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# “I’ve Always Been Scared That Someday I’m Going to Sell Out”: Exploring the relationship between Political Identity and Learning in Computer Science Education

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## ABSTRACT

While academic, cultural, and racial identities have been important concepts in sociocultural theories of learning and development, less attention has been given to political identity. Research on political identities in education tends to be limited to critical pedagogy or civic education contexts, leaving unexamined the role of political identity in supposedly neutral settings, like a computer science (CS) classroom. In this study I offer a conceptual framework that draws on theories of political identity and sociocultural theories of learning to illuminate a process I call *disciplinary values interpretation*—a process by which students reflect on the values of a disciplinary domain, as well as who they are and might become in relation to the domain. I then operationalize the framework by analyzing the ways in which students’ political identities interacted with their learning processes in a social design experiment conducted in collaboration with a high school teacher in a Computer Science and Technology academy of a large urban high school. Through case studies of two 10th grade students, Stacey and Lupe, I argue that the opportunity to design socially relevant technology provided new resources for disciplinary values interpretation, and had significant implications for how students came to view their own political identities and futures within the discipline of CS. This research has implications for ethical/political theories of learning and also contributes to enduring questions about identification and inequality in education.

I begin with a story that made national news in the fall of 2015. Leslie Miley, an African-American software engineer, left Twitter after frustrations with the company’s inability and unwillingness to meaningfully address diversity issues. While tensions over diversity in Silicon Valley (and other arenas) are now very much part of the public discourse, what makes this story unique is the rationale Miley provided after he left Twitter. Reflecting on a discussion with senior management prior to his decision to leave, Miley wrote:

As we continued the discussion, he suggested I create a tool to analyze candidates last names to classify their ethnicity. His rationale was to track candidates through the pipeline to understand where they were falling out. He made the argument that the last name Nguyen, for example, has an extremely high likelihood of being Vietnamese. As an engineer, I understand this suggestion and why it may seem logical. However, classifying ethnicity’s (sic) by name is problematic as evidenced by my name (Leslie Miley). What I also found disconcerting is this otherwise highly sophisticated thinker could posit that an issue this complex could be addressed by name analysis...While not intentional, his idea underscored the unconscious tendency to ignore the complex forces of history, colonization, slavery and identity. (Miley, 2015)

Miley’s decision to leave Twitter and his subsequent commentary encapsulates several interrelated topics that are central to the study described in this paper. On one level, his experience at Twitter may be unsurprising for those involved in efforts to remedy enduring problems of racism

and sexism in technology-related academic and career pathways. Yet, within the story he shares about his exchange with senior management lies a more subtle and complex analysis of how power functions within one of the most recognizable Silicon Valley companies in the world; namely to “ignore the complex forces of history, colonization, slavery and identity.” Particularly important for the purposes of the argument I make in this article is Miley’s decision to ultimately leave Twitter, which suggests a complex interplay and ultimately an untenable friction between his multiple identities (engineer, African-American, advocate for diversity), and the nature of the environment in which he was working. Though this is not a study about Twitter’s inability to retain a senior African-American engineer, Miley’s case does underscore the key phenomenon of interest that I explore in this paper: the critical importance of considering and understanding *how political identity functions in learning environments*.

Drawing on diverse theoretical traditions spanning psychology, sociology, and anthropology, sociocultural perspectives in the learning sciences have centered the role of identity in the learning process (Lave, 1993; Mehan, Villanueva, Hubbard, Lintz, & Okamoto, 1996; Nasir & Hand, 2006; Varenne & McDermott, 1998; Wortham, 2006). At the heart of identity research lies a recognition that supporting learning requires empirically and theoretically rich accounts of who students are as learners *and as people*, and who they might become through their future experiences in schools and learning contexts more generally. The notion that learning environments can either support or constrain particular kinds of identities, or “imagined trajectories of becoming” (Nasir & Hand, 2006, p. 468) is anchored in theorizations of learning as a fundamentally cultural process (Bang & Medin, 2010; Cole, 1996; Lee, Spencer, & Harpalani, 2003; Rogoff, 2003). Seeking to build on this work while simultaneously explore uncharted theoretical terrain in the Learning Sciences, there have been recent calls to more explicitly conceptualize and empirically study the impact of power, politics, ideology, and ethics on learning and schooling (Esmonde & Booker, 2016; McKinney de Royston & Sengupta-Irving, 2019; Philip, Gupta, Elby, & Turpen, 2018; Politics of Learning Writing Collective, 2017; Vossoughi, Jackson, Chen, Roldan, & Escudé, 2020).

The sociopolitical turn in the Learning Sciences signals two critical shifts in the field. The first can be characterized as a primarily theoretical project to intensify the dialogue between Learning Sciences (LS) and scholarly traditions historically deemed marginal to core LS intellectual concerns—fields including critical theory, geography, and philosophy, Black, Asian, Indigenous, and Queer Studies, and the Humanities more generally. The second is more political in nature and represents efforts to make the Learning Sciences relevant and responsive to the interlocking and intensifying crises we are facing as a species: namely crises of ecological precarity, settler colonialism, multicultural neoliberalism, and racialized militarism (Davis & Todd, 2017; Maira & Shihade, 2006; Melamed, 2011; Nxumalo & Ross, 2019). It is important to highlight that, given the historical context, theorizing learning as fundamentally cultural was similarly undergirded by deep ethical commitments. That is, rejecting the intellectual inferiority of nonwhite children and challenging Eurocentric epistemologies of knowledge and knowing were profound political interventions in their own right (e.g., Lee, 2001). In this way, we might say sociocultural theories lit the torch for investigations of learning motivated by ethical commitments, specifically illuminating otherwise obscured relationships between cognition, development, identity, race, and culture. The newly articulated focus on the ethical and political in the Learning Sciences aspires to boldly carry the torch forward. Sometimes this will entail conceptual layering, thickening, or refining of these constructs, while at other times it may mean inventing new frames for seeing and imagining learning anew.

In this paper, by taking up and extending theories of identity in STEM education, I introduce a new conceptual language for describing how young people are politicized (or depoliticized) through their encounters with learning. And importantly, how learning environments are imbued, sometimes explicitly and other times in more subtle ways, with ethical meaning (Hess &

McAvoy, 2014), and how these meanings have implications for individual sensemaking around the values of a particular discipline (i.e., *what is this really all about?*) as well as sensemaking around one's desire to pursue learning in a particular discipline or domain (i.e., *Do I want to be this kind of person in the future?*). For instance, in the US context, research has demonstrated that students often associate engineering and computing disciplines as embodying values antithetical to justice and human rights concerns (Garibay, 2015). How, where, and through what processes do students learn these associations? Might these associations be disrupted or reframed? How do the values students attach to particular disciplinary domains have implications for their future patterns of engagement and achievement, for their selection of colleges and majors, and ultimately their career and life pathways? These are open empirical questions with significant pedagogical and policy implications that come into focus when political identity is viewed and taken up as a fundamental aspect of human activity and behavior.

### Identity work in STEM for historically underrepresented students of color

There is a deep tradition and sustained focus on questions of identity with respect to equity and inclusion in STEM education research that I build from and extend in this paper. Broadly, looking at K-12 as well as higher education literatures, three central themes have characterized the complex relationship between identity and STEM learning. The first relates to *opportunity*. Spanning contexts and methodological approaches, the research shows unequivocally that high quality STEM learning opportunities in and out of school are largely denied to racially minoritized students (McGee, 2016; Pinkard, 2019; Riegle-Crumb, King, & Irizarry, 2019; Scott, Sheridan, & Clark, 2015). And further, that even when opportunity exists materially (e.g., through the availability of advanced STEM courses in racially diverse urban high schools), there are significant cultural and social barriers to participation that obstruct equitable participation by underrepresented groups (Margolis, 2008; Nasir & Vakil, 2017). Lack of access, in turn, limits possibilities for positive interest and identity development in STEM fields (Barron, 2006).

Second, tied directly to lack of opportunity and marginalization, racially minoritized students do considerable “identity work” to *navigate* male and white-dominated STEM classes and majors (Calabrese Barton et al., 2013; Margolis & Fisher, 2002; Seymour & Hewitt, 1997). Importantly, this type of identity work is specific to experiences of race and racialization (Nasir, 2012), and happens in addition to identity processes that are already embedded within any learning encounter. Varelas, Martin, and Kane (2012) state this clearly:

Black children who study mathematics and science negotiate identities not only as students and doers of mathematics or science in the context of their classroom practices, but also as members of a social group whose racial identity is salient and often subject to negative characterizations in school and other societal contexts. (p. 335)

Unfortunately, the burden of navigating does not end with childhood. Decades of research on STEM identity in higher education corroborates the identity work that racially minoritized students must do to persist in STEM majors (Heyman, Martyna, & Bhatia, 2002; Ong, Wright, Espinosa, & Orfield, 2011; Secules, Gupta, Elby, & Tanu, 2018; Seymour & Hewitt, 1997; Stevens, O'Connor, & Garrison, 2005; Tate & Linn, 2005). The key contribution here is that racial identity dynamically interacts with STEM learning in conceptually distinct and consequential ways.

