bang 2015; Gutiérrez, K. D., Baquedano-López, P., & Tejeda, C, 1999). In short, we use hybridity both as a “theoretical tool...as well as a principle for organizing learning” (Gutiérrez, Baquedano-López, & Tejeda, 1999, p 288) at the intersection of civics and computing.

To explore how hybridity was actualized and experienced by students in the YPRPT program, we also draw on theoretical perspectives that view learning as an active negotiation of meaning conducted through social interaction (Wenger, 1998). Furthermore, a view of interaction as a “social accomplishment” constituted by speakers and listeners through verbal as well as non-verbal communication is central to the analysis presented in this study (Erickson, 2004; McDermott, 1976). At its core, this study investigates how the interactional organization of a hybridized learning environment created opportunities for ethical sensemaking about advanced technologies. We do not make claims about effects on individuals’ learning, but rather how opportunities to engage in ethical considerations of technology were created, negotiated, and experienced in the context of a focal activity on social media surveillance. The focal activity presented a unique opportunity to study these dynamics. The activity revolved around a web-based surveillance tool, *GeoMedia*, which didn’t operate as planned during the activity. The pedagogical improvisation that followed opened a third space of activity (Gutiérrez, 2008) where underlying dynamics of the space were made visible. We found that the social media surveillance activity, and in particular the unexpected breaking and subsequent repair of the demonstration, was experienced by students as something exciting and awe-inspiring. We further found that anchoring the activity in geographically proximal and temporally-near contexts was a critical driver of student engagement. Implications of our findings are that by participating directly in the enactment of surveillance technologies, youth are afforded opportunities to deeply explore the stakes of these technologies in their own lives and communities.

Methods, context, and design

The YPRPT project is designed as a summer workshop and after school program based out of Family Matters, a community center situated on the edge of an urban and suburban area of a large Midwestern city. The border is significant as it draws a line between two very distinct cities and corresponding school districts. There were eleven students in the program, four from Townville High School and 7 from Boyles High School (1). Of the eleven student participants, 6 identify as Black or African-American, 1 as biracial (Indian and white), 1 as Asian/Japanese, 1 as Puerto Rican and 1 as white. Four of them are female and one student identifies as a member of the LGBTQ+ community. Many of the students had experience traversing this border and were aware of the perceived differences of the communities.

In the summer workshop, which launched in Summer 2019, YPRPT students learned about and explored the ethics of three advanced technologies operating in their communities: social media surveillance, cell phone communication tracking devices, and facial recognition technology. Students participated in real-time technical demonstrations designed to raise awareness around ethical and political dilemmas related to the technologies. In addition, students participated in a “spot the surveillance” virtual reality exercise, a walking tour of the city, and met with local activists and technology experts. For each technology, students reflected on the potential harm and benefits and engaged in discussions of the ways that these technologies might impact racially minoritized communities. Students presented their final artifacts - technical drawings depicting their understanding of how these technologies worked “under the hood” and infographics explaining the social impact of their focal technologies - to a group of parents, local educators, activists, and artists at an evening community showcase.

Design team

Our design team includes numerous partners, providing a variety of perspectives, interests and areas of expertise. Family Matters, a community organization serving low-income youth of color on the border of the two community

sites of participants - served as home base for the program. Chris Spence, an African-American male director with the Family Matters program, helped to recruit students, secured physical space at the Family Matters center for the program, and lead the practice of daily opening circles, a space of community building originating in indigenous practice. The second partner for YPRPT was Lucy Parsons Labs, an organization of tech-savvy activists focused on issues of surveillance and security. Additionally, our design team included a veteran local high school teacher, a professional computer scientist, and university-based educational researchers. Jonathan is a veteran civics teacher from Boyles High School with a 14 year career in social justice oriented instruction. Jonathan, who identifies as South Asian, supported the development of the YPRPT summer workshop curriculum and served as lead instructor. Temitope, a CS professional and entrepreneur, served multiple roles including tech consultant and lead designer of the *GeoMedia* system, a social media surveillance tool we discuss in further detail below. Temitope grew up in Southern California and identifies strongly with his racial/cultural heritage that traces back to the Yoruba people in Nigeria.

