Chapter 8
Meritocracy, Technocracy, Democracy: Understandings of Racial and Gender Equity in American Engineering Education

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Abstract The idea that technological labor produces both individual security and satisfaction *and* societal benefits has shaped engineering education in the United States since its inception. Educators and employers have historically cast engineering instruction as a route towards individual and collective uplift for the nation's citizens. But ideologies of racial, gender, and other categories of difference predicated on identity underlie all such claims and explain the less-than-democratic character of STEM occupations, in which minority citizens, women, LGBT persons and persons with disabilities remain under-represented despite decades-old legal proscriptions against such discrimination. This chapter explores two linked logics that perpetuate this inequitable distribution of opportunities: the technocratic understanding of engineering as an enterprise in which power relations play no part; and the related construction of engineering education as a field based solely on meritocratic judgments about eligibility and skill. Through both of these formulations American engineering supports the ongoing exclusion of certain communities based on perceived heritage and ascriptions of potential in turn based on those identities. This chapter also frames a recent strengthening of these ideologies under emergent neoliberal understandings of market, state, and the agency of individual citizens-as-learners. Finally, given the origins of engineering knowledge and practice in discriminatory social relations, this chapter asks whether improved diversity in engineering would in fact represent a liberatory change.

Keywords Engineering education • Educational standards • STEM • Laboratory instruments • Technocracy • Merit • Neoliberalism • Race • Gender • Disability • LGBT identities

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Introduction

In the United States, engineers have historically seen themselves as civic leaders, deploying the empiricism and practicality of their occupation for what are ostensibly societal benefits. From the mid-nineteenth century onward, American engineers, increasingly identified with professional organizations and formal educational systems, routinely spoke in technocratic terms of the improved public health, industrial productivity, and material developments rendered to the nation by their work. As is still often claimed today in mission statements and textbooks, keynote speeches and lists of engineering "grand challenges," the expertise of engineers serves collective aims (Kline 1995; Slaton 2012; Pfatteicher 2005). In the vast majority of such instances of self-description, however, the discipline of engineering has foreclosed the sort of reflexivity that would lead to authentic inquiry about such aims. That is, we rarely encounter frank inquiry about who in American society it is that actually benefits from the ingenuity and labor of engineers. The institutions for which engineers work—corporate, governmental, or military—are virtually never depicted in that occupation's promotional literature, let alone in technical documents, as forwarding existing structures of economic or political privilege.

The question of "for whom" engineering is practiced raises the correlate question of "by whom" it is practiced: Historically, who has become an engineer in America? Persons of what races, genders, ages, credentials, or family and institutional connections? Who in turn has not appeared among the rolls of university engineering students or faculty, or among the technical employees of industry, military or government sectors? Again: Of what race, gender, etc. are these "absent" persons? When we pose these queries, another register of question quickly arises: Which such categories have determined participation not just in engineering, but in U.S. culture more generally? And still another: What features of body or conduct or origin have delineated a person as being in each category—as a white, black or Asian person, a male or female person, a clever or slow, young or old, able-bodied or disabled person? With these questions, a raft of highly contingent social conditions busily shaping the demographics of U.S. engineering suddenly become newly visible.

At a certain level matters of inclusion have routinely received address by employers and educators concerned with diversity in technical occupations. In the United States, discriminatory habits that had historically excluded women and members of ethnic minorities from science and engineering disciplines faced powerful legal challenges beginning in the 1950s, and a wide range of educational and hiring initiatives have increased the diversity of science, technology, engineering and mathematics, or STEM, fields in the succeeding decades. Recruiting, scholarship, mentoring, and related programs have targeted groups of Americans traditionally excluded from engineering degree programs and employment opportunities (Slaton 2010).[1]

Yet, this inclusive programming has somehow left regrettable demographic patterns largely intact. Women are not proportionately represented in most STEM educational and work settings, especially in the higher reaches of universities, government agencies, and corporations. Persons of African American, Hispanic and Native American backgrounds; those of lower socioeconomic status; and persons with physical or intellectual disabilities are still drastically underrepresented across American engineering (Bayer Corporation 2011). LGBT individuals, too, face tremendous impediments to full participation in STEM occupations (Cech and Waidzunas 2011). Thus, questions about who is and is not likely to become an engineer in America, and about whose interests may be represented in the day-to-day practices of engineering occupations, can be seen as having been only tentatively confronted by most of those concerned with STEM diversity. Certainly the idea that the constituent elements of engineering, including its educational structures, epistemologies, and patronage networks, may impede democratic reform by their very nature rarely comes under discussion (Riley et al. 2009, 2014). This chapter frames ideas about how this selective address of inequity has arisen. It suggests steps we might take either to correct these instances of under-representation in engineering fields or alternatively, to reframe entirely our notions of what may constitute a more democratic industrial culture.