Third, there is a considerable body of work that has examined the role of *values* in the formation of STEM identity for underrepresented students. It is well established, for example, that perceptions of science as white and masculine play a critical role in the reproduction of race and gender inequity (Blickenstaff, 2005; Brickhouse, Lowery, & Schultz, 2000; Carlone & Johnson, 2007; Margolis, 2008). Supporting a multiplicity of epistemological values, and recognizing the historically accumulated “settled” values present in dominant representations of science have been a critical area of more recent work in science and environmental education (Bang & Medin,

2010; Nxumalo, 2018; Warren & Rosebery, 2011). In technology fields, a pervasive culture of competition and individualism has been shown to discourage students who have more altruistic or social justice ambitions (Carlone & Johnson, 2007; Garibay, 2015; Pawley, 2009). In an ethnographic study, Stevens et al. (2005) present in-depth case studies of two women of color who both, though being declared engineering majors, viewed engineering as lacking relevance for their personal development. In a similar vein, recent work has shown that negotiating one's current and future identity in STEM is mediated by "perceptions about self, science, and scientists' work" (Kang et al., 2019, p. 421). Few studies, however, have theorized or empirically investigated how sensemaking about the values of STEM disciplines is dynamically connected to students' political identities. That is, whereas racial and gender identity has been conceptualized as a distinct phenomenon that dynamically interacts with STEM learning, students' political identities with respect to STEM learning has scarcely been foregrounded (see Morgan, Davis, and López (2020) for a recent exception). This includes conceptualizing young people's ethical sensemaking about the politicized dimensions of the disciplines themselves as worthy of theory and study. Toward this end, this paper seeks to take up recent calls to interrogate the political dimensions of learning through a conceptual and empirical account of how political identity and learning may interact in the context of a racially diverse computer science classroom.

The study reported upon in this paper draws from a social design experiment (Gutiérrez, Jurow, & Vakil, in press; Gutiérrez & Vossoughi, 2010) conducted in a high school computer science class within a large urban high school, in which students were invited to design technologies that addressed social problems in their school context. My analysis examines how students' political identities shaped the ideas and artifacts they produced, and how, in turn, active participation in a learning community organized around equity-shaped students' political views and identities. I begin with elaborating on a theoretical perspective on political identity and learning that draws on diverse literatures including political science, political psychology, critical pedagogy, and sociocultural theory. After an extended discussion of my methodology, I present case studies for two students, Stacey and Lupe, who each illuminate the relationship between political identity and learning in a unique manner. Ultimately, the cases illustrate that explicitly attending to students' political identity deepens our understanding of their learning processes more generally, and also provides insight into ways that students make sense of themselves in relation to the disciplines they are engaging in. In the discussion I make the case that attending to political identity and learning has important theoretical and as well as practical implications for fields including but not limited to STEM education.

## Theoretical perspectives

### *Psychological and sociological perspectives on political identity*

In political science and political psychology research, research on political identity typically begins with and extends social identity theory, which has focused on psychological mechanisms underlying how individuals embrace or reject group membership, how processes of categorization and identification mediate intergroup conflict and conformity to group norms, and how the perceived status of particular groups shapes group behavior and attitudes (Brewer, 1993; Brown, 1995; Tajfel, 1981; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Building on insights and methods from social identity theory, researchers of political identity seek to understand how individuals form allegiances to political parties and the underlying psychological processes that contribute to an individual's embrace or refusal of particular political ideologies (e.g., Citrin, Reingold, & Green, 1990; Schatz, Staub, & Lavine, 1999; Sears & Henry, 1999). However, scholars of political identity have raised concerns regarding the suitability of prevailing methodological approaches and theorizations of identity common in social identity research to address the kinds of phenomena of interest to political identity researchers. For instance, Huddy argues that while social identity

researchers contend that identities are highly contingent upon context, this does little to explain the relative durability of individuals' political allegiances and ideologies across time and space (Huddy, 2001). Furthermore, she makes the case that more attention is needed to variability (how individuals come to choose identities) and development (how identity changes over time), both generally undertheorized in social identity research. I return to this point later in the paper to argue that the field of Learning Sciences offers precisely the kind of conceptual and methodological tools to address Huddy's and others concerns on variability and development. First, though, I turn to how political identity has been studied with respect to children and youth.

While research on political identity has largely overlooked the role schools as institutions play in mediating the political identity development of children, developmental psychological perspectives offer an important foundation from which we can examine political identity as it relates to youth, schools, and learning more generally. For instance, we know that adolescence and early adulthood is a critical period for the formation of political identity (Erikson, 1968). Moreover, even though psychologists have tended to undertheorize social context, there has been widespread recognition that political identity is deeply "influenced by such social dimensions of adolescent life as religious heritage, wars, and conditions surrounding wars, social class, media events, and cohort or generation effects" (Adams, 1985, p. 75). However, there is also a recognition that from a methodological and empirical standpoint, "...much is yet to be learned about the major role played by environment...in the development of political identity" (p. 75). Over three decades later, Adam's challenge to the field still remains, particularly when it comes to questions of how schools develop, constrain, or otherwise mediate the political identity of students. Notably, despite foundational work in education research theorizing the moral foundations of schooling and education more broadly (e.g., Nucci, Krettenauer, & Narváez, 2014; Noddings, 2013), research on moral identity, a closely related construct, has also primarily attended to psychological processes underlying moral behavior and action and generally ignored "how moral identity develops in relation to the environments within which individuals live and grow and how it can be fostered in children and adolescents" (Nasir & Kirshner, 2003, p. 138).

Recent sociological research on political identity offers another approach, shifting the focus from individual processes of identification, to how institutional, historical, and cultural processes shape the relations between self and context. In this frame new kinds of questions and relationships become of interest, such as how political institutions shape cultural meanings. As sociologist Mabel Berezin writes, "modern nation-states serve as vehicles of political emotion. Patriotism and nationalism, political love and political hate, define friends and enemies" (Berezin, 2001, p. 86). This line of work takes up political identity as it relates to citizenship, nationalism, and other forms of political belonging and participation. Interestingly, this view of political identity also challenges the premise that political identities are stable, pointing instead to their vulnerability to various forms of social and political upheaval. For instance, drawing from her research on the intersections of identity, political ritual, and national politics in Fascist Italy, Berezin defines political identities as subjective identities that are inherently "public identities," and as such are "second place to more deeply felt private identities" (p. 83). She goes on to say, "political identities tread a difficult line as they require that individuals feel that something exists outside the private self - the party, the state..." (p. 83) but nevertheless are linked to emotion and the realm of felt experience. This view of political identity centers the notion that political identities are highly malleable, historically contingent, and dynamically produced in relation to local contexts, a perspective acknowledged conceptually but glossed over empirically by the psychological approaches discussed earlier.

### **Critical pedagogy**

Thus far I've noted that political identity has been undertheorized with respect to environment and social context broadly, and more specifically with respect to schools and learning processes.

There is, however, an important body of work on critical pedagogy that takes seriously the responsibility of schools in the political formation of young people. Commonly tracing back to the work of Brazilian philosopher Paulo Freire (Freire, 1970/2002), the critical pedagogy tradition engages in questions related to the moral and political purposes of schooling and the means by which schooling activities can develop social and political dispositions of learners. The concept of critical consciousness, for example, has been critically vital to the work of activists and educators aiming to guide students toward a deeper awareness of systems and structures of oppression and marginalization (Akom, 2009; Duncan-Andrade & Morrell, 2008; Kirshner, Hipolito-Delgado, & Zion, 2015; Stovall, 2006). Consider for instance the foundational work of educational theorist Gloria Ladson-Billings on culturally relevant pedagogy (Ladson-Billings, 1995), which while often misread as a cultural but *not* political theory (Beauboeuf-Lafontant, 1999), is firmly anchored in the goal of racial and political empowerment of African-American children. Another example is youth organizing and participatory action research (YPAR) approaches, which provide opportunities for youth of color to leverage their immediate contact and experiences with systems of oppression in service of developing more nuanced and complex understandings of their social world (Cammarota & Fine, 2008; Ginwright & Cammarota, 2011; Kirshner, 2015). While a complete review of pedagogical approaches that share philosophical affiliations with critical pedagogy is outside of the scope of this paper, it is important to note that there is a very deep tradition of educational endeavors that, in addition to academic aims, center sociopolitical development as a primary end. However, it is also the case that the bulk of work on critical pedagogy has undertheorized identity, and learning processes more generally (Gutiérrez & Vossoughi, 2016). Themes of resistance, knowledge, agency, critical literacies and critical consciousness are undoubtedly central to any theory of political development, but my focus in this article is on the specific processes related to conceptions of self and identity. More specifically, I provide a conceptual and empirical account of the way that political identity and learning become intertwined in the context of learning to design technological artifacts for social change, which I argue has important implications for how *any* learning environment mediates the political identities of learners.