Design of GeoMedia

One of the technical artifacts we created specifically for the summer workshop is *Geomedia*, a web-based tool designed to mimic that of real social media surveillance technology company Geofeedia, which has been used in recent years by police departments to surveil students and activists (Pierce, 2018) (see Figure 1).

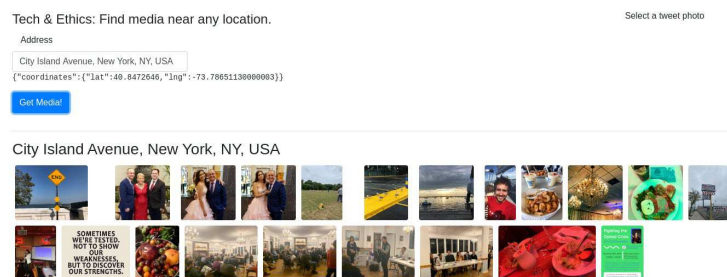


Figure 1. GeoMedia.

To create the tool, our design team utilized *Twint*, an open source library which allows programmers to gain access to Twitter data without a Twitter API key, as well as a Python back-end server, and CodePen, a commonly used front-end development environment. At its core, *Geomedia* allows users to collect or “pull” tweets geotagged within a certain radius surrounding that location including media (videos and photos). The user of the *Twint* is able, then, to pull corresponding tweets from Twitter that are matched to a given location. The activity using *GeoMedia* was designed to allow students to role-play both as the surveillor, allowing them to identify and experiment by inputting various addresses and exploring the results, and as the surveilled, prompting students to reflect on ethical implications of the tool.

Data sources and analytical methods

This article draws from a large data corpus which includes approximately 40 hours of video recordings from whole and small group working sessions, ethnographic field notes written by four different members of the design and research teams, curriculum planning documents, and student focus group audio recordings. Video recordings from one specific day, midway through the summer program, were central to our analysis. We began with a close reading of the content logs, developed by two of the research team members, for week two of the program which focused on giving students an opportunity to observe and tinker with the surveillance technologies under consideration. During this stage we individually used an open coding approach to develop a codebook. From this initial reading we identified the *GeoMedia* as an ideal focal activity to further analyze how learning was organized in the space. While it was representative of our hybridized approach to integrating civics and computing, it was also atypical in that the key the *GeoMedia* demo unexpectedly broke, affording an opportunity to view the underlying social dynamics of the learning environment.

We produced an audio transcription of a 37 minute episode within the day’s activity. Video content logs were created by producing low-inference ethnographic observations for each 3-5 minute interval. We then open coded the transcript as well as the video content logs, and coordinated emerging themes with two sets of field note data. This approach allowed us to attend to both verbal as well as non-verbal layers of interaction in the activity system of the classroom, which was particularly helpful in ascertaining the ethical and felt dimensions of experience that we learned were generative in the space. In this process, we identified a 3 minute clip within the

37 minute focal episode that captures the moment directly after the tool was fixed and subsequently unveiled to students.

We conducted a microethnographic analysis of this brief clip to more deeply explore nonverbal and embodied elements of the space. The clip was viewed on a large screen using VLC media player. The clip was viewed by the group using a variety of techniques, including slowing down the video to 50% speed, watching the video without audio, and choosing focal participants to track during the clip. With each viewing, the team identified features that were not previously captured with the verbal transcript and recorded amendments to the transcript.

Results

Social media surveillance as a focus of inquiry, and the *GeoMedia* tool in particular, compellingly engaged students in thinking about ethical considerations related to surveillance technology. Attention to the interactional details of this activity revealed a sense of excitement and wonder as students eagerly watched and participated in surveillance of locations near and far. Further, we note specific affordances of the tool that were critical drivers of student engagement. The flexibility to conduct real-time surveillance of locations that were temporally-near and geographically proximal forced students to grapple with how they are personally implicated, and also potentially complicit, in the core ethical questions under consideration. Table 1 describes key participants in the sequences of activity described below.