Importantly, this essay by no means dismisses efforts at STEM inclusion to date, but approaches those from a critical perspective that asks why such efforts have assumed the constrained form and scale that they have. How do seemingly well-intentioned efforts nonetheless promote a conservative social landscape, generation after generation? Such a perspective, interrogating both institutional and epistemic features of engineering over the last 60 years, finds that an uncritical belief in the meritocratic nature of engineering has delimited inclusive efforts in American engineering education since the civil rights movement. In the policy and curricular reforms intended to improve STEM diversity, we find an insistence on established "standards" of engineering performance. Even as college admissions or hiring priorities in engineering fields have been scrutinized for their discriminatory impacts, and in many instances reformed, unchanging presumptions about what constitutes "good" engineering in classroom, lab or factory serve to preserve exclusionary patterns of eligibility (Riley et al. 2014). Such unexamined commitments are common

[1] This essay builds on historical narratives included in my recent book on the whiteness of engineering in the United States (Slaton 2010). Here, I add two important analytical frameworks to those narratives. First, I begin to engage with intersectionality, such as the role of engineering's intertwined epistemic engagements with race, gender, disability and LGBT identities. Second, I articulate the significance of neoliberal ideologies that center on the primacy of market forces and thus camouflage social structural sources of occupational inequity in the Unites States.

in rhetoric regarding educational uplift in the twenty-first century (see, for example, Goldberg and Traiman 2001, p. 92) and deny the social foundations of technical knowledge and practice—of engineering epistemologies. Thus arises support for only a limited intervention in the prevailing social structures of engineering. For example, such standards largely foreclose the idea that students from poorer communities might appropriately spend an extra year in college to offset weaker high school math and science provisions; or that a minority-serving university might usefully receive added time and money from a federal funding agency to bring historically under-resourced engineering research programs up to competitive levels (Slaton 2010).

It is not only opponents of affirmative action who stress the necessity of preserving established expressions of rigor and selectivity in engineering, but also many advocates of enhanced minority inclusion. This aim is sometimes made explicit, as when STEM proponents defend the rigor of inclusive programming, but more often enacted through a strategic absence of critical inquiry into the content of engineering. Even many staunch advocates of enhanced STEM diversity in the United States assume that engineering need not change the pacing and content of its educational programs; its criteria for or amounts of research or scholarship funding; or, crucially, its level of reflexivity regarding these matters. But as this paper will explore, it is in those exact locations that occupational advantage and disadvantage reside.

The social functions of merit and the received criteria for meritorious engineering are inseparable. This is a linkage that today arises from and serves much broader neoliberal conceptions about the sources of economic welfare under industrial capitalism: The individual holds responsibility for his or her standing in a free market system ostensibly guaranteed to reward effort. The citizen must learn and work in ways that accord with prevailing definitions of valuable knowledge and labor, or face the consequences with only her- or himself to blame (Brown 2006; Walkerdine 2003; Wacquant 2009; Slaughter and Rhoades 2004; Gershon 2011).

The United States is of course not alone in undertaking this particular, modernized construction of productive citizenship. Globally, industrial capitalism brings stratified occupational structures and wage labor to more and more communities with each passing month. The conditions that today enable economic participation for individuals and polities worldwide, and certainly those surrounding labor in "advanced" sectors such as engineering, conduce to this stress on individual responsibility within state and corporate institutions. No doubt comparative cases will enrich this project. But the racial and gender ideologies underlying American notions of optimized productivity and of fairness are pronounced. These notions deserve careful investigation especially in light of decades-old claims of fully enlightened, legally protected civil rights in the nation. In this climate, privilege is conserved and the conservative is privileged, as this look at U.S. engineering education in the twenty-first century hopes to make clear. With that finding comes the unavoidable, disconcerting, but crucial second order concern of this paper: Should we even continue to pursue the entry of currently under-represented groups into STEM disciplines? Or should we instead cease to see such entry as having liberatory potential?

The Instrumentality of Technical Merit: Linking Content and Exclusion

A small but insistent body of scholarship over the last few years in the fields of race, gender, LGBT and disabilities studies, and in science and engineering studies, has shown that prejudicial and exclusionary treatment in STEM fields routinely occurs on the basis of perceived identity (Cech and Waidzunas 2011; Tonso 1996; Riley et al. 2009, 2014). This treatment sometimes takes the form of direct encounters between privileged and marginalized persons, either through blunt declamations of difference and ineligibility by those in authority or through the more subtle but equally damaging maintenance of an overall "chilly climate" for women, minorities, queer persons, or persons with physical or intellectual differences. Legal reforms have not done away with such discriminatory practices (Cech and Waidzunas 2011; Siebers 2010; Slaton 2010). But discouraging or exclusionary conditions are also perpetrated in engineering classrooms and workplaces through less direct expressions of privilege. Importantly, constructions of *positive* characteristics in some engineers and engineering students have rendered other persons ineligible for participation or success in the field. Traditionally in the United States these desirable traits would be whiteness, maleness, heterosexual identity, and whatever is seen to be bodily normalcy. As has historically been the case in many modern professions, the trusted practitioner in STEM occupations is often one with a particular set of ascribed identities. The veneration of objectivity and the suppression of "extra-occupational" personal attributes in the course of cognitive labor play particularly important roles in constituting professionalism in technical occupations. Claims of empiricism notwithstanding, in science and engineering the validity of findings at the bench derives from the experimenter, not the experiment; the reliability of a building material or industrial product is determined by the tester, not the test (Shapin 1989; Schaffer 1988, 1995; Traweek 1992; Knorr-Cetina 1995; Slaton 2001; Pang 2002).