### ***Theorizing disciplinary values interpretation***

Scholars of human development find common ground in the notion that learning is intrinsic to the human experience. Similarly, philosophers have long contended that being human is an inherently political experience. From Aristotle's famous aphorism, "man is a political animal," to more recent critical philosophical works (e.g., Sylvia Wynter's recent edited book *On being human as praxis* (McKittrick, 2015)), the idea that the activity of *being* or existing in the world (Dreyfus, 1991) as a human necessitates interaction with questions and scenarios of power, morality, and justice is axiomatic in the humanities. When viewed together, sociocultural and philosophical perspectives suggest seeing learning as "enmeshed with ethical relations" (Sengupta-Irving & Vossoughi, 2019). And if, as Wenger elegantly puts it, "learning is an experience of identity" (Wenger, 1998, p. 215) then shifts in one's identity not only give rise to new ways of making meaning of and interacting with the world but also shift one's ethical relationship with the world. As such, as one's sense of self undergoes transformation (through learning), one reorients and reinterprets the world around her, a process which includes conscious assessments of the newly afforded possibilities for thinking, acting, and being in the world. And this is precisely where I view the phenomenon of political identity to be of particular salience. Disciplinary learning always entails encounters with the values of knowledge that comprise disciplinary domains, and with the ways in which such knowledge facilitates or obstructs particular kinds of action, thought, and trajectories of becoming. A conceptual focus on political identity captures the specific phenomenon of individuals making meaning of such encounters.

Political identity has been defined by Yates and Youniss (1998) as an “outward-looking process in which youth anticipate their lives as adults and struggle to understand who they are within a social and historical framework” (p. 495). They go on to say, “as part of this effort, youth reflect on the values, ideologies, and traditions of their communities and the possible roles they will undertake in adulthood” (p. 495). In this article, I take up this broader perspective on political identity and extend it to examine how processes of reflection regarding oneself and possible futures for oneself are *intertwined with disciplinary learning processes*. I begin with the position that disciplines are themselves political in that they are dynamically evolving, historically accumulated representations of knowledge congealed together through complex interactions between history, politics, and culture (Bang & Vossoughi, 2016; Medin & Bang, 2014). Learning environments, therefore, *always* carry and convey political values. These values sometimes are enacted explicitly while other times the political valence of disciplinary knowledge may be implicit, subtle, and less easily discernible (Vea, 2018). Nevertheless, sociopolitical values of learning contexts interact with students’ learning and identity development in dynamic and often unanticipated ways. Similar to how scholars have theorized and empirically studied racialization processes in supposedly race-neutral contexts such as math classrooms (e.g., Martin, 2009; Shah, 2017), I take the position that politicization occurs in *all* learning environments. And that, “as a sociocultural and sociopolitical experience, learning any subject matter is about developing competencies related to this discipline and ‘a way of being in the world’ [Wenger, 1998, p. 151] relative to the discipline” (Varelas et al., 2012, p. 324). In addition, and alongside to becoming socialized into a particular way of being while learning content in a disciplinary domain, learning also entails a process I call *disciplinary values interpretation*, a process whereby individuals:

- Reflect on and interpret narratives surrounding the political and ethical values of their learning as part of a process of meaning-making *about their learning*
- Develop a broad sense of how their learning is connected to the “outside” world
- Consider the kind of person one has to be, or become, in order to participate in the communities of practice explicitly or implicitly associated with particular forms or domains of knowledge.

Disciplinary values interpretation co-occurs and is interwoven with content learning, and can have profound implications for how students’ political identities interact, align, or interfere with their disciplinary learning and identities. Consider for instance the case of an urban school serving primarily students of color that partners with a nearby technology company to offer computer science courses to students. And imagine that the community in which this school is located has a complicated and at times negative relationship with the technology industry, which many members of the community hold responsible for processes of gentrification, displacement, and cultural erasure. In this context, disciplinary values interpretation may capture students’ sensemaking about what the discipline of computer science is “all about,” and what it might mean for them to be a part of it as they begin to imagine their future academic, career, and life goals. *How will gaining expertise in this domain of knowledge help me? Will it help my family? My community? My society? What kind of person will I become if I pursue computer science in college?* Though rarely explicitly raised with students, these are the kinds of questions that lie at the heart of disciplinary values interpretation and those with which students in this study grappled with in the context of a computer science unit designed to probe the ethics and politics of technology. The research takes place within an urban community grappling with housing and demographic changes brought about, at least in part, by the aggressively expanding cultural and economic presence of the tech industry. This growth has included recent forays into computer science education, including partnerships to broaden access to computing with the school and district that I write about here. This paper is rooted in my collaboration with a computer science teacher to

design a curriculum unit that offered multiple opportunities for students to engage in sensemaking about the values of computer science knowledge and learning in their school and community context. Specifically, I sought to answer the following research questions:

1. How does the explicit framing of “technology for social good” create resources for students to reconsider the values associated with the discipline of computer science?
2. How are students’ political identities enacted as they participate in a learning community organized explicitly around equity and justice?
3. How do students’ political identities shape and become shaped by their engagement in designing socially and personally meaningful technologies?

## Methods

### *Research setting and context*

This study reports on a social design experiment (Gutiérrez, Jurow, & Vakil, in press; Gutiérrez & Jurow, 2016; Gutiérrez & Vossoughi, 2010) conducted in partnership with a computer science teacher at Bay Prep<sup>1</sup> (referred to as “Prep”), a racially diverse public school in the Greenwood Unified School District (GUSD). Prep is the largest comprehensive public school in the district, serving over 1800 students. Although they were previously the majority population of the school, at the time of the study African-American students currently constituted less than 40% of the student population. The remaining population was almost evenly divided between Asian, Latinx, and White students. Over half of the students at Prep are classified as socioeconomically disadvantaged. However, due to neighborhood gentrification, this number has been declining in recent years. Prep is known throughout the district for its academies and learning pathways, including the Computer Science and Technology (CST) Academy. At the time of this study, 40% of CST students were Black and 17% were Latinx (compared to 5% for both groups in the Mathematical Sciences Academy, the other STEM-focused academy of the school). However, with respect to gender the CST academy had the largest differential between boys and girls, 73% and 27%, respectively.

I collaborated with Mr. Mayson, a Black teacher and director of the academy, to design and teach a 10-week unit that drew connections between design, computer science, and educational equity topics. The structure of the 10-week curriculum was based in large measure on insights about the school and the CST Academy gained from an ethnographic study of the school (Nasir & Vakil, 2017). These include the following: (a) the CST Academy was established and operates as a racial justice intervention in the school. The academy was actually founded as a direct response to the lack of diversity in the Mathematical Sciences Academy; (b) students of color at Prep were well aware of the history and purpose of the academy; yet (c) discussions of equity, gender, race, and other politicized topics were largely absent within the 10th grade Introductory Computer Science classes. This absence persisted despite the formal adoption of the culturally relevant Exploring Computer Science (ECS) curriculum developed by UCLA teachers and researchers (Goode & Chapman, 2016).

Based on these insights, the 10-week project-based unit, Designing for Equity at Prep (DEP), consists of a series of activities intended to reframe students’ experiences with race and equity issues as highly relevant to the teaching and learning of computer science and to therefore offer an opportunity to reconsider the disciplinary values students often associate with the discipline of CS. Students worked in groups on problems of their choosing to design computational artifacts that addressed specific equity challenges in their school. Interwoven with the design process, students were prompted to engage in disciplinary values interpretation throughout the unit.

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<sup>1</sup>The name of the school, district, and all student and teacher names are pseudonyms.

For example, students wrote write memos reflecting on the politics of their technological artifacts, defined as how a technological artifact always frames and “locates” the problem it is trying to address (see [Appendix A](#)). The learning objective was for students to gain an understanding that their technological artifact would itself stand as an argument for how the group was conceptualizing the underlying social problem they were hoping to remedy, as well as to provide an opportunity for students to reflect on the disciplinary values of CS.

### **Data collection**

The DEP curriculum unit was implemented in two periods of Mr. Mayson’s 10th grade Computer Science class, with approximately 30 students in each class. From these two classes, my study focuses on 12 focal students, spanning 7 student groups, each group focusing on a specific equity issue within the school. To study the relationship between political identity and learning, I collected and analyzed multiple sources of data. I conducted semi-structured group-based artifact interviews with 7 design teams, resulting in 14 interviews. Interview questions were focused on understanding how students were making sense of the technological artifact and the social impact they hoped it would have. Additionally, I have approximately 17 hours of video recordings capturing design teams collaborative work. Two video cameras were used, and each recording was either focused on a single group, pedagogical and instructional practices, or whole-class conversations. In addition to these data sources, I wrote weekly field notes and created a questionnaire that I administered prior to the design experiment, and immediately after. The questionnaire was created by drawing on the ethnographic phase of the study mentioned previously to understand student interpretations of computer science as a discipline, to assess students’ position on educational equity issues in their school and community, to learn about motivations students had for selecting the CST academy, and to probe their views on the potential for technology to intervene as a force for change in the social condition of their school and community. The questionnaire is available in its entirety in [Appendix B](#).

### **Analytic approach**

Given this range in data sources, my analytical methods were varied. I did a number of things with each component of the data set. The first phase of my data analysis entailed gaining a preliminary understanding of students’ political and disciplinary identities at the start of the project. To gain an understanding of how students identified with respect to computer science and to get an initial snapshot of their political identities, I relied primarily on questionnaire data, student work from the *Identity Memo* assignment (see [Appendix A](#)), and field notes documenting my discussions with Mr. Mayson. I conducted an open-ended coding of these data resulting in conceptual categories related to how and why individual students entered into the CST academy, their engagement and performance in the class, their participation in after school programs and clubs, and their understandings of and feelings toward educational equity issues that were salient in the school. Using these conceptual categories, I wrote analytic memos for each focal student that I modified throughout the course of the experiment, which also provided a record to examine how students’ identities were shaping and being shaped over the course of the design.