Table 1: Key Participants (* indicates instructors)

Sanjin*	Co-author & activist with Lucy Parsons Lab, served on the design team. Co-led design of <i>GeoMedia</i> and facilitation of social media activity w/ Temitope. Identifies as Middle Eastern.
Temitope*	Computer scientist, co-led design of <i>GeoMedia</i> . Identifies as having shared lineage with African-American students.
Jonathan*	Veteran civics teacher and lead instructor of the 3 week summer workshop. Limited expertise in technology and computer science. Identifies as South Asian.
Brandon	11th grade student at Boyles High School, member of youth program at Family Matters. Identifies as African American. Resident of Boylesville.
Davion	11th grade student at Boyles High School, member of youth program at Family Matters. Identifies as African American. Resident of Boylesville.
Charles	11th grade student at Townsville High School, the only member of the Family Matters program who does not attend Boyles. Identifies as African American.

Coco the guinea pig and “CIA stuff”

Before the unveiling of the *GeoMedia* social media surveillance demo, the day began with a lesson on the centrality of servers and clients in computer networks generally and internet technologies specifically. Core computing concepts and practices were introduced drawing on the metaphor of placing an order at a restaurant, where the customer (client) places an order (client request) and the kitchen staff (server) process a customer’s request, cook the food (data processing), then present the customer (client) with requested meal (server response and data visualization).

The activity was designed for students to experiment in real-time with these concepts in the prepared *GeoMedia* demo. However, after connecting Temitope’s computer to the projector, to the dismay of instructors and students, the IP address of the backend server necessary to process Twitter data was temporarily and inexplicably inoperable. The demo was effectively broken. At this point, Temitope commenced to troubleshoot the tool, while Sanjin improvised by using a manual workaround of the Twint technology. Sanjin’s workaround utilized a command-line interface typically used by advanced computer programmers who perform “under the hood” manipulations of web technologies like Twint. Rather than otherwise distracting the students while Temitope fixed the *GeoMedia* too, Sanjin launched the command-line and projected it on the screen for students to see for themselves. As they squinted to make sense of the mysterious black screen before them, Sanjin drew connections to their previous discussion on web servers and clients and how they comprise the underlying

structure of internet technology (Content Log, 7/23/19). In this way, the breaking of the prepared demo presented an unplanned opportunity to give students a peek into a commonly obscured layer of advanced web technologies.

The command-line workaround allowed Sanjin and the students to collect tweets from a specific geographic area. Students watched and commented at various images displayed on the screen. In one instance, a Twitter user's guinea pig named Coco appeared on the screen, and it linked to the user's Instagram account in Denver, Colorado. One of the students, Brandon, shook his head and smirked to his neighbors, as if to convey a sense of disapproval and disbelief. When asked by Sanjin to share his thoughts, Brandon mentioned that he felt like we were invading the Guinea Pig owner's privacy by looking through his instagram.

To build on this emerging engagement with the ethical implications of the tool, Jonathan proposed taking a picture of the students and live-tweeting to his Twitter. He wondered out loud if the tool would be able to pull the tweet in real-time. Sanjin ran the command using the location of the community center and to the amazement of students, the tweet immediately appeared on the screen! One student exclaimed ominously, "this is CIA stuff!" While students were visibly engaged with the manual demonstration, there was also a growing sense of anticipation as Temitope was still working diligently to repair the broken tool. Importantly, he hadn't retreated to another room or even to a corner of the room as he worked to fix *GeoMedia*, but rather remained visible and physically proximal to students as he hacked away to fix the demo.

"That's bogus as hell!"

As we see below, the reveal of the repaired *GeoMedia* demo excites and inspires awe in students, providing an important opportunity to *feel* the urgency of the ethical implications of surveillance technologies. Through the following micro-interactional analysis, we show "up close" how students' embodied and enacted their sense of excitement through verbal and non-verbal forms of communication. The segment begins with a gentle nudge from Jonathan to Temitope asking if the demo is ready.