To highlight the pattern by which notions of meritorious practice follow from ascriptions of eligibility, and not the other way around, I have elsewhere described cases in which ideas about whomever was undertaking an engineering task configured ideas about the validity of the work being done. In the 1970s and 1980s, as academic programs for the correction of black, Hispanic and Native American under-representation in U.S. engineering took form, many university engineering departments recognized that minority identity often went along with attendance at under-resourced and under-performing public high schools. The resulting shortfalls in math and science readiness for minority students were well understood, but at the same time the provision of resources and coursework that might have achieved parity across educational systems remained unimaginable to most educators and policy makers. Through arbitrary restrictions on the types and amounts of minority-focused post-secondary STEM programming provided, the disadvantaged student was cast as irredeemable in certain practical ways.

For example, in the majority of university STEM departments concerned with minority inclusion from about 1970 onward, the provision of remedial coursework was largely deemed to be ill advised. Many university engineering departments felt that to undertake “compensatory education” of this kind would be to lower their standards for both program admission and completion. By contrast, individual tutoring and dedicated social support systems for under-represented student groups (such as dormitories or classes earmarked for minority or women students), and brief preparatory or “bridge” courses such as weekend or summer classes for entering minority students, evaded the stigma of remediation for a department. Similarly welcome were small-scale programs that ferreted out the few so-called talented students among the many presumably untalented that made up poorer urban and rural school systems (Slaton 2010).

All of these sorts of programs found support from corporate and philanthropic sources, as they still do today, and inclusive efforts have clearly had the imprimatur of the professional worlds in which STEM finds its applications in the United States. That American industry consistently puts some value on racial and gender diversity, a point to which I return below, is without question (Holvino and Kamp 2009; Gordon 1995). Yet, these academic interventions into inequity—small, brief, and staged outside the spaces and calendars of “normal” instruction—have since their inception been distinguished in both form and content from the main body of pedagogical activity in engineering schools, creating a cordon sanitaire that could deflect perceived threats to institutional reputation.[2] With a few exceptions, institutions have felt that altering the structure of existing engineering curricula or offering divergent paths towards graduation for students of different backgrounds or inclination could mark a school as having lower caliber students and graduates (Slaton 2010). But in no cases I have found have opponents of remedial work made clear how it was that a practicing engineer whose training included, say, a set of math classes prior to or beyond the standard curriculum, would necessarily fall short of conventional skill levels. What would be missing or flawed in the resultant practitioner is nowhere articulated, any more than American critics of black participation in higher education prior to the civil rights era supplied thoroughly argued reasons for race-based exclusion from educational opportunities (Gurin and Epps 1975).

This is instead an arbitrary ascription of low potential to certain populations that has arguably followed from ideologies of class and race difference. Educational deficits in the United States historically map onto socioeconomic status, and to ascribe some inherent lack of intellectual talent to those living in communities with weak public high schools is to make a leap of logic (Brint and Karabel 1991; Hursh 2006; Ebeling and Slaton 2010). It is also an ascription that follows familiar notions of racial difference. Since the first stirrings of emancipation there have been influential countervailing voices in America insisting that to be born of particular heritage (racial, ethnic or gender minority) is to lack intellectual capacity (Duster 2003).

[2] Academic time and space, as described by Vinao, are “never neutral,” but rather expressed ideals of optimally ordered and sequenced experiences (2001, pp. 133–135).

The association of identity with cognitive or moral capacity of course extends to many cultures in many periods (Carson 2006; Gould 1996), but in thinking about engineering education we find a particularly effective recourse to ideas of rigor among those who wish to confer or limit eligibility for participation by certain populations (Slaton 2010). Currently, scholarship on disability helps us see similar social instrumentalities related to bodily difference. For example, when a blind student in a university chemical engineering class suggested in 2012 that she might use an "assistive technology" that converted the visual read-out of a probe to audio signals, she was told by her professor that the resulting data would not be equivalent. Yet, the professor could identify no feature of the audio output that contravened the meaning to be derived from conventional visual readout used for this experiment; the audio signal was different in form only, it would appear (Supalo et al. 2007; Bryan 2012).