In the next phase of my analysis, I examined how students’ political identities were enacted within classroom discourse and activity. Toward this end, I analyzed field notes as well as content logs created from video recordings taken of groups working on their designs throughout the course of the experiment. Video content logs captured specific episodes of interaction between students that highlighted how their political identities were shaping and being shaped by the group’s talk and interaction. In my initial reading of field notes and video content logs, I searched for moments in the data where topics related to educational inequality, or values of

technology were explicitly referenced. I created codes to identify when the political talk was initiated by students (*i-students*, 17 times), extended by students (*e-students*, 34 times), initiated by either myself or Mr. Mayson (*i-teacher*, 54 times), or extended by either myself or Mr. Mayson (*e-teacher*, 64 times). For example, in a class session in the second week of the unit, a group of girls identified gender inequity in the Computer Academy as the problem they were hoping to address in their project. They presented statistics documenting the disparity and also shared their personal experiences as girls in the academy. This was coded as student initiated, and Mr. Mayson's commentary directly after the presentation was coded as teacher extension: "Yes.that was very good.let's give them some appreciation (*students clap*)... Jessica and Sam make very important points. If a certain group of people is making technology, then technology will only reflect the values of that particular group, but if you bring in different groups, the technology will accommodate different perspectives... the technology and computers of tomorrow should have input from all different groups."

In addition to explicit moments of political talk, careful review of my video recordings and field notes revealed students' political identities were also made visible in episodes I coded as *political-racial contestation* (24 instances across data corpus), which I define as stretches of activity where students' racial identities became salient in how they positioned themselves, or were positioned by others, in relation to a particular political topic. An example of this is how several students of color expressed disapproval of a white student's idea to create a website documenting racial inequity in the school. Interestingly, their objection was not rooted in disagreement with the proposed content of the website, but rather in the perceived legitimacy of a white male student to address racial inequity. After a series of contestations from several students in the class, a Black male student seated in the back of the room solemnly asked, "why do *you* care about this problem?," implicitly questioning the authenticity of the student's project.

Finally, to examine the interaction between students' political identity and their learning, I employed two strategies. First, I looked across my data for instances where students' identities were consequential for specific design choices they made. For each design group, I constructed a two-column table with specific features of the artifact on the left, and the corresponding sociocultural or political idea and description of how students' political identities related (or not) to a particular design feature. An example of this is a web-based surveillance system proposed by a group of all-male Asian students to mitigate racist harassment they encountered on a frequent basis. In the first few weeks of the curriculum, the students had voiced that Asian students are frequently bullied in the hallways and in the bathrooms by students "roaming the halls who don't care about school.really" (Field notes, March 10). They had also made frequent statements that the school provides equal opportunities for all students to be academically successful, contradicting their peers' concerns about systemic racial and gender inequities in their school. When viewed together, it was clear that their political and racial identities were highly salient in the decision to include a surveillance feature as part of their technology solution to the social problem of bullying. In addition to tracing how students' identities were influencing their learning and design decisions, I also looked for instances in the data where participating as a member of the learning community (within design activities, collaborative talk in small groups, or whole-class discussion) had observable consequences for their emerging political ideas and identities. I drew on student artifacts, questionnaire data, and artifact-based interviews of groups to refine the analytic memos I had written for each of the twelve focal students.

The process of refining the analytic memos led to the decision to create cases (Stake, 1995; Yin, 2002) of two focal students in particular, Stacey and Lupe. The decision to create cases for Stacey and Lupe was based on my goal to more carefully examine the relationship between learning and political identity. The analytic memos revealed that Stacey and Lupe had very strong computer science identities in a traditional sense, and also histories of participation as active members of the learning community. Both students were deeply engaged in the class, prior to

and during the design experiment, and were viewed by their classmates and by Mr. Mayson as class leaders. Interestingly, however, they expressed very different political identities prior to the experiment. The fact that they displayed strong similarities in terms of their disciplinary identity and engagement in the learning community yet had stark differences in their political identities provided an opportunity to explore specifically how their political identities shaped and were shaped by their participation in the learning community. Drawing across several of the analytic memos, I begin each case by providing background on the case study, describing the group the case student was a part of, their educational equity topic, and the technologies they designed. Throughout these descriptions, I focus particular attention on contributions made by the case study student. Finally, drawing on multiple sources of data associated specifically with the case student, I describe in close detail how the student's learning processes and political identity interacted with one another and mediated one another's evolution throughout the course of the design.

## Case studies

In this section, I closely examine the identity experiences of two students, Stacey and Lupe, throughout the ten-week social design experiment. My analysis focuses on how their political identities guided their participation in learning processes and ultimately informed the final technological artifacts they designed. The two cases illustrate not only that students' identities informed their production of technological artifacts designed to stimulate social change in their school, but also that being engaged in the practice of socially relevant technological design mediated the development and centrality of students' political identities. Though the identity trajectories and transformations of Stacey and Lupe were quite different, the case of each student illuminates the dynamic interaction between political identity and learning. For Stacey, engaging in a collaborative process of designing socially relevant technology challenged her ideas about educational inequality, and offered new opportunities to embrace a political identity. Although she was a highly engaged and motivated CS student prior to the design study, she took on a new identity as an advocate for social justice that emerged in the context of, and therefore tightly linked to, her participation as a learner in a CS classroom. Lupe was a similarly engaged and a high-performing CS student prior to the 10-week unit. However, in contrast to Stacey, Lupe had a robust political identity that existed alongside but in tension with her CS identity. The experience of engaging in the practice of socially relevant design strengthened her overall CS identity by attending directly to this tension, ultimately allowing Lupe to view her interest in CS as complementary—rather than contradictory—to her political commitments.

To tell the story of Stacey and Lupe and the artifacts they created, I have to also tell the story of the groups they worked within. I begin each case by describing the technological artifact and the corresponding politics it was attempting to enact, focusing particularly on how the artifact was enacting a particular political stance on educational inequality. I then narrow my attention to the unique experiences of Stacey and Lupe, focusing specifically on the identity trajectories and transformations they experienced throughout the design process. I begin with Stacey and the Woodland Fairies Group.

### Case of Stacey

At the time of the study, Stacey was a 15-year-old high school sophomore at Bay Prep who, in her own words, had “lots of experience with diversity and bilingualism.” Her mother is from France and her father from California. Stacey grew up speaking French and English and, prior to Bay Prep, attended a small private French-American school. Stacey holds both of her parents in high regard, which is not surprising given that her mom is a doctor and researcher of child

leukemia, and her father is a grip, someone who works as a lighting or rigging technician in the film and video production industry. Upon completing her private elementary school, her parents enrolled Stacey in a public middle school. Transitioning from private to public schools was eye-opening for Stacey. She describes this through a metaphor of a “widening lens.” Once entering high school, Stacey explains that her lens “to see the world widened at least eight notches.” In her identity memo, Stacey identified herself as “a tall skinny mixed girl with crazy curly hair who could speak french and english.” Throughout the course of the design, she was hesitant to identify as “Black,” despite some of her Black peers encouraging her to do so. Stacey, despite showing awareness of how certain groups were underrepresented in certain academies, displayed a reluctance to explain these disparities in terms of racism, or even race: “I began to notice that the mixed girls I was seeing in the hall weren’t in my advanced courses, and the girls with the poofy hair weren’t in my [Excelsior] class...” In the classroom, Stacey was a natural leader, well-liked by teachers and students alike. In the CST academy in particular, Mr. Mayson described Stacey “as one of the best and most motivated students.” She was enthusiastic about technology and in her pre and post questionnaire reported a strong desire to pursue computer science as a college major and possible future career pathway.

### ***Woodland fairies group and the “Shadow App”***

Stacey and her group mates, Lidiya, Angela, Candice, and Ben, call themselves the “Woodland Fairies group.” They worked together for several weeks to design an app that aimed to increase diversity in the most rigorous academic spaces in their school. Stacey, in her Politics of Technology Memo, describes the equity issue her group addresses as “...the inability of low income and of minorities to be exposed to the amount of crucial opportunities they could be provided.”

Their final app was an intervention upon the shadow system<sup>2</sup> of the school and was appropriately titled “The Shadow App” (See [Figure 1](#)). The shadow app aims to alter the processes through which incoming students are matched with upper classmen in the school’s existing shadow system. The current shadow system of the school has been implemented to help incoming 9th graders gain a sense of the various programs and academies within the school by “shadowing” an upper classman. The students call the one who is being shadowed the “shadowee.” Angela, a quiet but thoughtful member of the Woodland Fairies, elaborated further in her Politics of Technology Memo:

We are taking the basic Shadowing system here at [Prep] and building onto it... This will enable students, and anyone else who wants to see, to get a more in depth view of academies and programs and other things that are offered at school. The target audience is mainly incoming freshmen, but as we develop the idea, could be useful for students in general. We would like to provide a source of role models for minorities.