Jonathan: *Temitope, how are you doing?*

Temitope: *I'm doing fantastic.*

Jonathan: *You got anything to show us?*

Temitope: *I do, I do, that demo I promised y'all.*

Corey looks over, "You've been working on that the whole time?" Jonathan and a few of the students stand up and reorganize the chairs. As Temitope reminds students how the Twint interacts with web servers to send and process data, students who had been gathered in the other room stream in. Charles, Corey, Brandon and Davion are laughing. Temitope continues to narrate his process for fixing the demo, while the students settle into their chairs and stop talking. Charles shifts in his chair, Corey fidgets with his hands. Temitope offers to share more about the coding offline with students who want to "go into the guts." Charles pounds his fists on top of each other and continues to swap glances with Corey. At this point all of the students are sitting, organized in a semicircle around the projector. Will and Sanjin, two of the adult facilitators have also taken seats in the circle with the students. Temitope stands at the top of the circle, opposite the screen while Jonathan stands ready at the computer to enter information on the projected laptop.



Figure 2. Before and After the Fix.

“An address...anyone?” asks Temitope. He offers up the address of the community center after Brandon offers and then rescinds his offer to share his personal home address. He doesn’t feel safe to do so; something Temitope affirms by praising him for his caution. Brandon, Davion and Charles, the three students in front exchange looks and Charles mouths the word “never.” As they wait for the page to load, Corey dances in his seat. One student sits up in her chair, her fingers to her lips as if to bite her nails. Another student in the foreground of the video, sits back in his chair and gazes between the teachers and the screen. The anticipation continues to build, yet several students remain distracted.

And then it happens. The demo is fired up. “Therrrrrrre we gooooo,” remarks one of the instructors, signaling to students that the demo is now live. In the moments that follow, there is an observable change in how bodies are positioned and how the collective gaze of students seem to coalesce, as one, focused on the screen where twitter posts scroll. There was a marked change in the energy of the room, akin to a switch being turned on. Several of the students lean in, including one student previously sitting back slightly outside the circle who peers around the students in front of him, angling for a better view. Brandon, a football player with a large stature, suddenly dives forward, eyes wide open, and points assertively with his finger toward the screen (see Figure 2). This surge of energy and movement shifts and intensifies the collective gaze on the screen. He covers his mouth and then turns to tap Davion, as if to confirm he is also witnessing the text and images unfolding before their eyes. Jonathan looks back and forth between the screen and Temitope while Sanjin jumps up and moves to a standing position in order to get a better view. “This is blowing my mind,” he says. Two students, Charles and Corey, who were the last to look at the screen, change their posture. They are sitting more upright and instead of looking back and forth to each other, their eyes are fixed intently ahead. Some students seem to be reading silently to themselves, mouthing the words that scroll before them. Others, share out loud what they are seeing. Brandon once again taps Davion, who says out loud, “oooh, there go my dog,” presumably noting a tweet or image of someone he knows from the community. Temitope continues to discuss how the demo is operating and pointing out different features while the students continue to read the posts. As Charles reads he proclaims, “that’s bogus as hell!” “You see that old man?!” Brandon asks Davion as he points.

The specific interactional organization and pedagogical unfolding of the *GeoMedia* activity generated an intensity of emotion and excitement around questions of technology and surveillance. The close micro-analysis of instructor and student interaction illuminates the embodied and affective characteristics of engagement made possible in a learning environment organized explicitly around ethics and technology. We observed bodies shift as participants moved their seating arrangements and altered their postures to ensure a more direct line of sight to the screen. Students who were only seconds before exchanging looks with each other now had their eyes intently trained on the scrolling display of covertly captured tweets authored by absolute strangers. Seeds of joint meaning making were observed between students and expressed through a physical tap, a gesture forward, and an occasional glance toward each other then immediately back to the surveillance unfolding in real-time. With eyes wide and jaws dropped, students’ ethical and technological imaginations were stirred.

Discussion

We’ve described in this paper how students were afforded opportunities to explore “under the hood” of surveillance technologies. We demonstrated in concrete ethnographic detail how these opportunities emerged and were negotiated through a complex interaction between the students, instructors, and the pedagogical affordances of the *GeoMedia* tool (Philip & Garcia, 2013). Our findings are in line with previous studies that have investigated how opportunities to learn emerge through talk and interaction, and significantly, are prerequisites for deeper and sustained learning (Louie, 2016).

The technological and pedagogical design of the *GeoMedia* activity made possible two distinct ethical experiences with respect to surveillance - namely, that of the surveillor and that of the surveilled. Students interacted directly with Twitter data, inputting locations that were not near where they lived and emulating the role of someone who surveils. They also ran searches for Townsville as well as the Boyles Gardens Neighborhood, which revealed the vulnerability of the students to the same level of surveillance. By effectively enacting a tool of surveillance from different vantage points, instructors and students engaged in a learning practice called reperforming injustice (Calabrese-Barton & Tan, 2019). They read the tweets posted by members of their own community, sent from the same location where they sit, and were able to view information that would otherwise be unavailable. In doing so, together they approached an ethical border that implicates them in collectively violating the privacy of others by viewing things that were posted publicly but for which the authors were not asked for consent. The power to participate in surveillance, to not just observe but to *sense and feel* surveillance that was real-time and geographically proximal, infused the learning space with urgency, excitement, and awe.

Our findings also highlight the ways in which opportunities to learn are not solely constructed through apriori pedagogical design, but also emerge through in-the-moment instructional decisions and sequences of

activity. The unplanned breaking of *GeoMedia*, and the subsequent pedagogical improvisation organized learning in ways that provided openings for students to widen their imagination about how these technologies function “under the hood.” It was significant, for instance, that Temitope, the chief architect of *GeoMedia*, remained physically proximal and centrally visible to students as he passionately hacked away to debug and ultimately repair the broken demo. When he concluded his work and was getting ready to unveil the repaired demo, it was likely this proximity that created the context for Corey to look over and ask with a sense of admiration, “*You’ve been working on that the whole time?*” We view Temitope’s decision to remain visible and close as he worked his magic as intentional, and functioned pedagogically as an implicit invitation for students to marvel at and consider how the technology actually works. Later this invitation was made explicit when Temitope offers students to follow up with him if they want to delve deeper “into the guts” of *GeoMedia*’s design. Meanwhile, in parallel to what we may think of as Temitope’s purposeful performance, Sanjin’s improvisational command-line workaround further invited students to peer into the world of an advanced computer programmer. Significantly, this unplanned “tour” of command-line interfaces was preceded by the lesson on server-client relationships, and extended the opportunity for students to explore the computational processes and systems “under the hood” of the surveillance technologies under investigation.

Conclusions and implications

This paper points to new possibilities for learning that emerge in hybridized learning environments like YPRPT. In light of the increasingly consequential and complex ways in which advanced technologies intersect with issues of race, power, and inequality more broadly, creating meaningful learning opportunities for students to get under the hood of these technologies becomes an urgent educational project. Our approach embodied in the *GeoMedia* activity, and in the YPRPT project more broadly, is undergirded by a vision for interdisciplinary collaboration between historically disparate disciplines like computer science and civics education. This will require, of course, rethinking of traditional disciplinary boundaries. We need to reconsider and ultimately expand what counts as “civics” to be inclusive of scientific and technical linkages. Likewise, disciplines like computer science can no longer background the ways in which an increasingly algorithmically-driven world raises significant ethical and political questions. Surveillance is but one of many examples that illuminates both the opportunity for creatively imagined interdisciplinary collaboration, as well as the complexity inherent in such endeavors. We end with a brief comment on the past and future identity of the Learning Sciences community and implications for future directions of this work. The first International Conference of the Learning Sciences (ICLS), held in 1992, was animated by research at the intersections of Artificial Intelligence, technology-enhanced learning, and cognition. Three decades later, recent calls have urged the field to engage more deeply with political and ethical aspects of learning (Booker, Vossoughi, & Hooper, 2014). Theoretical and empirical research that foregrounds complex interactions between ethics and technology has the exciting potential to fuse past and future identities of our field. Technology, like *GeoMedia*, can certainly enhance learning, but it simultaneously surfaces the ethical and political contradictions of technology. Developing the capacity to hold both these truths is a critical task facing our field.

Endnotes

(1) The names of all students, schools, and neighborhoods are pseudonyms.

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