Of course, the meanings of the visual and audio signals in this case are entirely coincident with authority structures in the teaching lab. Within the purposes defined for this laboratory exercise (the conveyance of what the professor believes "the lesson" to be), there is no significance to signals apart from the professor's notion of where meaning resides. The student is not only a blind person, but an inexpert one who by definition cannot yet understand what signals do and do not "work" in this experiment…The experimenter's regress! Her advocacy for alternative mediums is inadmissible in the class on multiple levels. Historians of science have shown that even where the phenomena ostensibly observed and recorded may not differ among practitioners, the choice of representational convention itself confers or denies status to one practitioner or another (Pang 2002; Daston and Galison 1992; Slaton 2001). At bottom, the blind student's instructor made a determination of what counted as rigorous laboratory practice based on student identity (here, an identity predicated on bodily "otherness"), not on investigative procedures themselves.

The Challenge of the Social Justice Agenda in STEM Fields

When we combine the methods of science studies, which interrogate the meanings of representational conventions in science and the construction of legitimacy and certainty, with those of identity studies to reveal such elisions, it is not hard to see that invocations of rigor perform exclusionary work in STEM fields. However, the question of precisely *how* the work of engineering instantiates racial and gender privilege is extremely complex. There is no simple formula for tracing how the material, economic and political purposes towards which engineering knowledge and labor are put actually create new inequities or further existing ones. This difficulty reflects the naturalization of two cultural conditions in the United States: discriminatory ideologies in post-segregation America and the historical reputation of the sciences writ large (including social sciences) as value-free practices. I am not writing from outside either cultural condition, obviously. But I do write with the aim of criticality as far as my training within the academy, directed towards the study of power in knowledge systems (including my own), will allow. In other words: Reflexivity about our own history or social science techniques may highlight good reasons for aggregating certain aspects of STEM activity as consequential social practices. This seems like it might offer a step towards understanding how those activities accomplish distributions of power and privilege.

Many historians and social scientists today contend that normativities pervade all technical activity, whether the seemingly isolated task of conducting a compression test on a single specimen of concrete or the construction of an entire interstate system, and the social intentionalities involved in such tasks are many and layered. The very delineation of these activities as occurring at different societal levels, as typifies much existing literature in the history and sociology of engineering, is a politically freighted gesture. After all, the design of a concrete testing machine may reproduce occupational opportunity structures that follow the same lines of majority racial or ethnic advantage reflected in highway planning (Slaton 2001). My training as a historian and STS scholar and participant in emerging Engineering Studies networks has created the possibility of my belief in these contentions, at least. That such a claim does not translate meaningfully into settings where STEM content is taught and deployed, except in extraordinary cases (Riley et al. 2009; Catalano et al. 2008), begins to shed a light on the persistence of discrimination in that sector.

It seems safe to say that few historians would still maintain that human-made artifacts do not have politics, a traditional view of technology for which Langdon Winner offered his corrective some 30 years ago (Winner 1980). Socially inflected historical understandings of industry, centered on labor, have now penetrated many more general narratives of economic development. Similarly, feminist concerns have drawn scholars' attention to reproductive and other medical technologies so that those artifacts no longer seem like the inevitable result of accreting scientific knowledge. Issues of sustainability, public health and safety, and global impacts of industrialization have encouraged still other historians to pay attention to the uncertain social and environmental impacts of engineering.[3] But engineering disciplines rarely engage with any of these analytics, for the most part still tending to firewall concerns about the social impacts and origins of technologies as matters for ethical or regulatory engagement only. But neither of those two framings encourages authentic address of social justice issues. Ethics education readily predicates reform on behavioral changes on the part individual engineers and can too easily default to liability concerns. Instruction in regulatory matters is aimed at enabling compliance, not a critique of structural factors like poverty, racism or global imperialism or the role of such factors in shaping the products and processes of engineering (Catalano 2006; Riley 2008; Little et al. 2008).

A group of engineering educators concerned with social justice have articulated the many ways in which customary engineering instruction stigmatizes that kind of critique, casting it variously as a concern of "do gooders" or simply as something

[3] At the same time, happily, fewer and fewer self-identified historians of technology are using deterministic models of technological history. Multi-causal and value-laden explanations now prevail in articles found in the journal *Technology and Culture*.

outside the purview of "real" engineering (Riley et al. 2009). They have articulated an "ethic of care" in light of which the narrowed and self-serving priorities of corporate, military or state-focused engineering become clear, but it nonetheless remains extraordinarily difficult to posit a significant role for the priorities of non-engineers inside the technical classroom or workplace. These social justice scholars propose that in engineering, "the problems that are 'solved' should be authentic in the context of domination, and ring true in communities with subjugated knowledges." But they realize, too, that such an objective verges on absurdity in the terms normally used to define important engineering learning and research in U.S. institutions (Riley et al. 2009, p. 28).