The students argued in the course of the design process that tailoring the shadow system to students’ interests would allow a greater number of students of color, who are drastically underrepresented in many of the school’s academies and programs, to make a connection with and ultimately seek entry into one of the school’s rigorous academies. Stacey, again in her Politics of Technology memo, addressed the issue of race/ethnicity (and gender) directly: “We also provide the opportunity to choose the gender and ethnicity of the individual if they feel more comfortable identifying with race than with the subject itself.” Similarly, Angela frames the shortcomings of the current shadow system in general and the ways their artifact would improve upon it in terms of potential benefits to students of color in particular.

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<sup>2</sup>The shadow system allows incoming 9th graders to observe or “shadow” upperclassmen in academic as well as social spaces in the school.

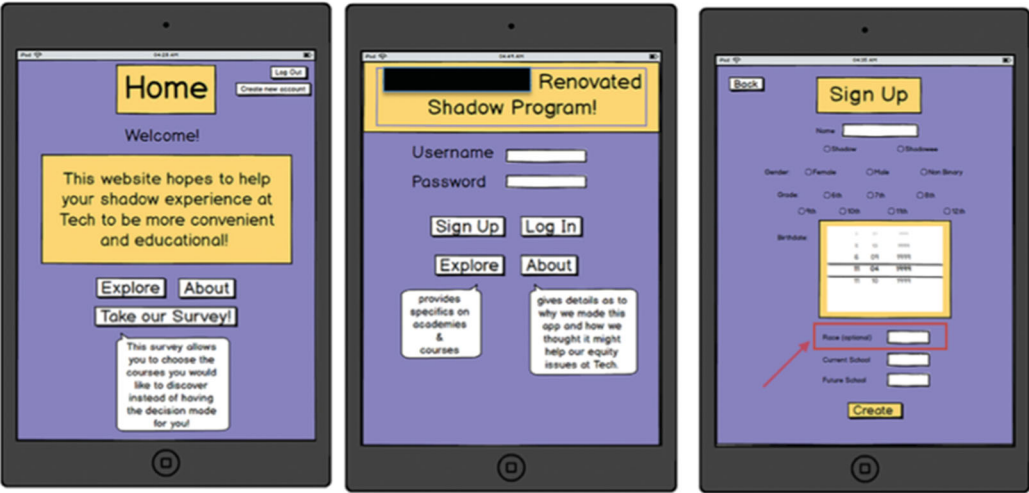


Figure 1. Shadow App.

Table 1. Politics of Shadow App.

Technology feature/function	Politics enacted
Repository of information about academies	Lack of role models of particular race/genders in rigorous academic spaces contributes to discourse that marginalizes students of color in the school.
Survey to assess student interest	Race-conscious systems are needed to address racialized inequities in the school.
Matching Algorithm	Student interest as tied to opportunity structures.

We want their stories to be up on our site for encouragement or information or just to let people know that people like them exist; people like them have checked out the opportunities at [Prep]. The Shadowing aspect will work with [Prep] to schedule more detailed shadowings. Students should be able to go in and get a first person view of the things they are interested in and are thinking about checking out at [Prep]. With our current system, students are either set up with a friend/relative or a random person, and these options do not necessarily give students a wide range of things to see. The website/app itself will have a menu page that clearly links to people’s advice, descriptions of academies and what not, and a contact page. It should be easy to navigate, and easy to set up a Shadowing visit... This method addresses the equity problem because it allows for minorities, who are statistically less present in academies and such at [Prep], to see what they are interested in and get a role model’s perspective. It empowers kids to know that they can beat racial biases and do what they want to do.

To these ends, the app offers three primary functions/services: (a) a repository of detailed information about each of the school’s various academies, including course sequences and requirements for admission; (b) a survey intended to develop a profile of student interest (including race and gender information to allow students of color and girls to select a shadowee from a race/gender category of their choosing); and (c) a matching algorithm that connects students to shadowees based on the profile and availability of shadowees. By intervening on a school level structure (the existing shadowing system) and framing student interest as being deeply connected to structures of opportunity within the school, Stacey and her groupmates ultimately designed an artifact which enacted a critical stance toward issues of educational inequality (see Table 1).

However, it is important to note that the specific features and functions of their final artifact and the politics associated with it were constantly in negotiation throughout the course of the 10-week unit. The final design of the Shadow App, and its political meaning, represents the culmination of Stacey and her group’s design processes. The design journey leading to the Shadow App was one of complex and often uncomfortable conversations between students about

their own identities and experiences, the values of their school, and why certain groups in their school were excluded from the most coveted educational opportunities and resources. I now turn to an examination of how Stacey's understanding of her school and her place within the school shaped and was transformed through the course of the design process.

### ***Stacey's identity processes and transformations***

In stark contrast to the critical stance reflected in the Shadow App, in the early weeks of the design process Stacey expressed a political identity closely aligned with deficit narratives that tend to obscure ways in which inequality in achievement between racial groups is linked to a long history of structural discrimination (Solorzano & Yosso, 2001). During a discussion with members of her group about a commonly used phrase in the school, "Two [Preps]," which highlights the highly unequal and racialized experiences of students within the school, Stacey stated:

I think what people mean by that term is that the people who are chosen are part of an elite that, that academy prefers... preferences either through grade, ethnicity... um, and I guess behavior maybe... but I disagree with it though because if you put your mind and effort everyone can have the same opportunities.

The following week, Stacey and her group had settled on diversity as their equity topic, though they were still working out as a group how best to characterize the problem. In my field notes, I begin to notice a relationship between Stacey's racial identity and her conceptualization of the diversity problem at Prep:

Students worked today to identify root causes of the diversity problem in their school...lots of good discussion and some disagreement. Interesting that Stacey, the only other Black student in the group besides Lidiya (who is of Eritrean descent), frames diversity mostly in terms of the culture of underrepresented groups, and even referred specifically to "group mentality" amongst African-American students to explain why they are not represented in some of the academies. I also observed that she talks about Black students in a way that suggests she may not see herself as Black. I wonder how this plays into her understanding of diversity issues? (Field Notes, March 26)

A few classes later, in another discussion with her group, Stacey voluntarily brought up her own racial identity while discussing the experiences of Black students in the academies. "I'm not complete black, I'm mixed but..." Lidiya, who identifies both as Black and Eritrean, was seated on a table, interrupted Stacey, leaned down and patted her on the shoulder while saying with a warm smile, "...you are Black," as if to affirm her authority in talking about the experiences of other Black students in the school.

Interestingly, the following week after another group in the class comprised of white and Asian students had presented their design ideas about addressing diversity specifically within an Honors English/History pathway, Stacey raised her hand and offered up her own experience as testimony during a class debate about whether or not the presenting group was justified in taking on this issue. This was significant because directly after the group had presented, several students of color in the class had expressed strong disapproval, not with the content of the presentation, but with the fact that *these* students had taken up racial equity as their focus topic. Video from that class session shows students rolling their eyes while muttering "white kids," followed with a student blurting out "racist!" The momentary relief to the otherwise uniform challenge to their authority came when Stacey offered her own presence as an underrepresented Black student in the academy as evidence to support and legitimate the group's focus on African-American students: "so I understand why they would ask that question... in my [Excelsior<sup>3</sup>] class, Brian and I are like the only Black people." In my field notes from that class, I noted that Stacey's voice had lowered a bit while speaking to the class, and that her statement marked a significant

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<sup>3</sup>An advanced learning pathway focused on English and Social Studies.

moment where Stacey claims a Black racial identity in front of the entire class as a way to legitimize her viewpoint and bolster her argument in support of the presenting group. In this way, her evolving racial identity was inextricably linked with her reconceptualization of the diversity problem as a uniquely racialized and structural issue in the school, signaling a shift in her political identity. In a written assignment midway through the unit, Stacey elaborated her growing understanding of the diversity problem her group was tackling. “I began to notice that the mixed girls I was seeing in the hall weren’t in my advanced courses, and the girls with the poofy hair weren’t in my [Excelsior] class, which caused me to reevaluate how diverse the school actually was on a smaller level, the classroom.” Importantly, the tensions playing out at the classroom level are reflective of escalating racial tensions operating at the level of the school and city. The lack of what we have called *politicized trust* in this particular classroom limited possibilities for collective learning, technology design, and social analysis (Vakil & McKinney de Royston, 2019).

Stacey’s active participation as a learner and designer in the classroom community was supporting a renewed understanding of educational inequality as a specifically racialized and structural issue in her school, which in turn was seeding possibility for an emergent racial and political identity. These identities, then, were opening space for new forms of participation in the design process, and new ways to interpret the values associated with the discipline of computer science. For instance, during her interview when asked to comment on the extent to which the design of their final artifact met the social goals of their project, Stacey said the following:

Although most of our ideas and technology is thought out, there are still a few problems with our concept...like...so there might not be a black sophomore in the engineering academy next year that a sophomore was hoping to visit, but we will try our best to fix those flaws through more brainstorming and effort.

Here, Stacey is speaking specifically of the design feature that matched incoming students to current students based on race, a feature that was added to the design to directly meet the needs of students of color. It’s important to know that the inclusion of this feature was the source of much debate, and at times friction, between students in the group who felt strongly that their app should be race-neutral and others who argued that the primary purpose of the artifact was to disrupt racialized structures and processes in the school. In the first few weeks of the unit, Stacey was firmly in the former group, resisting the notion that Prep disadvantaged students based on race. In the statement above, however, we see a shift in her thinking which also coincides with her expanding racial and political identities. By voicing a nuanced concern about a potential scenario where their artifact in its current iteration would fall short from its intended goals to support students of color in effectively navigating school structures, she demonstrated a new sensitivity and focused attention to the experiences of Black students. Her political identity is activated here within the context of what we might characterize as an emergent racially-conscious technological design sensibility (Fouché, 2006). As such, the relationship between Stacey’s political identity and her engagement in learning and design processes was highly dynamic and reciprocal in nature.

It also became evident that the experience of collaboratively designing socially relevant technology was an opportunity for Stacey to reflect on the values of computer science as a discipline. In the pre- and post- questionnaire, students were asked to describe how and why they selected to enroll in the CST academy. Stacey answered the same question quite differently in the post questionnaire. In the pre- questionnaire, she wrote: “I joined the academy because I believed a basic knowledge in this field is good to enter when finding jobs in the 21st century. I also believed there would be many jobs in this field for women and I hoped it would prepare me for the future.” In the post- questionnaire, she similarly framed her interest in the CST academy in terms of future employment opportunities. However, in addition to the gendered analysis, she also included a racialized and political narrative absent in the pre-survey:

I chose the Computer Science and Technology Academy because I have always had an interest in technology as well as the belief that one day every job will involve technology...When I visited [Preps]

courses before officially enrolling in the school, Mr. [Mayson] converted me even more towards practicing computer science with the thought that, especially as a mixed girl, it would open so many more opportunities that I never believed I had.

That Stacey links learning computer science to the opening up of new opportunities “especially as a mixed girl” underscores her emergent racial identity, but also shows how Stacey was making meaning about what it means, specifically for her, to pursue computer science. Here, Stacey is reflecting on not only her own identity within CS, but also of the values she associates with CS as a discipline and as a career path (“it would open so many more opportunities that I never believed I had”). When prompted to reflect specifically on the experience of designing socially relevant technology, she wrote the following:

Because of this project, I am not only creating and coding an app that hopes to aid the issue, which is something I never envisioned accomplishing, but it has also opened the door to so many opportunities and interests I never knew I had such as internships and maybe the chance to lead a club that's aim will be to help [Prep's] equity issues. This unit has taught me so much about my community and how it is structured, why it is the way it is and what we can do to make it better through technology. I have loved discussing my point of views with peers and reevaluating thoughts I once thought were true, but now not so much. I hope that by pursuing and perfecting my app that I will learn more.

Stacey's response here shows the experience of collaboratively designing a socially meaningful technological artifact served as a catalyst for her racial and political identity development, and also that the project provided new ways for her to make sense of how CS as a discipline might matter in the world. Stacey voices agency that she can intervene in her community and “make it better through technology,” a powerful embodiment of both the political stance of a student who believes her actions can make a difference in the world, and also a perspective that technology (and by extension CS) can be a part of that change process. Significantly, for Stacey, her experiences of developing a racial and political identity as a Black girl who can create change in her world happened in the context of a computer science classroom.

### **Case of Lupe**

Lupe was born and raised in a racially diverse urban city known for its working-class roots, high rates of crime and violence, as well as a rich legacy of political dissent and social activism. Her dad is Mexican and her mom is white. According to Lupe, because her mom speaks Spanish, she sometimes identifies as Mexican, which Lupe feels is “really messed up.” Lupe, similar to Stacey, used to refer to herself as “mixed.” She reports having been bullied by other students who called her white due to her fair skin, but that she has since “realized she is a person of color.” She also identifies as a feminist and participates actively in the feminist club, where she begrudges the occasional presence of boys. Lupe's political identity is evident not only in the way she situates and understands her own experiences, but also in her nuanced understanding of complex topics regarding inequality and marginalization in her school. In an activity toward the beginning of the design experiment, she identified sexism and misogyny as serious equity issues at Prep:

Sexism and misogyny in classroom settings usually aren't blatant, it's the underlying attitudes and practices of male classmates and teachers that make women uncomfortable and alienated. Examples of this could be making jokes to a mostly male audience that belittle and insult women, or patronizing women and treating them like they always need help or like they are not capable.

Her political identity was also evident in her understanding of how race operates to exclude and frame students of color at Bay Prep. Going beyond a description of how students of color are underrepresented in certain academies, Lupe dives into the even more complex issue regarding an underlying ideology that ties academic success to notions of “good” and “bad” students of color. Specifically, she calls out

that attitude that only the best of the best of people of color can be in [Excelsior] because it's so elitist but that's obviously not true seeing some of the white people. This promotes the belief in privileged people that there are "good" poc [people of color] and "bad" poc, a very common attitude at [Prep]. [Excelsior] is only another class and while its challenging, it's not impossible. I think theres a wrong image of it that it's only for the elite (even tho thats what it acts like when accepting poc) which is a reason of many why poc might not apply.

Though she is critical of the "elite" spaces like [Excelsior], she is herself a high-achieving student who is part of those academies. Yet, she has resisted assimilating to the cultural norms and practices of these exclusive spaces, and instead works with other students to not only criticize but also to transform the oppressive structures of her school (Solorzano & Yosso, 2001). Her participation in the CST academy is no different: she is there because of her strong interest in technology, though she is highly critical of the male-dominated environment.

### ***Stem Gal: a game by and for girls of color in STEM***

Lupe, along with her best friend and design partner, Candice, created a video game designed to empower girls of color in STEM spaces. In contrast to Stacey, Lupe and Candice's racial as well as political identities were central to how they defined themselves, and were evident from the very beginning of the curriculum unit. Lupe and Candice, an African-American girl, repeatedly expressed the deep connections between race and gender issues. In her Identity Memo, Candice drew links between her out-of-school interests and her own racial and gender identity:

Feminism is important to me because I'm a BLACK GIRL [caps original] which is 2 minorities wrapped into one... I'm in a lot of clubs at school like film club which is where we watch movies and feminist club where we talk about feminism and QSA where we talk about queerphobia.

Similarly, Lupe said that social justice concerns were central to her identity:

I really want to make a change in this school but also in general. I am a feminist and I feel like that covers intersectionality and the problems that people of color and trans people and disabled people and all the types of oppression that comes together in this world. In my experience as a girl I have felt uncomfortable and definitely annoyed with male teachers and just overall not the same environment as a female teacher environment. [Excelsior] is something I especially want to fix because there are so little people of color and girls speak only when called on while boys speak when it's not even their turn.

While brainstorming about specific equity issues to address, the students narrowed their focus on gender inequality within the CST academy itself. However, their analysis and focus on gender was not disconnected from their broader experiences related to race. As Candice stated in her Politics of Technology memo:

And when I say gender inequality I'm not just talking about gender, race comes into play too. I'm one of I think 4 black girls in my year of technology academy. I think Lupe is 1 of 3 Latina girls in Technology Academy. It's important that with our technology we target girls, but getting girls of color involved in STEM is really important to us too.

Using the Scratch programming environment, Lupe and Candice designed *Stem Gal* (see Figure 2), a video game to help girls of color resist negative stereotyping in STEM environments. *Stem Gal* incorporates elements from a genre of video game design known as action role-playing games, or action RPGs, in which the player's success is a function of the speed, frequency, and timing of particular actions. In the case of *Stem Gal*, the primary objective for the main player, a customizable avatar set by default to a phenotypically Black female, is to effectively navigate a hostile STEM environment by avoiding condescending remarks and interactions from (white) males and to build solidarity with other girls of color in the environment and earn "confidence points" while doing so.

The concept for this game not only reflects Lupe and Candice's political identities in a general manner, but also emerges from and reflects specific experiences the students have



Figure 2. Stem Gal.

Table 2. Politics of Stem Gal.

Technology feature/function	Politics represented (political qualities)
Girl of Color Avatar as Protagonist and White Male Avatar as Antagonist	Girls of color experience marginalization in White and male-dominated STEM spaces. Social justice is achieved through empowering people of color.
Confidence points	Individual members of marginalized groups can develop confidence through acts of solidarity with one another.
Simulation of motion/navigation through STEM space	STEM learning environments are relational environments. Interactions with other students shape quality of learning experiences.
Simulation of Jumping Over White Male Antagonists	Racism/sexism should be actively confronted and resisted.

experienced at Prep. During an interview, Lupe described one such experience in the Computer Academy:

The tech world has so many guys but there really aren't a lot of girls and when there are, they're in a male dominated environment that makes them self-conscious about their abilities, purpose, and a lot of other things. We know this because this is how we feel... One time we were doing a lab [in the Computer Academy] where we take apart a computer and this boy came and super patronizingly asked us if we needed help. He said we looked like we needed help because we were going a little slower than everyone else. That would be a huge reason for girls not wanting to be in STEM. And then I think for girls of color it's because there's no representation. You rarely see anyone that looks like you that's painted in a good light in the media if you're a girl of color, so you probably really won't see one in STEM.