Once we become aware of the belief that legitimate engineering derives from persons thought by the profession and its patrons a priori to hold the potential to be legitimate engineers, we can begin to pay attention to the problem of essentialism. This notion pervades crude understandings of diversity within engineering that promote inclusion on the basis of the presumed characteristics of different social groups. Such understandings attribute an interest in social issues to women and technical matters to men, or a concern with problems of urban infrastructure to those who live in "degraded" inner city neighborhoods. Wendy Faulkner helpfully makes the point that classifications of behaviors or values along demographic lines are not inherently oppressive; thought or belief distinctions among social groups can be meaningful. But as she puts it, given any combination of men, women, and involvements by both groups with technical tasks, we will encounter *not* "innate differences in technical ability," but rather "some differences in some settings" (2009, p. 148). Corporate diversity strategies by contrast frequently invoke the likelihood that hiring members of under-represented groups will yield untold product innovations and competitive advantage in niche markets that follow demographic lines (Holvino and Kamp 2009; Gordon 1995). This seems to me to be a set of projections indefensible on any basis other than rank essentialism or racial or ethnic stereotypes. To paraphrase Faulkner, a Hispanic product designer and Hispanic consumers may display "some commonalities in some settings," but any more certain association of STEM engagements with heritage is highly problematic.

The problems with such ascriptions go beyond inaccuracy alone. To traffic in this kind of attribution is to reinscribe gender dualities, racial categories, and a host of other potentially oppressive taxonomies. The apparent ambiguity of Faulkner's formulation, "some differences [or commonalities] in some settings," actually leads us to make two important disaggregations here, pushing us away from certainties where they could do the most discriminatory damage. First, the ambiguity forces us to trace connections between life experiences and values held by the individuals under scrutiny, rather than conflate experience and values, or worse still, heritage and experience and values. Second, the contingency of the formulation is a deterrent to the easy sorting of people and actions. It obviously doesn't prevent the most reductive and circular forms of racial or gender classification (which are likely to proceed under any circumstance, since unassailability is their primary function), but it discourages any simple ascription of group identity on the basis of behavior and thereby interrupts attributions of capacity on that basis.

That such attributions are still flourishing in 2015 is apparent. The trope of "missing" and "untapped" technical talent pervades discussions of America's global economic competitiveness beyond corporate diversity schemes; it bolsters a much broader claim of a looming national "skills gap" (National Science Board 2010; Harvard Graduate School of Education 2011; Ebeling and Slaton 2010). That kind of phrasing has always done more to deflect critique of STEM educational structures than enable it, suggesting as it does that there are expert- and worker-shaped holes that can be filled by expert- and worker-shaped people. No need to inquire about the shapes themselves. Again, the explorations now being undertaken in disabilities studies shine a bright light on the essentialist risks here. Recent media reports about the suitability of persons diagnosed with autism for certain STEM careers reinscribe problematic ideas about what constitutes a personality or learning style in need of diagnosis (Cook 2012). Although this new appreciation for the STEM-related talents of some autistic individuals challenges a conventional belief that such a diagnosis mandates treatment or correction, and may offer much-needed economic opportunities to persons with few other job options, this remains a potentially discriminatory situation. On one level, it reflects a narrowly conceived appreciation of technical talent that reifies some technical jobs as appropriately centered on repetitious or tedious labor. Just because we decide that a "type" of person enjoys a "type" of work does not mean that this kind of employment is morally defensible. To presume a "fit" between worker and job here is to ignore many ethical questions about how we understand both (Siebers 2010).

On another level, autism spectrum disorders represent a strongly contested field and here criticality about the label is nowhere to be found; a person's unusually good memory or pronounced affinity for order, repetition, or mathematical reasoning confers an identity of deviant or disabled. Without taking on the full range of epistemic challenges involved in an analysis of disease definition, we can at the very least understand that notions of "natural ability" for STEM labor reproduce eugenic ideologies and deny the existence of structural conditions under which math and science ability are or are not cultivated in individuals (see above). Certainly this kind of claim hurries non-quantitative approaches to design or technical problem solving, and other nontraditional learning or reasoning styles in engineering, rapidly towards the status of subjugated knowledges (Faulkner 2009).

The Primacy of Neoliberal Logics

The understanding among many STEM educators, employers and policy makers in the United States that achievement derives from inborn characteristics may continue a long discriminatory tradition, but its presumptions have been bolstered in the last 20 years or so by the rising influence of market-focused neoliberal ideologies (Rodgers 2011; Hursh 2006; Brown 2006; Gershon 2011). Those ideologies stress market forces as a reliable guide to and result of effective economic planning, and project a particular role for education and training in service to those forces.

American educational policy has long manifest a "vocationalist" outlook that casts education as the answer to social problems. Poverty, unemployment and civil unrest have all been ameliorated, proponents claim, through education for work (Labaree 2008; Grubb and Lazerson 2005; Popkewitz 2006, p. 124). But the stratified nature of labor in America has historically meant that "good education" is that which reproduces unequal educational experiences for different communities or populations. Some Americans receive well-resourced, intensive, and open-ended instruction as they prepare for a wide range of careers and upward mobility; others face an educational experience that is of lower quality, shorter duration, and unlikely to produce secure, rewarding and remunerative career options. Industrial capitalism has naturalized the idea that there must be managers and workers, salaried and wage labor pools and American education reproduces that structure along with attendant, variable levels of security, intellectual reward or remuneration. These are patterns that unsurprisingly follow distributions of economic resources; poorer communities in the United States, disproportionately minority, produce fewer graduates with professional or managerial credentials. Women overall hold lower paid jobs and are paid less than men for the same jobs. Divisions among groups (identified through the arbitrary classifications of race, gender, age, ability etc.) and different life opportunities thus constantly reproduce themselves. In an era in which market forces are granted primacy in social planning, policies which might address structural inequities along lines of race and gender inherent in American education gain little traction (Hursh 2006; Apple 2001).

Along these lines, recent projections of how best to increase participation in STEM disciplines forward the notion that some people are simply innately suited to high-level instruction (through 4-year university degree work or beyond) while others should not be encouraged to attend college (Harvard Graduate School of Education 2011). As noted above, the proliferation of educational standards serves a doubled essentialist purpose: defining talent and locating the talented. The projection of a national need for a scientifically and technically adept workforce entails the construction of a boundary between talented and less-talented persons that is continually delineated but rarely questioned as a project (Popkewitz 2004). Even if that boundary was to be loosened and its social instrumentalities questioned, the nation would still have some way to go towards achieving a more democratic social system. Influential studies have naturalized the absence of African American males of lower socioeconomic standing from 4-year colleges, for example, by predicting their low likelihood of success *based on their identity*. Celebratory language regarding diverse intellects and the contributions such diversity may render to society as a whole does not disguise the discriminatory power of this vision.

A report issued in 2011 by the Graduate School of Education of Harvard University, for example, is apparently dedicated to establishing the value of sub-baccalaureate education for many Americans who might otherwise find themselves pursuing 4-year degrees. The authors seem to support a systematic disavowal of "college for all" ideologies on the basis that young Americans should be offered a "menu of possible selves." The report's title, "Pathways to Prosperity," lends a note of pluralism: The pursuit of a 2-year or vocational credential is shown to be no less admirable (and its rewards, presumably, no less desirable) than attainment of a 4-year or graduate degree. Diverse life goals and talents are to be welcomed; all levels of aspiration and ability are to be cultivated and even celebrated. But tellingly, aspiration and ability are also mapped onto identity in this report; minority background disturbingly figures here as a predictor of lowered educational potential:

> Behaving as though four-year college is the only acceptable route to success clearly still works well for many young adults, especially students fortunate enough to attend highly selective colleges and universities. It also works well for affluent students, who can often draw on family and social connections to find their way in the adult world. But it clearly does not work well for many, especially young men…Similarly, among the low-income and young people of color who will make up an increasing portion of the workforce of the future, this single route does not work well either. (Harvard Graduate School of Education 2011, p. 13)

The degree to which the authors appear to accept racially and socioeconomically determined opportunity structures, both "fortunate" and not, is hardly reassuring if we are seeking to maximize opportunity for all Americans.

The Harvard GSE's frank diagnosis of discrepant educational performances among communities of different socio-economic status might appear to be a starting point for the remedy of such discrepancies. We should note, however, that the mismatch described here between certain individuals and successful prospects in the 4-year college is not cast by the authors as something to eliminate. Rather, they seek to point "low-income and young people of color" away from the pursuit of the baccalaureate degree. That is seen to be an appropriate aspiration for the more affluent student, or one with family and social connections. The poor match posited between disadvantaged citizens and 4-year higher education fails to admit the possibility of repositioning disadvantaged citizen relative to bachelor's level educational opportunities. The problem is defined as one of fit, rather than fitness, we might say, and thus in this case, the acknowledgement of identity-derived difference does not empower democratic reform.

A second worrisome trend in planning for economic inclusion through STEM is even more difficult to tease out in light of its seemingly generous intentions. In the literature of educational inclusion, success in science and engineering is routinely associated with a student's self-confidence. Women and minority students have been found by analysts to lack a sense of self-efficacy. Researchers hold that when that trait is cultivated in members of under-represented groups, greater success in STEM programs is achieved by those groups (Marra and Bogue 2006; Slaton 2011). Because such studies seek concrete sources of improved self-efficacy (classroom teamwork, support groups, or mentoring) and pay attention to the experience of schooling (not merely its outcomes), they can be instructive rather than merely circular. But this focus on self-efficacy derives from only a first-order reflexivity within STEM fields. This kind of analysis ultimately returns responsibility for performance in school to the individual, who with support achieves efficacy or fails to do so. It makes no claim for the value of any sort of collective will or attainment and posits no larger structural impediments to inclusion such as poverty, racism, or sexism. Its corrective potential resides in helping the student conform to behavioral norms, with only a very selective critique of social relations in the university. This final assignment of behavioral responsibility to the student her- or himself arises from and supports neoliberal ideas of the individual in society as the source of achievement or cause of failure; what Brown calls a focus on "self-care" (2006).

For social problems to be seen as individual problems soluble through market forces, as Brown shows to be the case with contemporary industrial culture, the projects of the market must seem unassailable to all potential stakeholders. The nearly complete characterization of technological change and innovation as a positive societal force among Americans works beautifully to deflect attention from larger social structures, in exactly this technocratic way. The conditions in which universities and certain aspirants to STEM attainment thrive and in which marginalized populations remain disadvantaged are close to invisible within STEM curricula; the apparent value of reflexive thought is nil. The selectively oppressive functions of industrial capitalism are of course not a topic of instruction in the vast majority of STEM courses. Periods of widespread doubt about the safety of science and technology and the contributions of those realms to human welfare have occurred in the United States, but this has not been a significant trend since the late 1970s. Thus, when economic sustainability, environmental justice, or global food security do today find expression in engineering curricula, it is often as part of a brief introduction or ancillary framing that would not be likely to disrupt flows of economic and political influence in the nation (Riley et al. 2009). Instead, innovation carries a totalizing positive meaning. Since 2000, as China and India have gained global economic influence, we have seen particular popularity for the notion of "innovation" as an important means by which America can regain global competitiveness and achieve economic and (especially since 9/11) military security.

The ways in which such upbeat projections deter democratic reform in STEM fields are not confined to a foreclosure of discussions about technology's ill effects and occupational inequities. Rather, the promissory nature of rhetoric about innovation means that improved opportunities can be said to always be just over the horizon, and no one need be held responsible for their absence in the current moment (Waxman 2012; McCray 2012). In the nanotechnology sector of the current day, for example, the failure of promised industrial scale-up to occur and bring with it the projected jobs is easily attributed to the natural indeterminacy of scientific discovery. Inventive serendipity brings progress but it is, after all, serendipitous and must be allowed to remains so. The global mobility of capital so celebrated in the current climate is part of the problem: American capital bears no fixed responsibility for American labor, so high-risk research and development ventures hold no moral dangers for their backers (Head 2003; Rip 2006).

Technocratic Leanings and the Deflection of Critique

Much of what I have described here could certainly apply to education or employment in the service sectors, as well as to other public or private realms beyond those associated with STEM fields. Industrial capitalism is not merely a system of technical labor and knowledge, of course, and critical literature on schooling makes it clear that humanities and liberal arts can enact similarly discriminatory effects. The conservative social lessons carried in canon-focused humanities instruction have long been clear (Bourdieu 1990; Popkewitz 2001; Apple 2000, 2001). But there is a kind of cultural instrumentality involved in technical education and labor that renders questions about equity particularly difficult in the normal course of those enterprises.

The firewall that exists between credible engineering conduct and concerted attention to social matters is well established in U.S. higher education (Slaton 2010; Kline 1995; Pfatteicher 2005). Within American universities, schools of engineering and schools of arts and letters are almost universally distinct entities. Common definitions of rigorous practice require strengthening that distinction; tenure and promotion, granting, and accreditation processes do not promote a melding of technical and arts instruction. In engineering occupations, one may certainly take an interest in arts or politics without undermining one's reputation (although there are of course limits to what counts as seemly or palatable cultural engagement). However, any prospect of testing the claims or aims of a technical field in the terms used not by engineering but by, say, history or sociology or philosophy, let alone painting or poetry, can threaten one's credibility as an engineer (Catalano 2006; Catalano et al. 2008). What is more, even within schools of engineering individual disciplines function best when they disarticulate their specialized nature relative to one another; the curricula of different departments within an engineering school or polytechnic recapitulate expectations of the profession, with distinct research, teaching and accreditation expectations for each. If civil, mechanical and chemical engineering cannot deeply engage with the nature and function of their own boundaries, it will be nearly impossible for their participants to probe how any of these disciplines choose their problems, train their future representatives, attain their institutional influence, and justify their own existence to wider publics. It is only with those questions that social origins and impacts of an expertise can be interrogated.

This uncritical assertion of boundaries for technical expertise, which renders problematic any inquiry by engineers into the social features of engineering, of course trickles down to students (Riley et al. 2009; Cech and Waidzunas 2011; Seron and Silbey 2009). Students in engineering majors in American universities are exposed to humanistic inquiry about engineering; accreditation structures mandate some content of this kind (Riley 2012; Slaton 2012). This material can take the form of laudatory historical narratives or more incisive critiques of engineering. "Liberal education," as such instruction is labeled within the American Society for Engineering Education, is today variously provided by historians, sociologists, anthropologists, and policy or STS scholars, depending on the school, and this coursework unquestionably represents a wide range of political sensibilities on the part of instructors. But even the most critical or open-ended liberal-education pedagogies may not actually empower students profoundly to question how well or poorly engineering fulfills democratic ideologies. Critical social inquiry is not part of creditable engineering epistemology; the very definition of technical work requires lip-service to the false dualism of "people" and "technology." As Wendy

Faulkner has articulated, this binary is performed despite such obvious contrary evidence as the fact that technology is made *by people*, because the binary instantiates the authority of those (engineers) who claim that social issues (such as equity) dilute technical rigor (2009, pp. 143–144; see also Slaton 2010). Raising questions about such definitions is not likely to make one appear prepared for service in the field. That is, to propose to one's civil engineering instructor that civil engineering is at times a socially irresponsible endeavor may not go so far as to alienate that professor, but nor will it constitute a sign of mastery of engineering content.

The political disciplining accomplished by educational standards of this kind is powerful. In engineering as in all fields of education today, to turn away from standards is not merely to risk acquiring the wrong bodies of knowledge, it is also to risk regressing to the naturally lower state of the undisciplined mind (Popkewitz 2004). Goldberg and Traiman warn that, "Standards mean that students grow as they learn; without them, they learn to settle" (2001, pp. 75–76). Valuable learning in the American engineering curriculum means skirting unfamiliar questions or ones that have not been certified as having value by those who derived their authority from previous standards; a conservative system indeed!

In the formation, deployment, and enforcement of standards for STEM education, objectivity compels as a tool which scientists wield deliberately and particularly well among all professionals; all fields within STEM carry some of that cache (Seron and Silbey 2009). The supposed subjectivity of non-science (i.e., social or political) inquiry helps stigmatize that inquiry within STEM institutions but it is important, Faulkner adds, not to accept that duality as any more solid than the "people/technology" one. As Riley et al. write, this marginalization of social concerns in technical education follows the logic that any practice which is intentionally more caring or more just cannot simultaneously be more scientifically appropriate (2009, p. 24). Circular as it is (or exactly because it IS circular), this construction of "scientific-ness" (as that which lessens attention to care and justice) commands our attention as an instrument of neoliberalism. The forward motion of society through the fulfillment of market functions requires a narrowly instrumental approach to knowledge about nature and to any applications of that knowledge. According to that worldview, problem choice (as in: what should be studied about nature, and what technologies thereby developed) must proceed with issues of care and justice cast as mere distractions.

Conclusions

The objective of this paper is to break open the black box of racial, gender and other inclusive projects in American engineering education to understand why inclusive efforts have only minimally disrupted conventional social relations in that field. I have tried to highlight the complexity of the issue, pointing to the roles of multiple cultural commitments ongoing in the United States today…to technology, to ideas of merit, to the neoliberal embrace of market forces and the strategic denial of the structural conditions that impede democratic reform. The motivating question of this paper might be more simply phrased this way: To what problem is STEM diversity programming the answer? That query stands in sharp contrast to the myriad questions that make up most research on STEM diversity, which focus on student experiences, teaching and learning styles, and quantitative measures of how well or poorly inclusive interventions have functioned. The tasks of engineering, to which some Americans not previously involved should now be introduced, are not themselves subject to inquiry; add minorities and stir, as the ironic catchphrase goes.

Thomas Popkewitz builds a compelling case for the ways in which education since the late nineteenth century has set the stage for inculcating precisely this set of narrowed epistemic priorities in students. Schooling, he proposes, enacts the production of the cosmopolitan citizen, the individual operating in support of a larger social structure and its privileges, "taming" if not banishing unwelcome "subjectivities" in order to produce a citizen subject to administration. Science is not coincidentally central to this education:

Cosmopolitanism makes possible the conditions of the modern state, its citizens, and the pedagogy of the school by bringing together the scientific order of reason and the individual who reasoned through science (Popkewitz 2004, p. 190). Essential to this project, Popkewitz explains, is the construction of the student as one who must be taught to distinguish between knowledge and non-knowledge. Here, he quotes Charles Eliot summarizing this prescription in an influential study of the early 1890s:

> One is fortified against the acceptance of unreasonable propositions only by skill in determining facts through observation and experience, by practice in comparing facts or groups of facts, and by the unvarying habit of questioning and verifying allegations, and of distinguishing between facts and inferences from facts, and between a true cause and an antecedent event. One must have direct training and practice in logical speech and writing before he can be quite safe against specious rhetoric and imaginative oratory. (Eliot 1892–1893, p. 424 [quoted in Popkewitz 2004, p. 205])

We can take Popkewitz even further and understand the students' historically prescribed work of distinguishing knowledge from non-knowledge to be the work of fabricating knowledge. Constructivist understandings of science indicate that the work of scientists brings the subjects of science *into being*; that is, there is no nature or material that holds meaning apart from our efforts to give those objects of our attention meaning. Applied to engineering, this might suggest that to build a bridge, HVAC system, or artificial spine comprises engineering through social relations, but it would be more precise to say that each of those tasks is necessarily both engineering and an expression of power.

The point is that technological activity is not figure to the ground of society or culture. With that organic, integrative understanding in mind, the discriminatory habits of STEM education and labor in the United States are not easily demarcated from other epistemic commitments of American science and engineering. Many dedicated educators and policy makers have worked for decades to understand STEM inequity, but in turns out that merely defining the problem is even harder than we thought. Yet, it is the recognition and embrace of precisely that difficulty that may finally lead to change.

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