I now provide a closer examination of the nature of the politics advanced through *Stem Gal*, summarized in Table 2. Both Lupe and Candice were clear about *whom* their game was being designed for: girls of color in STEM spaces. Designing intentionally with specific target users in mind is generally regarded as an important design practice (Abrams, Maloney-Krichmar, & Preece, 2004), but in this case, it is also an enactment of Lupe and Candice's racially-conscious political identities. In her Politics of Technology Memo, Candice elaborated:

Games that are targeted at privileged people in the point of view of oppressed people are so problematic. They don't ever accomplish anything because they tell the story that oppressed people have been trying to

tell forever. It promotes the practice of disbelieving oppressed people until the privileged ones have experienced it. They pat privileged people on the back for a) creating the game if they did and bringing about ‘change’ by playing the game and showing basic decency and empathy which creates the idea within privileged people that they’ve done something of substance (I guarantee they’ll think “I’ve ended racism/sexism/etc!!”) It gives the impression that they’re changing something when in reality all they are doing is dominating the narrative of the oppressed and closing their ears further to oppressed peoples experiences.

In addition to creating a game that explicitly aims to empower girls of color, the incentive system of the game also made an argument for an active and even confrontational kind of resistance to gender and race-based marginalization. Lupe elaborated in more detail:

You have interactions with all types of people you would normally encounter as a scientist who’s a girl. There’d be a conversation with a male peer who’s trying to incite you or subtly making fun of you and the choice bubble will tell you this and ask you what you’d like to do next. You can walk away or give him your two cents (more points for this one). and then you’ll see yourself saying to him something you could actually say yourself irl [in real life].

*Stem Gal’s* incentive system encourages users—girls of color—to directly confront marginalization (“you can walk away or give him your two cents (more points for this one).” The main player is empowered by actively resisting (in the game this is jumping over) white men characters who have condescending or negative things to say, such as “good job sweetheart,” as well as by building solidarity with other women in the space. It is clear how Lupe and Stacey’s political identities mediated their learning and design processes. From concept, target audience, and specific game design features, Lupe and Stacey created a computationally sophisticated artifact that enacted a specific political perspective and identity. Yet, especially considering that their political identities were already highly robust and central to their sense of self prior to this project, did the experience of designing *Stem Gal* also have implications for students’ political identities? To answer this question, I turn to a closer examination of Lupe’s understanding of herself, the discipline of computer science, and her relation to it before and after the project.

### ***Lupe’s identity processes and transformations***

What is important to keep in mind about Lupe is that alongside her mature political identity, Lupe was also a highly engaged and successful computer science student. After all, Lupe, like Stacey, had self-selected into the CST Academy, and she was already one of the best students in the class (evidenced by her academic standing as well as corroborated through multiple informal conversations with Mr. Mayson). However, a closer look reveals that Lupe, despite her interest and success in computer science, also carried deep critiques of CS as a discipline both in terms of her own sociocultural experience as a girl of color within a CS learning environment, as well as how she made sense of the disciplinary values she associated to computer science. In her Identity Memo, she wrote unequivocally about her passion and skill for technology and computers, but then questioned whether pursuing computer science would amount to abandoning her social and political commitments:

I’m at the age where the question “what do you want to be” is becoming more relevant. I’ve always been scared that someday I’m going to sell out and do something that I hate. I feel like I even think of computer science like that, like being a part of a huge unfeeling oppressive corporation that makes you money sure, but never does something good.

The notion that affiliation with the discipline of computer science could be tantamount to “selling out” is a tension that Lupe navigated as she attempted to simultaneously pursue her intellectual curiosities and natural proclivities toward computers, while also honoring her political values. Her comment linking CS to “huge unfeeling oppression corporations” also coincides with the recent highly publicized partnership between the CST academy and a powerful technology company (Vakil, 2018), as well as to the general sense of distrust that exists between communities of color in the Bay Area

and Silicon Valley (Opillard, 2015). Her relationship to CS is even further complicated when considering her sociocultural experiences as a girl of color in the CST academy. As discussed in a recent paper (Nasir & Vakil, 2017), Lupe had a chance to share her perspective with a local reporter who was visiting her school to shine a positive light on the CST academy. The reporter, oblivious to Lupe's astute critical perspective, asked her to comment on how more girls like herself might become interested in computer science, to which Lupe said the following:

It's not so much that girls and people of color are not interested, it's that they come to high schools and many computer, technology and just science classes in general have environments that are discouraging, they are usually dominated by boys and white people and that is just discouraging to the girls and students of color.

We see in these instances that Lupe's robust political identity was also deeply mediating the ways she was making sense of computer science as a discipline, both in terms of its broader links to society, as well as how she was personally positioned within computer science learning environments. What is important to highlight here is that if we were to only consider her academic standing in the class, or inspect the computational ingenuity reflected in the design of *Stem Gal*, we may conclude that Lupe's story is a straightforward, even exemplary, case of success for an underrepresented student of color in a STEM classroom. Yet, in the time I spent observing and participating as a teacher in the CST academy, despite Lupe's evident skill and interest with technology, I also frequently observed Lupe appearing frustrated in class, even irritated, what she explained to during an interview as stemming from a general sense of annoyance at feeling like she did not belong in the space. These experiences, combined with the ways she was beginning to interpret the values associated to computer science as a field, were complicating Lupe's relationship to computer science.

The opportunity to channel her political commitments into the design of a technological artifact did not erase these tensions, but it did offer Lupe a new and exciting possibility to be political while engaging in creating technology within the context of her CS class. In the interview, in response to a question regarding reflecting on the unit as a whole, she remarked:

I think that's another thing that this project opened up for me. I never actually thought of computer science doing something like this. Well I had but it was so vague like it was always "you can create anything. It could change the world," which makes absolutely no sense because like how do you do that? How does it work? But now I totally know the process of how to locate a problem and narrow it down to something workable.

In the final interview, I asked about her comments suggesting computer science might position her as part of a "huge unfeeling oppressive corporation" and asked her to comment further on it. Smiling, she replied "oh yeah," and then followed with, "But now my idea of this has changed ... not about those corporations but in general, and that this could be something that I could pursue and be passionate about." This excerpt captures the dynamic interconnectedness of Lupe's political identity and her learning over the course of the unit. Her political identity shines through in her uncompromising stance on "those corporations," but there is also a sense that Lupe can imagine a future in which she remains on a CS pathway without "selling out" her political commitments. The experience of creating *Stem Gal* provided Lupe with the chance to rethink and reinterpret the values of CS, and in doing so seeded a vision of the future where politics and technology could exist together in Lupe's professional identity.

## Discussion

Stacey and Lupe's complex sensemaking about themselves, about computer science and technology, and about who they are and might become in relation to participating in computer science learning is reflective of a sophistication of thought and being the girls are beginning to embody. We see in their cases how managing the interplay between their political identity and learning

involved interpreting the values of a discipline and making meaning of those interpretations in relation to their sense of current and future self all while managing the demands of learning disciplinary content and navigating social relations and expectations of the classroom. There is a pedagogical and curricular implication that should be noticed here. Explicitly engaging politics in the CS classroom made visible ethical contradictions that students were subsequently forced to hold, confront, and evaluate, and in doing so ushered them into a liminal space pregnant with the possibility of transformation.

While there is an unmistakable sense of hopefulness and possibility in Stacey and Lupe's stories, there is an obvious and critical caveat we must consider. Recall the case of Leslie Miley, the Twitter engineer who left the company due to disputes over diversity with senior management. For Leslie, there was ultimately an irreconcilable tension between his political identity, which led him to agitate on behalf of racial diversity issues, and the demands of working at a major technology company. Perhaps his story most closely resonates with that of Lupe, who was also grappling with identity tensions related to the conflicts between her interest in activism and her interest in computer science. Fortunately, at least temporarily, Lupe seemed to be entering a space of expanded possibility where her political identity and her CS identity could not just coexist, but even become intertwined with one another in a productive fashion. And for Stacey, engaging in designing a personally and socially meaningful technological artifact in her computer science class set the stage for an expanded racial and political identity which, while still emergent, was beginning to alter her view of CS in really generative ways. Yet, if they persist, this is only the beginning of Stacey and Lupe's journeys in the world of CS and tech. Given the status quo of CS education (both at the K-12 level as well as at the undergraduate and graduate level) where socio-cultural, political and ethical connections are seldom pursued (Vakil, 2018; Vakil & Higgs, 2019), their subsequent CS learning experiences will likely contradict the notion that their political (and racial) identities are relevant, or even welcome, in the context of CS learning and design activities. What then will become of their newly affirmed (Lupe) or recently developed (Stacey) political identities? Will their fates be similar to that of Leslie's, where ultimately, they will be unable to reconcile their political commitments with the values of the tech world? We don't know the answers to these questions, but what is clear in hindsight is that failing to prepare the students for what they are likely to encounter in future learning CS learning environments was an unfortunate limitation of the pedagogical design.

### ***Political identity and disidentification with CS***

Stacey and Lupe's cases demonstrate that students' political identities are intertwined with their racial, gender, and academic identities, and that these intertwinings are consequential. Importantly, these identities are not static but rather function within learning environments in complex ways, both shaping students' engagement in learning processes as well as dynamically evolving in relation to the content and nature of learning activities. Moreover, we saw how students' political identities were made visible in their sensemaking about the values of CS as a discipline, which in turn played into how and the extent to which they imagined themselves persisting along a CS trajectory. This is a crucial point that deserves further contemplation by CS (and STEM) education scholars focusing on issues of equity and diversity, and also more generally in scholarship on race and inequality where questions of participation, achievement, and persistence have been central themes. In particular, a renewed focus on students' political identities, in connection to the politics of knowledge in particular disciplinary domains, will raise new questions and challenge old premises in a long and storied tradition in education research theorizing how minoritized students' disidentification with school or learning is related to a clash between the values of mainstream public school culture and students' cultural or racial identities (Kohl, 1994; Majors & Billson, 1993; Ogbu & Simons, 1998; Osborne, 1997). Often absent from

narratives of students' rejecting or disidentifying from learning is a recognition of how students' desires and sensemaking around which educational trajectory to pursue or refuse is also bound up in their political and ethical values, experiences, and interpretations, as well as the political and ethical valences of particular academic pathways, disciplines, or institutions.

For instance, in computing education, the notion that underrepresented students are unmotivated to learn CS due to a perceived clash of values has become a powerful narrative with implications both for how diversity is conceptualized as well as for how interventions are designed to create more inclusive learning contexts. Eglash (2002), for instance, has argued that members of racial minority groups disidentify with CS due to its "geeky" reputation, while Margolis and Fisher (2002) have argued that girls disidentify due to its reputation as being a male-dominated field. Building from these perspectives, DiSalvo, Guzdial, Bruckman, and McKlin (2014) report that providing African-American students explicit opportunities to "save-face" in a CS learning intervention allowed them to engage in rich computational activities while also maintaining their reputations and identities with friends and family. The political identity perspective advanced in this article complicates and challenges these narratives. To explain Black (and other minoritized) students' motivations about what to learn or not to learn as tied to their perceptions of what is "geeky" (or inversely what is "cool") obscures more complex dynamics underlying student resistance or interest in learning particular domains. As I've argued in this paper, these dynamics include the sophisticated political sensibilities and identities that shape how youth make sense of the values of particular disciplinary domains.

### ***Future directions for research***

I close with some suggestions for future directions toward a research agenda on political identity and learning, noting implications for research on computer science and STEM education. A primary argument made in this article is for an increased attentiveness in Learning Sciences research to adolescents' political selves and identities, and in particular to how these identities become intertwined with learning processes. As I have alluded to above, political identity research will play a critical role in advancing a political/ethical theory of human learning and development, while also providing insight into enduring questions of diversity, equity, and inequality in education. At the heart of this research agenda lies the recognition that individuals, in particular those who have experienced acute forms of marginalization and oppression, experience the world not just culturally or racially but also *politically and ethically*, and develop political identities in relation to these experiences. Youth then carry and enact these identities in various contexts including within learning environments that either take up and nurture these identities or suppress and marginalize them. Understanding the long-term implications of how various learning environments including formal and informal contexts mediate political identity is a timely and open empirical project.

In the context of disciplinary domains such as STEM and CS education, there are multiple exciting and important avenues of possible inquiry. For example, there is a need for ethnographic, historical and comparative studies of political identity that illuminate how cultural, sociopolitical, and historical processes shape the production of political identities within various institutional and learning contexts. In my own ongoing work, for instance, I am employing a comparative case study methodology (Bartlett & Vavrus, 2016) to explore how contexts of war and social upheaval differentially shape the learning and identity experiences of engineering students in the US and in Iran. A related line of inquiry pertains to recent critiques problematizing increasing corporate and military involvement in STEM educational initiatives and reforms (Blue, Levine, & Nieuwsma, 2013; Philip et al., 2018; Vossoughi & Vakil, 2018). What has not been systematically pursued, however, are ways in which students make meaning of these developments and the resulting implications for their political identities and subsequent educational trajectories. Finally,

there is also a unique opportunity and need for community-engaged participatory design studies (Bang & Vossoughi, 2016) that explicitly aim to develop students' political identities alongside and interwoven with content-related skills and practices. In this sense, a conceptual focus on political identity also aligns with recent calls to emphasize civic engagement and social awareness in K-16 STEM education (NGSS; National Research Council, 2013; Penuel, 2016). Ultimately, centering political identity compels us as a field, and as a society, to take seriously the ethical consequences of and possibilities for learning.

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## Appendix A: Description of Key Activities in DEP Unit

### Identity Memo

The identity memo, inspired by the researcher identity memo in Maxwell's qualitative research methods (Maxwell, 2012), asked students to write 1-2 page biographical statements that contextualized their chosen equity issue drawn

from their own lived experiences. Students were asked to situate their equity topic within their current as well as past schooling experiences. The goals of this assignment were that students tap into their own histories as a resource for understanding their topic and develop a deep, meaningful, personal connection to their equity issue.

### Problem Analysis Presentation

Group work was emphasized throughout the unit. After identifying important equity issues that students cared about, groups of 4-5 students worked to identify a “theoretical framework” which helped them analyze the root causes of the equity topic chosen. For example, while various groups decided to examine diversity within various pathways, students’ reasoning about diversity varied widely. Some students identified structural or systemic causes for racial/gender inequities in the school and others characterized student apathy or lack of motivation as underlying explanations for lack of diversity in certain academies or pathways. The problem analysis presentation was a group assignment that culminated in a presentation to the class to highlight the significance of the problem identified and the way the group identified root causes of the problem.

### Design Ideation and Politics of Technology Memo

This activity marked the turning point in the unit. At this point, student groups were asked to brainstorm various technological “solutions” for their equity issue, and identify how their solution was framing and “locating” the problem they were attempting to address. In other words, *the politics of their technology*. There was significant whole class discussion and accompanying activities that led up to this assignment, which helped students understand how various solutions, technologies, and artifacts have political values and sociocultural worldviews embedded within them. A salient example of this is a group of Asian American males whose equity issue was interpersonal racism experienced by Asians in the school. Their solution was to install video cameras throughout the school, including the bathrooms, to increase surveillance and thus security for Asians at the school. In discussing the politics of their solution, the students discussed the tradeoff between student safety and privacy, ultimately arguing that while they recognize their solution compromises the overall freedom and privacy of other students, it is worth it because “safety comes first.” The goal of this assignment was precisely this -for students to name the tensions, contradictions, and possibilities inherent in the various solutions they had identified for their final projects -and to ultimately understand and be able to articulate the politics of their technologies.

### Final Designs and Portfolio

The final three weeks of the unit were devoted to students working in smaller groups, with the intent being to first create “mock-ups” of their solution using the Balsamiq wireframing software. Students then designed initial prototypes using either Scratch programming environment, web development using HTML/CSS, or application development using visual Basic.net. At the end of the unit, students were asked to compile all of the class assignments, along with their final projects, into a comprehensive design portfolio.

## Appendix B: DEP Questionnaire

### Instructions:

Please answer the questions below to the best of your abilities. You may skip any questions that make you feel uncomfortable or that you do not wish to answer.

### Background Information

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

#### What is your gender?

- Male
- Female
- Other: \_\_\_\_\_

#### Which race/ethnicity best describes you? (you can choose more than one)

- Hispanic or Latina/o
- Black or African American
- Native American or American Indian
- Asian
- South Asian
- Middle Eastern
- Pacific Islander
- White
- Other: \_\_\_\_\_

### Equity Orientation

**Please answer the following questions to the best of your ability; please make your thoughts/argument clear.**

*Please describe how and why you selected the Computer Science and Technology Academy (Were there other academies you applied for? What were the main factors in your decision?)*

*What are some of the barriers to academic achievement in your school? Which students are most disadvantaged, and why?*

Using the key below, please indicate the extent to which you disagree or agree with the following statements.

Key:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

*Inequalities in my school are the result of racism.*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

Please explain your answer. (How do you define racism? Why or why not is it a factor at your school?)

*Inequalities at my school are caused by student laziness and lack of motivation.*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

*Inequalities at my school are a result of parents who do not care enough about education.*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

*Inequalities at my school are the result of teachers and programs at the school that exclude certain students.*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

*My school should do more to support African American, Latina/o students, and low-income students.*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

### Technology Views, Experiences, and Identity as Technology Activist

**Please answer the following questions to the best of your ability; please make your thoughts/argument clear. Please provide a thorough/complete answer.**

*Do you think it is important for all students to learn computer science? Why or why not? Please explain.*

*What is the role of computer science in society? What are the main ways that computer science or computing is used in our country? In our world?*

*What do you plan to do with your knowledge of computing and technology?*

*Where and from whom do you learn about computer science and/or technology? (other than in the Computer Academy)*

Name two examples of technology that are inspiring to you. Explain why.

I can use my knowledge of computing to create social change in my school and in my community.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I feel that computing and technology can effectively address equity issues in our school.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I view myself as “smart” in computer science.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I can see myself pursuing a career in computer science or computing.

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

I can see myself using computer science and technology as a way to participate in activism (e.g., Ferguson activists using Twitter to organize #BlackLivesMatter protests).

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree