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THEORY

Contextualizing the Past to Guide the Future: Situating Three Critical Theoretical Frameworks for Educational Culture

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Background: The engineering education research community has increasingly acknowledged the importance of addressing equity and inclusion. Qualitative research approaches have a unique power to reform classroom practice, create empathy for students, understand context, and point towards new paradigms and solutions. In our work, we have found critical social theories provide useful ways of looking at, critiquing, and reimagining inequitable educational settings. However, many scholars theory in a limited way with theory, treating it as a utilitarian choice rather than requiring deep engagement. Without careful consideration of the situated historical context for a theory's origin, we can distort its original purpose.

Purpose: This paper highlights funds of knowledge, cultural production, and cultural construction as three prominent theoretical frameworks for educational culture. Following the methodological approach of historicizing, we recontextualize the present use of the theoretical frameworks by better understanding their historical context.

Scope: We introduce each of the three frameworks and present an account of the history of the origins of the frameworks, emphasizing the context within which the originators found themselves and what problems they saw themselves as addressing. Next, we discuss how it is currently being leveraged in US engineering education or related fields, noting perceived problems or patterns related to the application of theory. Finally, we consider the differences between the past and the present contexts to help guide future use of the framework, noting what lessons we can take away from the past that speak to issues in the present.

Conclusion: We compare the nuanced differences between the frameworks and call on readers to make a more careful and less casual choice regarding theory. We also note the importance of considering historicity, situatedness, and reflexivity when deeply engaging with research on educational culture and critical theoretical approaches.

Keywords: theoretical frameworks; critical social theory; ethnography; culture; equity; historical context

Introduction

Prioritizing Theory in Engineering Education

Engineering education is a hybrid discipline that draws on multiple disciplinary histories. First, engineering education is a discipline-focused subset of a wider education research community. Scholarship on education has a long tradition of philosophers, activists, and researchers dating back centuries. Education research is itself a particular subset of wider social science research. In this regard, engineering education has always drawn on concepts that are vital to social science research, including a deep engagement with social theory. Second, engineering education is fundamentally grounded in engineering, both in its content and in the audience it communicates to. While engineering does deal with philosophy and theory (Bucciarelli, 1988, 2003), it could be considered more fundamentally pragmatic—focused more on what works to produce the best solution than on the process of building knowledge (Bulleit, 2017). In our methods and processes, we are

social scientists and philosophers, but in our collective practitioner community (and many of our prior or parallel lives) we are still pragmatic engineers.

Caught between these two orientations towards theory, engineering education has been developing its own disciplinary norms. Originally a field that was somewhat dominated by engineering professors performing their own scholarship of teaching, engineering education began to formalize as a research community and discipline (Borrego, 2007). Parallel conversations on rigor (Riley, 2017; Streveler & Smith, 2006), quality (Walther et al., 2017), and impact (London & Borrego, 2017) have pushed the field to reflect on what it means to conduct engineering education research and by which criteria we should assess that research. In parallel, over the course of a few decades, theoretical frameworks seem to have gone from quite rare to a nearly required component of engineering education research publications and proposals.

While the quantity and usage of theoretical frameworks has increased, the authors of this paper find that many in the field do not engage deeply and widely with theory. Perhaps stemming from our own individual or collective pragmatic orientations, theoretical frameworks are spoken about in engineering education with utilitarian language: for example, "I used <name of theory> to look at <topic>". Divergent theories, which each bring with them a deep set of philosophical assumptions about the world and a social historical context for their origination, seem to be given little deep reflection and are placed relatively simply next to one another for selection. In doing so, we can box theory in and diminish it, making it more palatable but less powerful.

Also, within engineering education, theories can organize researchers socially. We learn about which theories to use from our advisors, from collaborators, or from conferences. With so many available and possibly relevant theories from a wide variety of social sciences, it is not surprising that we often simply name these traditions rather than engaging deeply and broadly with the possible theoretical lenses we could bring to a subject matter. In response to this, an expanded conversation about theory could help our field develop a more strategic understanding of our own research design, a more nuanced understanding of the findings presented by others, and a deeper sense of wisdom about education overall.

The authors of this paper come from different theoretical perspectives focused on culture and marginalization in educational settings. We have each reflected on the process of bringing theories in from anthropological or sociological traditions, how we personally have navigated this transition and what these theoretical traditions can offer engineering education. We wish to demonstrate both breadth and depth of engaging with theory. In breadth, we consider multiple theories within this single paper, allowing an opportunity to see the potential power, implications, and unintended pitfalls of using each of the theories. In depth, we demonstrate their historical contexts and deep philosophical orientations of theory.

To begin this expanded conversation, we focus on theories currently used to explore culture, marginalization, and inequity in engineering. Our contemporary context has brought issues of inequity to the forefront, and these theories offer an important starting point for and illustration of the ways in which deeper historicized understandings of theory can enrich all our work as engineering education researchers.

Theory in Research on Culture and Marginalization

In addition to recognizing how engineering's pragmatic nature influences engineering education, we call attention to the history of social exclusion and the privileging of certain demographic groups in the engineering profession (Secules, 2019; Slaton, 2010). We believe that engineering education has an ethical imperative to contend with this history, to call attention to it, and to find ways to shift engineering to provide greater access and representation for marginalized groups. Overall, we name this, our starting place, as a *critical theoretical orientation to engineering education*.

Critical theory, and critical social theories more broadly, contend with power and oppression in society (Mejia, Revelo, Villanueva, & Mejia, 2018). In a critical lens, knowledge generation and empirical study are not neutral, but are political in the sense that they contend with power relations (Secules et al., 2018). From a positivist or interpretivist research perspective, a critical lens could be seen to introduce bias, in looking for the power relations and forms of oppression that are presumed to be present in society. Alternatively, researchers from a critical lens would contend that all knowledge about society fundamentally concerns power relations and that these power relations can mask truth (e.g., because the winner lives to tell the tale) (Riley, 2017; Secules, 2017a). Critical research involves naming and identifying the power relations underpinning society so that they can be dismantled. Thus, the particular importance of theory in equity-focused research is multifold and may extend beyond that of other engineering education topics. Dimensions of equity research including power, epistemology, positionality, historicity, and politics require deep theorizing in order to parse.

In particular, the frameworks we discuss in this paper focus on *culture*, a term which has so many multi-faceted meanings that many anthropologists have debated abandoning it in favor of other more precise constructs (McDermott & Varenne, 2006, p.5). Alternatively, for engineering education, the construct of culture has not been over-theorized to the point that it is meaningless, it is still a relatively simple and common way that the community refers to taken-for-granted educational norms (Godfrey & Parker, 2010; Secules et al., 2018) or the typical associations and expectations related to an engineering sub-discipline (Murzi et al., 2015). Within the complex landscape which can be considered culture, theoretical frameworks help concretize the conversation by providing a working definition and ontology, as well as a methodological signpost that

can guide the empirical process. Our paper explores three critical theoretical frameworks on culture to demonstrate the importance of these theories, the potential misuse of the theories, and the lessons the historical context for the theories can teach us about the ways researchers can leverage theory in their work.

Paper Process and Author Positionality

This paper emerges out of the Secules's dissertation work (Secules, 2017b) on critical cultural lenses and the second author's published work on funds of knowledge. The critical cultural lenses discussed in the first author's dissertation included cultural construction, cultural production, and liberatory pedagogy, and it seemed necessary to provide a comparative discussion of the frameworks to help a reader make sense of the contrasting approaches and assumptions within different parts of the dissertation. Having taken up this comparison of cultural frameworks, the discussion also centered on the parallel historical origins of the three frameworks, the affordances and limitations of each, a *thought experiment* example application of each framework in a similar engineering context, and a discussion of epistemology and researcher positionality. The present paper grows out of that effort.

Mejia has published widely on aspects of equity and social justice in engineering education and has particular familiarity with the critical framework of funds of knowledge. Secules and Mejia met through other collaborations and realized through conversation that there were parallel issues of historical context and philosophical depth with the usage of critical frameworks each author was most familiar with. A decision to coauthor meant that comparisons between frameworks could be externalized in conversation and collaborative writing, and this comparison would become more educational for each coauthor and for readers. As such we shifted from the initial three cultural framework comparison to be between cultural construction, cultural production, and funds of knowledge.

Secules identifies as a White man, former engineering professional, and current engineering faculty member working at a Hispanic Serving and Minority Serving Institution. Coming from many demographic and professional positions of privilege, but some experiences of marginalization, Secules has a sense of dual consciousness by listening to and revoicing marginalized student perspectives and remaining in critical conversation with faculty and privileged identity groups. Similarly his prior lived experience in both the US and the UK makes him curious about different cultural modalities, and his research attempts to problematize dominant cultural norms in US undergraduate engineering education that lead to inequity and marginalization. Mejia is a Latino that identifies as Mexican American, former engineering professional, and current engineering faculty member at a predominantly White institution. Mejia's interest in working on equity and social justice issues in engineering education emerges from his own lived experiences, close proximity to the Latinx community, and cultural background. Through his work, Mejia proposes the adoption of asset-based approaches to engineering education and challenges deficit approaches. Mejia also recognizes marginalized individuals as creators of knowledge who have become victims of epistemicide due to centuries of colonial subjugation (de Sousa Santos, 2014). Both authors have discussed positionality in more detail elsewhere (Secules et al., 2021).

Methodological Approach and Paper Organization

The paper's methodology resonates with approaches from cultural studies that suggest that historically contextualizing (also termed history of the present, or historicizing) the past can help understand the present (Foucault, 1977, 1982). In this case, the historical context we seek is for theoretical frameworks related to equity and culture in engineering education. The tradition of historicizing the past to contextualize the present has been used in engineering education (Secules, 2019) and science education (Kirchgasler, 2015). The tradition of historicizing particularly situates present day circumstances within a broader critical historical and cultural context to more precisely represent present-day circumstances.

Each of the cultural frameworks we discuss and our associated experiences in engineering education research are embedded within traditions of education research, anthropology, sociology, and other social sciences, and are associated with the methodology of ethnography. Given its reliance on discovery through participant observation and interviews, educational ethnographies can have a tendency to emphasize the present and the immediate. However, there is a strong emphasis within the anthropology of education to return historical context to anthropological observations and to treat historical accounting as a methodological tool (Rockwell, 2016). As pragmatic disciplines, education research and engineering (and thus engineering education) are also primarily present-oriented (Secules, 2017a). This paper's focus on historicizing is thus partially in response to the strong present-day orientation of the associated disciplines and methodologies to help treat the frameworks with accuracy and develop greater insights.

To account for the treatment of the theoretical frameworks in the present-day literature, we draw on our prior work reviewing the literature on the use of critical theoretical frameworks (Mejia et al., 2018; Mejia, Revelo & Pawley, 2020; Secules, 2017b) in engineering education research. In the spirit of collegiality, we have called attention to patterns in the engineering education literature without centering the discussion on a critique of any particular author or study. To assemble the historical contexts for the study, we looked to review articles accounting for the history of the disciplines (e.g., Gonzalez, Wyman, & Connor, 2011; Levinson & Holland, 1996; McDermott & Raley, 2016; Velez-Ibañez & Greenberg, 1992)

to provide an overview account from those who were a part of the theories' respective origins. We further probed the literature for the primary sources of research from these historical periods, delving deeply into the original texts by foundational authors to synthesize their original contexts, perspectives, and purposes.

The paper proceeds with a discussion of three frameworks associated with culture and equity in education: (1) funds of knowledge, (2) cultural production, and (3) cultural construction. We intentionally present and synthesize the information in the following sections in narrative form to prevent any reductionist representation of these frameworks. The nuances of these frameworks would not be well-captured if summarized, for example, in a table form. Our goal is to encourage others in engineering education research to embrace the nuances of these frameworks, critically reflect on the historical developments of these frameworks, and immerse critically in the literature.

Findings

Funds of Knowledge

Funds of knowledge is a research approach and framework that looks into the assets of students while challenging deficit notions (Garcia & Guerra, 2004; Rios-Aguilar, Kiyama, Gravitt, & Moll, 2011; Rodriguez, 2013). A funds of knowledge approach seeks to recognize the historically accumulated bodies of knowledge, skills, practices, and cultural ways of interacting and doing as assets that emerge from the household and community. The integration of funds of knowledge into the classroom activities can help create a bridge between formal and informal learning and provide students with a rich learning environment that valued their lived experiences and embodied knowledge (Moll et al., 1992). Of great importance to this work is the emphasis on the labor history of the households involved in the study of funds of knowledge. This emphasis on labor history challenges the idea that working class children have lower qualifications because of the inadequacy of the household. Funds of knowledge challenges these perspectives and seeks to deconstruct how household knowledge is rich, important, and provides students with a wealth of tools and skills. Moreover, it accentuates a positive and realistic view of the household that defies "the accepted perceptions of working-class families as somehow disorganized socially and deficient intellectually" (Moll et al., 1992, p. 134).

Historical Context for Funds of Knowledge Framework

Mexican Americans in the Southwest United States have constituted a large minority group for centuries. They have also experienced years of inequity as a result of historical subjugation from colonizers who enforced their Americanization and White dominance. As a result, schools in the Southwest were overwhelmingly controlled by Whites who later used certain policies to keep Mexican American students segregated (Hurstfield, 1975). Students were given certain characteristics or classified as *handicapped* to justify this illegal segregation. In the 1960s, for example, social constructions such as *culturally deprived* or *culturally disadvantaged* were used to create the myth that Mexican American children and their households were inadequate to reach the same academic achievement as Whites (Valencia & Black, 2002). Parents were also blamed for the existing educational inequities created by decades of unequal access to education. Then, in the 1980s, *at risk* became the new term used to re-emphasize the inadequacy of the home along with the *cultural disadvantage* of the Mexican American students. *At risk* also became a term to describe the likelihood of failure while accentuating familial and personal deficiencies such as ethnicity, socioeconomic status, or single parenthood (Valencia & Black, 2002). These deficit-oriented perspectives and framing continue, to date, to affect the education of Mexican American children in the Southwest leading to significant educational inequities.

Research in the 1980s and 1990s sought to challenge these deficit perspectives and debunk the idea that Mexican American households were to blame for the lack of access to education (Rodriguez, 2013). More researchers started to focus on constructing new narratives and describing the Mexican American family as rich and the main source of educational resources. Thus, the concept of funds of knowledge emerged and was initially used to describe the existing strategic and cultural resources utilized by Mexican American families along the U.S.-Mexico border for survival and well-being (Velez-Ibañez & Greenberg, 1992). University researchers and teachers in Tucson, Arizona, including Luis Moll, Norma González, Cathy Amanti, James Greenberg, and Carlos Vélez-Ibáñez sought to identify the skills, practices, and knowledge that would challenge the perceived idea of inadequacy of Mexican American households and families in the U.S.-Mexico border, and to use this information to better inform instructional practices in the classroom (Rodriguez, 2013).

Vélez-Ibáñez & Greenberg (1992) argued that, historically, Mexican American families responded to their economic, environmental, and social landscape by generating a comprehensive repertoire of skills and knowledge. For instance, living in the Southwest meant that many of these families lived in areas with no doctors, or were sometimes rejected for not having the economic means to afford medical services. This situation led families to rely on, and develop, remedies and first aid procedures based on their ancestral folk medical knowledge (Velez-Ibañez & Greenberg, 1992). In addition, living in arid regions of the U.S.-Mexico border meant developing complex sets of skills to engage in agricultural practices. Given the lack of water resources, Mexican American families mastered their knowledge about "environments, water management, flood control, and climate variations" (Velez-Ibañez & Greenberg, 1992, p. 317) to continue to produce their own food and ensure their survival.

Research in the 1990s characterized funds of knowledge as the production of resources, and the exchange of such resources, within social networks for the well-being and survival of the household. These networks of reciprocal exchange were based on long-term social relations where *confianza* became the glue that maintained those social networks (Lomnitz, 1977; Moll et al., 1992). Families, households, and communities were described as units that use their funds of knowledge to create reciprocity, where labor, skills, ingenuity, and creativity are strategically used as a "currency of exchange" (Velez-Ibañez & Greenberg, 1992, p. 318); this value system contrasts capitalist ideals of markets' supply and demand. As indicated by Velez-Ibanez and Greenberg (1992), household knowledge requires critical perspectives, such as the type of knowledge that is passed on or ignored and how material dominance can be challenged. Households provide the unique environment for learning "where error is not dealt with punitively and where self-esteem is not endangered" (p. 326), as opposed to the formal classroom setting where ability and intellect are contested by dominant norms and discourses fostered by deficit models of students of color.

Before funds of knowledge were framed and used in educational contexts, the primary goal was to emphasize that this wealth of knowledge had a strategic importance for economic well-being and survival. Then, through a "combination of ethnographic observation, open-ended interviewing strategies, life histories, and case studies" (Moll, Amanti, Neff, & González, 1992, p. 132), teachers and researchers from the Southwest United States began to explore the wealth of knowledge, skills, and practices that families hold to ensure the well-being of their households, and the ways in which that knowledge becomes the repertoire of information—typically ignored in educational settings—that children bring into the classroom. These qualitative ethnographic investigations allowed the teachers and researchers to understand the historical, sociopolitical, and economic context of Mexican American communities in the Southwest United States (González, Moll & Amanti, 2005). Moll and colleagues (1992) highlighted the importance of the qualitative nature of doing funds of knowledge work in educational settings. The primary purpose of funds of knowledge in an educational context was *not* to build curriculum or lesson plans, but to confront the idea that Mexican American students coming from low-income households received inadequate experiences in their household that prevented them from reaching a particular level of academic achievement. Moll and colleagues (1992) would also later emphasize that *confianza* is necessary to both investigate funds of knowledge and eliminate deficit views of children, households, and their communities.

Funds of Knowledge in Engineering Education

In engineering education, a growing body of research has introduced funds of knowledge (Denton & Borrego, 2021) in an effort to address deficit views of students and the increasing challenge of broadening the participation of minoritized groups (Mejia & Wilson-Lopez, 2016; Smith & Lucena, 2016a; 2016b; Verdin, Smith, & Lucena, 2020; Wilson-Lopez, Mejia, Kasun, & Hasbún, 2016). These studies have provided a more expansive view of students' wealth of knowledge, skills, and practices that have been traditionally ignored in engineering education. However, the engineering education research tends not to approach funds of knowledge with a Marxist orientation or to view them within the context of reciprocal networks of exchange. Without this element of anti-capitalist productivity, funds of knowledge can rely on a static typology of culture that essentializes demographic groups (González, Wymann, & O'Connor, 2011). Further, some studies in engineering education seem to be moving towards a quantitative approach to identify funds of knowledge and to relate these to self-efficacy, belonging, and success through the use of instruments (Denton & Borrego, 2021). While this quantitative approach is innovative, quantitative research may obscure the nuances that exist in the production or quantification of funds of knowledge (or assets), and instead frame them as homogeneous, bounded, and static rather than focusing on its relational and materialist nature.

Moreover, a quantitative approach to funds of knowledge may create the perception that information is finite and quantifiable. The quantification of funds of knowledge could result in the stratification of what could be considered valuable and invaluable forms of knowledge, thus feeding into the narrative that only certain ways of knowing, doing, and being in engineering are valid. For instance, an individual using an instrument to identify or categorize funds of knowledge may take on the role of a funds of knowledge finder and introduce a hierarchy indicating whose knowledge is more important. This contradicts the original goal of funds of knowledge to acknowledge students' home and community experiences as rich learning environments.

While some may assume that *funds of knowledge* is a synonym for culture, the reality is that a funds of knowledge approach is grounded in the materialist theory described by Marx (Small, 2005) and Vygotsky (1978) social development theory. That means that everyday practices and worldviews are tied to productive activities, and those activities lead to the construction and production of knowledge. In this sense, funds of knowledge are dynamic, relational (i.e., centered around social networks), and linked to productive activities.

In general, funds of knowledge research in engineering education can lack an analysis of the power dynamics that contextualize the ways in which children, households, and communities are marginalized in the dominant culture. This decontextualization makes it difficult to truly challenge deficit views of marginalized communities that continue to exist in the field of engineering. For example, current research in engineering education that does not analyze power dynamics in

the engineering discourse or curriculum may perpetuate the idea that only certain ways of knowing, doing, and being are meritorious (Godfrey & Parker, 2010) by imposing a dominant White, male, Western epistemology. These actions lead to the perception that marginalized communities have nothing to offer to the construction of engineering knowledge, while continuing to see these communities as deficient. In order to level the playing field in engineering, and increase the participation of minoritized groups, it is important to recognize people of color as holders and creators of knowledge (Delgado Bernal, 2002).

Contextualizing the Past to Guide the Future

Current and future engineering education work requires positioning funds of knowledge as the foundation for expanding the teaching and learning of engineering, while recognizing that cognitive and sociocultural processes do not exist in isolation. A funds of knowledge approach should guide our own path toward critically confronting our own deficit perceptions of minoritized students. Simplistic categorizations of funds of knowledge will not produce a realistic and authentic view of households and communities.

In addition, quantifying funds of knowledge is inconsistent with the framework's historical origin and may do more harm than good if it unintentionally leads to hierarchies of funds of knowledge. A quantitative approach may also reduce or ignore the complexity of the reciprocal networks of exchange that are fundamental to understanding funds of knowledge. Funds of knowledge seeks to recognize "the critical role of social history and context in mediating what is learned (and taught), thus holding the potential for vast levels of transformation and knowledge production—and shifting definitions of academic success" (Rodriguez, 2013, p. 101). Thus, recognizing these networks of reciprocal exchange is necessary to counter deficit views and move toward an asset-based education.

Fundamental to the core of funds of knowledge is also an analysis of power to prevent falling back into the structures that led to deficit perspectives in the first place. For example, it is important to recognize that most researchers and educators do not live in the same communities that are of interest or concern, and minimal exposure to the lived realities of the students, their households and their communities is often the norm. It is necessary to move beyond the scholarship and interrogate power relations, the impact of being outsiders, and how the community is being scrutinized because it is foreign to the researchers or educator (Mejia et al., 2018). Rather than adhering to a simple view of funds of knowledge as a framework that will provide an easy pathway to a responsive curriculum for an entire demographic group, instead it is of extreme importance to challenge the academic and educational systems in which we are embedded, to critically engage in conversations that transform power and agency, to contextualize the lived realities of the students, families and communities, and to reflect on how we may be participants in reproducing deficit models by our actions.

Cultural Production

The cultural production framework addresses the ways that systems of cultural oppression are reproduced or that novel cultural productions (counter to the status quo culture) can be produced instead (Levinson & Holland, 1996). For example, gendered patterns of professional work in STEM consistently recreate the reality that STEM is a masculine-associated discipline, but this cultural reality can be counteracted in specific majors or work settings (Eisenhart & Finkel, 1998). Holding that broader (macro-level) reality in mind, many cultural production scholars delineate local (or meso) cultures at the level of a classroom, school, or other group that are consistent with or subversive of the oppressive (macro) norm, and then they look to document the aspects of culture that have helped create or subvert that meso-level oppression, the "resources for and constraints upon social action, the interplay of agency and structure in a variety of institutions" (Levinson & Holland, 1996, p. 3). Particularly in documenting the practices that seem to lead to novel cultural production and innovation or oppression and inequity (e.g., Carlone et al., 2011), these studies tend to uncover useful strategies, promising practices, and policy recommendations.

Historical Context for Cultural Production Framework

The cultural production framework originates from an organizing principle from Marxist sociology: social class tends to reproduce divides between capital and labor regardless of any façade of economic opportunity or political change (Marx, 1867/1976). This simple observation generated a polemical and theoretical branch of European and British sociology, where social class is arguably the most powerful system of power and oppression (Morrow & Torres, 1995). An early adaptation of social reproduction to education theory in the 1960s and 1970s claimed simply that education reproduces social class (e.g., Bowles & Gintis, 1976; Entwistle, 1978). In the US, social reproduction theory emerged as an important counterweight to narratives about education as the great equalizer of access to the American Dream.

Criticisms of the initial social reproduction in education theory accused it of being tautological rather than mechanistic, an unprovable black box. Inspired by Gramsci (1971), a next generation of educational sociologists sought out the educational structures and actions which reproduce social class. Paul Willis was an early leader in this work, providing insight into the mechanisms which reproduced social class among the lads of working-class England. The mechanisms of social

reproduction included the lads' views that their male teachers were emasculated by their education and that acting out behaviorally ("having a laff" p. 3, Willis, 2004) was an important resistance of that emasculation. The inclusion of actions and perspectives of the lads themselves invigorated the theory with agency and interaction, and Willis and his contemporaries (e.g., Apple, 1982) provided critical movement towards a more thorough understanding of social reproduction.

In the United States, realities of social class intersect with several other forms of oppression, perhaps most notably racial oppression and white supremacy. In the period when the British theories were being developed (1960s–1970s), scholars in the US were increasingly conscious of the national climate of racial oppression which the simple social reproduction of class could not account for. To theorize the maintenance of this more arbitrary hierarchy, scholars turned to Bourdieu's (1984) theory of *cultural capital:* the (French) elite maintained separation from the working class in part by defining the ineffable aspects of elite culture—the tastes for literature, art, music, cuisine, dress, etc. These aspects of culture were arbitrary but functioned as a tool to justify and reify the social hierarchy. In education, arbitrary cultural values recreate the contours of the ruling classes and justify their demarcation. Although scholarship that looks to cultural difference (or social or cultural capital) as a root of oppression persists in social and educational analysis (Carlone & Johnson, 2012; Martin et al., 2014), it has also been criticized for being essentializing and incomplete as an explanation, where inequities between social groups are entirely explained by the social and cultural differences themselves.

Borrowing from Bordieau's cultural capital and Willis's interactive form of social reproduction, American anthropologists formalized a dual theory of *cultural production* (Levinson & Holland, 1996). The first part of the theory, cultural reproduction, invigorates structure and culture into the work of reproducing oppressive systems around race, gender, class, and other systems of power. The second part, *cultural production*, emphasized the process of cultural change. As the name suggests, cultural production scholars often place greater weight on novel productions of culture, rather than mechanisms for status quo reproduction.

In foundational work, Dorothy Holland and Margaret Eisenhart studied how women were socialized in a college campus cultural landscape of romance, and how this contributed to their taking certain career pathways that reproduced gender inequities such as in science and engineering fields (Holland & Eisenhart, 1990). Eisenhart's next work championed several novel cultural productions (i.e., counterspaces) to gender inequity, such as bioengineering labs and environmental activist groups that provided women access and agency to science careers (Eisenhart & Finkel, 1998).

Cultural Production in Engineering Education

Cultural production has been taken up prominently in science education research (Carlone, 2003, 2004; Carlone et al., 2011) and is an emerging approach in engineering education research (O'Connor et al., 2015; Tonso, 1996, 2006a, 2006b). Several studies in science and engineering education focus on the dimension of gender oppression, discussing whether features of a classroom reproduce or subvert the pattern of oppression (Carlone, 2004; Carlone et al., 2011; Tonso, 1996, 2006b). These scholars often focus on identifying the structures (e.g., national policies, standards, school environments, pedagogical practices) that lead to novel or oppressive forms of culture. Particularly in documenting the practices that seem to lead to novel cultural production and innovation or oppression and inequity (Carlone et al., 2011), these studies tend to uncover promising practices and policy recommendations.

While cultural production theory is a broad theory of society that does not delineate a specific set of methodological steps, a substantial portion of cultural production scholarship in STEM simplifies cultural complexity into delineated macro and micro cultures and a single dimension of oppression (e.g., gender) with positive or negative consequences. Inherently, that singular focus requires less priority on the simultaneous intersections of race, socioeconomic, and other forms of privilege and oppression simultaneously being created in the classroom. It also reduces attention on interactional complexity.

Cultural production work in STEM primarily seems to treat participant accounts with a mix of ethnographic realism and critical scrutiny, documenting the culture as told by insider participants to problematize one central construct such as identity as a "science person" (Carlone et al., 2011, p. 393). Cultural production in STEM education has often focused on disciplinary identity as an orienting construct and on features that correlate with novel cultural settings that counter oppressive norms, rather than on examining processes of reproduction or the recreation of oppressive norms that cause inequities. Without an analysis of power and agency regarding the reproduction or recreation of oppression, the causal links these studies often suggest to structural sources of oppression and the mechanisms for change within oppressive systems can be difficult to establish. Relatedly, cultural production studies focused on identifying the features of specific instances of novel educational culture may not translate into change elsewhere that this culture does not already exist. Thus, the scholarship may be somewhat inert, documenting existing culture without testing possibilities for change within the system.

Contextualizing the Past to Guide the Future

Cultural production grew out of a Marxist critique of the reproduction of social class and over time has shifted to place significant weight on the positive cultural productions that counteract oppressive norms. While leading scholars have consistently identified the critical and Marxist origins of the framework, many cultural production studies in STEM or engineer-

ing education do not center critical discussions of power within their analysis or do so with a somewhat narrow definition applicable to only one dimension of identity. Perhaps one lesson from the historical context is to remember the critical orientation of the framework, to resurface the issues of equity and power that overlap with the micro cultures, meso institutions, and macro society. In studies that primarily focus on gender, how do issues of race, socioeconomic power, culture and taste, and other intersections of oppression impact the reproduction or novel production of STEM culture?

The focus on identifying structures that lead to novel production of culture or oppressive reproduction of culture can tend to assume the role of documentarian of cultural practices rather than an active agent documenting what works to create change. Remembering that the original purpose of the focus on novel/positive cultural productions was to counteract the theories that ended the discussion at a tautological statement about the status quo always reproducing itself, we could invent new and nuanced ways of discussing what is created anew and what is reproduced. Would taking a participant action orientation (Jurow et al., 2016) or a critical design ethnography orientation (Barab, 2004) provide a useful new lens for thinking more actively and imaginatively during cultural production research? Applied towards participatory and design research paradigms in collaboration with engineering instructors, the cultural production framework could provide a useful framework for instructors conceptualizing the on-the-ground work of creating educational culture for oppressive or progressive means.

Cultural Construction

Cultural construction is a framework that provides a form for cultural critique of American educational culture and its various categorizations of success and failure (Varenne & McDermott, 1999b). Cultural construction scholarship problematizes the status of an accepted educational fact, usually a deficit-based fact, as a presumed naturally occurring fact about an individual student or student group. To contrast possible constructions of educational facts, the framework highlights individual trait and socialized difference as common and ultimately unsatisfactory explanations for student difficulties. The researcher then deconstructs these educational facts by investigating the interactional and cultural precursors that surround the individual's circumstance and contribute to the construction of the fact. Some of the prominent scholars in cultural construction have deconstructed educational facts/institutional labels such as Learning Disabled (McDermott, 1993) and illiterate (Dore & McDermott, 1982), often demonstrating that attributes we presume to apply to an individual's psychology and consistent across settings actually shift depending on environmental factors and cultural contexts.

Historical Context for Cultural Construction Framework

The roots of cultural construction scholarship have been traced back to the American anthropological tradition, with ethnographers in the early 20th century shifting their attention from traveling to exotic locations to casting a critical gaze on American culture itself (McDermott & Raley, 2016). The impact of two world wars alongside ever-increasing immigration and globalization led anthropologists to try to understand the fundamental character of individuals from different cultures including at home in the United States. The resulting scholarship sought the cultural roots for disagreements and difficulties among diverse and mixing groups (Benedict, 1946, as cited in McDermott & Raley, 2016). Personality studies aimed at solving a problem among people in interaction and brought more critical attention to one's own cultural personality, in comparison to other groups, thus these studies led to new critical comments about American culture. In education, personality studies looked critically at the affective position of the American student inside of American school (Henry, 1963, as cited in McDermott & Raley, 2016). This work brought an important critical focus to the psychological position of the American student, with a posture to question and challenge that culture and psychology.

The 1960s Civil Rights movements of the 1960s brought new attention to and shifted the dynamics of educational inequities. Discrimination was no longer sanctioned or codified in law discrimination became more covert, masked behind culture, taste, IQ, academic performance, and other social markers not overtly about race (Bonilla Silva, 2006). In social theory, Oscar Lewis presented a prominent cultural psychology of socioeconomic inequity, his *culture of poverty* theory (Lewis, 1971). Lewis saw the socialized cultural deficits of poor people as both the source and the effect of poverty, the structures, culture, and actors of the dominant groups were not implicated in his theory. Lewis' ideas were pervasive and consistent with an overall deficit view of marginalized communities in society, and his ideas have arguably continued to reverberate in education scholarship: for example, in Haberman's (1991) *pedagogy of poverty* which finds the root of school failure in the pedagogy that results from conditions of poverty, and arguably throughout deficit-oriented conversations in the present day.

The late 20th century brought about a group of critical American ethnographers that resisted this much larger theoretical movement as victim blaming (McDermott & Raley, 2016, p. 41). Scholars like Ray McDermott, Hugh Mehan, Herve Varenne, and Lois Hood conducted what was known as "interaction studies" (Hood, McDermott, & Cole, 1980; McDermott & Roth, 1978; H. Mehan, 1979, as cited in McDermott & Raley, 2016) which developed "tools for the defense" (McDermott & Raley, 2016, p. 42) of marginalized students, exposing everyday discrimination and mechanisms of marginalization that underscored the persistence of systems of oppression in education. These scholars leveraged a set of tools including an

ethnographic attention to everyday K–12 classroom settings and interactions, the relative methodological advance of using audiotape and videotape that had not been available to traditional ethnographers, and a post-structural attention to the interactional production of categories and accepted realities rather than traditional ethnographic documentation of these received categories. These technological and analytical tools seem to have furthered the intent of this research to resist subtle discrimination in everyday educational settings; because no teachers would admit to or acknowledge such discrimination, it was only by carefully parsing educational interactions (which had been caught on camera) that they could be critiqued.

In the 1990s, cultural construction anthropologists spoke directly to psychometric trends in education research that typified students with deficit labels. The approach to problematizing these educational facts about student archetypes was to examine the ecological validity (Cole et al., 1997) of psychometric educational tests such as IQ. One prominent example was of a student named Adam, who was identified as having learning disabilities and reading difficulties (McDermott, 1993; Varenne & McDermott, 1999a). McDermott documented Adam's participation in four contrasting cultural settings: a psychometric testing setting, a classroom setting, a school extracurricular field trip, and at Adam's home. McDermott demonstrated that Adam's disability was most prominent in psychometric testing and classroom settings, and that it disappeared in the less structured settings of home and extracurriculars. McDermott argued that rather than interpreting the psychometric test as the most valid setting to observe a learning disability, one should interpret psychometric testing as the most artificial setting that has been carefully constructed in order to categorize students into those with and without learning disabilities. McDermott's work was a major precursor of the social model of disability that focuses away from individual medical differences and deficits to the ways that social structures and cultures have created problems for the individual. McDermott also worked with a group of practicing exterminators who were being excluded from the profession due to lack of literacy skills to take a written test. In this case, McDermott took an engaged practitioner scholar approach to deconstructing the source of marginalization that was constructing the exterminators as incapable (McDermott & Varenne, 1995).

Cultural Construction in Engineering Education

While cultural construction's premise of deconstructing an educational fact or a deficit label about an individual continues to reverberate in education research (especially focused on the original contexts of learning disability and language learning) and cultural studies, it has seen less application to STEM education and engineering education contexts (Secules et al., 2018). Nevertheless, there are many deficit categories leveraged within those contexts that could be deconstructed. Gresalfi et al., (2009) adapted cultural construction to problematize categories of competence in mathematics classrooms (Gresalfi et al., 2009). O'Connor et al. (2015) took a similar approach to problematize calculus-readiness in undergraduate engineering departments, and Secules et al. (2018) investigated the construction of "not cut out for engineering" in an undergraduate programming course. These initial studies show the possibility of creating scholarship-to-practice insights, by focusing on local interactions and settings that build up to large-scale inequities, these individual settings can be better understood and transformed. They also provide a strong framing for critical scholarship, clearly delineating processes by which deficit labels are created and thereby reducing some of their inherent power.

In short, we perceive the primary limitation of cultural construction scholarship in engineering education as a lack of uptake. This lack of uptake may be related to a perception that cultural construction studies are complex and challenging to recreate. In that the framework looks for the root causes contributing to the construction of students as failures, it is also seen by some as pessimistic and unable to find solutions. In addition, there is a perception by some that cultural construction studies, as rooted in individual interaction and local conditions, therefore ignore the broader structural and historical preconditions that lead to inequity.

Contextualizing the Past to Guide the Future

Engineering educational culture, including both practice and research, continues to create categories of deficit that label students and a self-fulfilling prophecy to blame these categories and student attributes for their failures rather than the cultural, structural, and environmental forces that supersede them. Cultural construction could provide a powerful counterargument. We have a different understanding of learning disabilities in the 21st century, and we might not attempt the exact same tests of ecological validity. Still, cultural construction could help examine the forces used to blame students today. Consider the individual-psychology based topics such as motivation, giftedness, or (to a lesser extent) identity. We may think of these as positive attributes, but in a critical lens we must account for the students we label not motivated, not gifted/special education, or not identifying with a discipline. How do we think of these students? Is this a stable attribute we place inside of students that governs their participation in academic settings and the world beyond? If we took these individual-deficit constructs to task, identified their component parts and began to deconstruct and shift them, we could find the tools to help dismantle marginalizing educational culture.

Originators of cultural construction did not always explicitly interrogate racial, gender, or other demographic categories and the deficit labels and narratives that are associated with them. Yet, they noted in later writing that racial categories and other

demographic deficit narratives function in similar ways to their typical objects of inquiry and are urgent for scholars to identify and deconstruct (McDermott & Varenne, 2006). This analysis will likely call for a fluid multi-pronged approach, it will not be enough to look at how a single psychological deficit label is created and conferred on a student, but to look at the racialized and gendered patterns that have contributed to it, to see beyond the individual students how systemic bias and inequity have influenced the identification process. In taking and expanding these tools to examine the construction of problematic educational labels, engineering education scholars can create tools for the defense of marginalized students and their misattributions.

Discussion

Comparison of the Frameworks' Underlying Purposes

Comparing theoretical frameworks can be challenging in ordinary circumstances. As we have argued, theoretical frameworks require deep engagement to appreciate and to apply appropriately, and a deep understanding of more than one theoretical framework takes time to develop. Theoretical frameworks also tend to reinforce a particular view of the world, making it hard to discuss another theoretical framework without preemptively prioritizing one of the frameworks. Differences in epistemology and foundational goals may further make the frameworks incommensurate with one another. Nevertheless, we take the opportunity of this discussion of multiple theoretical frameworks within one paper to point out some notable similarities and contrasts in the underlying fundamental goals of each framework.

One subtle distinction for each of the three frameworks on culture comes in their naming and what piece of culture they are referring to. In cultural production, the meaning of the framework is that a researcher is investigating how a particular novel culture is produced—novel culture is the focal phenomenon. For cultural construction, the culture is assumed to be always already there, shaping perception and reality of local settings, interactions, and the construction of an educational fact—the educational fact is the focal phenomenon. In funds of knowledge, a theory commonly assumed to characterize a particular individual's home culture or demographic culture, the focus is actually on the resources and knowledge that individual brings to a specific activity or domain—knowledge is the focal phenomenon. A particularly difficult but important aspect of working across scholarly discourse is recognizing when key terms are being used in nuanced different ways. Those who do not recognize subtle distinctions in these meanings will be more likely to misrepresent and misappropriate the respective frameworks.

We are reminded from the historical review that each of the theoretical frameworks has leveraged different research design to achieve different communicative goals to a general educational audience. While all three of these frameworks critique dominant culture, cultural production and cultural construction were developed by academics as approaches to a critical ethnography of schooling (Levinson & Holland, 1996; McDermott & Raley, 2016), and are useful ways of analyzing and critiquing the dominant systems of schooling from the inside. Cultural construction leverages its strongest insight at the level of human interaction and taken-for-granted realities, whereas cultural production focuses on structural, historical, and policy aspects. Funds of knowledge on the other hand was developed by critical academics who from the beginning were focused on posing that critique from outside of the dominant cultural setting. Funds of knowledge researchers valued the participation and valuable knowledge of outsiders to the dominant norm, by empowering teachers to get out of the classroom and analyze the funds of knowledge of their students, households, and communities. In addition, both funds of knowledge and cultural production tend to critique dominant oppressive culture by presenting an alternative: a valuing of students' funds of knowledge, or a demonstration of a positive instance of schooling culture. Contrastingly, cultural construction creates its critique by documenting instances of oppression playing out in everyday settings.

In further considering the implicit values underlying each framework, we found two distinct and diverging purposes. The purpose of funds of knowledge and cultural construction is not a specific set of instructions, interventions, curricula, or policies that can solve equity once and for all. Although there may be some pragmatic or curricular implications arrived at peripherally, the central purpose of these two frameworks appears closer to changing the hearts and minds of each educator or researcher who reads and engages with the scholarship. By awakening each individual educator to broader injustices, we help them find their own local solutions and transform educational culture more deeply from the core. In contrast, much of the cultural production work in STEM education results in a summary of promising practices, a *what works* for producing novel cultural production/culture that does not recreate oppressive marginalization. These contrasts may also impact the form of the argument, with cultural construction and funds of knowledge research sometimes making a less traditional format, with cultural construction leveraging evocative language and funds of knowledge prominently centering indigenous language constructions. Cultural production scholarship tends towards somewhat more traditional ethnographic scholarly formats for documenting the evidence for production or reproduction in a particular setting.

Dimensions of Deep Engagement with Theory

As we advocated at the beginning, we think deep engagement with theoretical frameworks is crucial to all work in education research, and particularly engineering education research that focuses on equity. Based on our exercise exploring these three theoretical frameworks, we distill the following dimensions for researchers to consider when attempting to engage deeply with theory, particularly critical social theory.

Historicity

Through a historical review of these three frameworks, we have reflected on how the world has and has not changed since the late 20th century period when the frameworks were developed. Educational systems continue to devalue the contributions of non-dominant student groups and create categories of failure for them to embody. Education scholars continue to contend with issues of equity and injustice. A group of pragmatic practitioners continue to seek new ways to organize educational settings that reduce harm and improve learning for students from non-dominant communities. Yet the world has also changed. Deficit lenses like the culture of poverty that were themselves a disguise for more aggressive racism and classism have disguised themselves even a bit more (Harper, 2010; Mejia et al., 2018). We now praise the resilient and "grit"-ty child without ever formally addressing the "ungritty" child who lacks motivation or the system that created the obstacles for the students in the first place. We seek "No Child Left Behind," and then create funding schemes that punish low-income students through defunding low-performing schools so that they continually cannot keep up (Hursh, 2007). We are even more aware of the complexities that overlap race and class, valued knowledge, and the construction of institutional systems and rules. We have determined that many standardized test systems are biased, and that race is a social construct, but still treat race as a predictive variable (Zuberi & Bonilla-Silva, 2008) and float new neurological genetic theories for the racial differences we see (Painter, 2010). Critical education scholars find themselves in a new period of coming to the defense of students, with a new set of complexities and new prevailing narratives that need challenging. The traditions we have inherited often require adaptation and innovation to respond to the new wisdom and changing times.

Criticality

All three frameworks that we considered originate from critical perspectives, each including at least some inspiration from Marxist philosophy. Recentering the idea of labor's struggle against the maintenance of the status quo of society's social classes may help scholars assess their cultural work with a new lens. Consistent with the frameworks' origins, scholars taking on funds of knowledge, cultural production, cultural construction, or other associated work should conceive of themselves as in solidarity with a class struggle and/or other struggle with major systems of oppression. When thinking of students' assets, we should be thinking of (re)positioning students' construction of knowledge and students themselves as valuable (Delgado Bernal, 2002; Mejia et al., 2018), not reducing them to the pieces of knowledge we value. When examining a classroom dynamic, we should deeply question the systems of control undergirding the classroom, and not look for only the easy or aesthetic interventions. When presenting our findings, we should remember our position of solidarity with oppressed groups and hold our own feet to the fire regarding whether we have earned that role with our work. While not all frameworks stem from critical perspectives, it is important to consider whether a framework has its origins in a critical analysis of systems of power, and how to stay true to that original purpose.

Situatedness

This historical review of funds of knowledge, cultural production, and cultural construction reflects the importance of the ways in which different factors may impact how the research is conducted, materialized, and interpreted. Social situatedness, or the ways in which the research process and researcher perspective are shaped by the interactions with environmental, cultural, and social factors (Frank, Dirven, Ziemke, & Bernárdez, 2008), is important to not fall into the trap of providing an overly simplistic analysis of the culture, the home, or the community. Theories have not only a specific time (historicity) but a specific place, a specific context, a specific people associated with them. Those who adapt a theory to a brand-new context should not only be praised for creating new knowledge, they should also give pause to the limits and challenges of relocating the theory. Funds of Knowledge research was conducted by Latinx researchers in the Southwest United States, in collaboration with K–12 educator-ethnographers, who engaged directly with a local community, to better understand the valuable knowledge their students had and to decenter their own dominant cultural views of their students as incapable. While this work may inspire funds of knowledge research by White researchers who do not share primary common identities with their student populations, or in higher education contexts where researchers do not have access to engaging with students' home communities, those researchers should be extremely scrutinous of how the social situatedness of their contexts is different. Adaptations of the surface features of a theory without attending to its deeper purpose are at extreme risk of trivializing the theory, or introducing a colonial or hegemonic gaze. Situating these frameworks' origins appropriately is critical to truly adapt and engage a past framework developed in one context into new and differing contexts.

In addition, we acknowledge our own situatedness in a US context in writing this paper, as represented by the works we reviewed, the applications of theory we considered, and the focus of our own work. While we do not attempt to speak to issues outside of our own experience, we recognize that considering the US, Western, and Global North as default research settings can be its own act of epistemological colonialism. We think there is clearly an opportunity for translation beyond the US context that would simulate the act of situated translation that we have discussed in this paper. While we are not well-suited to guide that translation, we invite those beyond our own contexts into conversation and community around that process.

Positionality

González and colleagues (2011) argue that critical reflection is particularly important nowadays given the changing political contexts in the US. There are an increasing number of students of color in our public schools, while academia is primarily occupied by White individuals. This basic situation should require careful reflection and attention, and we have argued elsewhere that considering one's positionality, in terms of one's primary intersecting social identities of privilege and oppression, is a vital component of pursuing equity-focused education research (Secules et al., 2021). We note that it may be particularly challenging for individuals from dominant identities to reflect on and identify their role in equity, in a way that does not take a patronizing positionality or assume a familiarity with oppressed groups that is not possible. We should also think carefully about our position of power as researchers, the access and rapport we gain with our research participants and the choices we make in representing their lived experiences. We should consider whether we are insiders or outsiders to the community of participants and consider multiple axes of identity and experience when making this (non-dichotomous) determination. As a White man, Secules usually does not directly theorize communities of color unless in collaboration with a coauthor (Berhane et al., 2020), instead finding his voice and role through the cultural construction framework in speaking to dominant communities and culture. Mejia, in contrast, centers his shared identity and solidarity (*confianza*) with Latinx participants to embody the sense of racialized and classed critique inherent in the funds of knowledge framework. Failing to engage with positionality in terms of our identity, community membership, power, and experience prevents us from engaging fully with the complexity of equity research (González, Wyman, & O'Connor, 2011).

Praxis

Research in engineering education should encourage more reflection on the enactment of the theory in practice in the research activities. The goal of this research should focus on building *confianza*, or trust, with the communities, reflect on the nuances of doing anthropologically based work, embrace the lived realities of students of color, and reject any simplistic conceptualizations of cultures. But most importantly, critical social research should recognize the original purpose of the associated theoretical frameworks and consider how well they embody that purpose with their research. These frameworks did not originally prescribe simple best practices or remediation measures, nor did they give educators a list of items to be included in lesson planning. These frameworks grappled deeply with instances of oppression in local settings and documented, challenged, or resisted the forms of oppression they encountered. These foundational scholars often took an active role, whether by encouraging educators and researchers to become active participants in getting to know their students and participants and to reject their own deficit-oriented preconceived notions, or by engaging in their own active liberatory instruction. Researchers and educators should strive to gain the conceptual tools to challenge deficit models and participate collectively with students, their families, and communities in mutual transformation. Researchers can reflect on how the research is framed to prevent a deficit lens from being introduced (Mejia et al., 2018). Purposeful anti-deficit reframing of research questions can help conceptualize and reflect on a new approach to research and pedagogy that is not based on predetermined deficits notions of students.

Implications and Conclusion

Research papers are often framed as scholarly exercises that are complete unto themselves, and while writing an implications section is common, these are often framed as possible future directions of research or possible practical applications. But work can also be misinterpreted and misused—the originators of the funds of knowledge framework did not anticipate their work would lead some of their successors to essentialize and quantify student personas in terms of their value to dominant groups. From this paper, we take away a need for explicit guidance in implications, explaining not just what could be done in the future, but what should and what should not be done. These potential misappropriations are not always easy to anticipate. For example, the first author's (2018) prior cultural construction research noted the presence of many advanced programming students in an introductory programming course, and it mentioned in passing the possibility that a pre-test on prior programming knowledge may have reduced this dynamic. The first author did not anticipate that this finding would be cited by proponents of educational tracking in higher education, which, ironically, seems like a form of constructing educational deficit categories that the larger point of the research was trying to resist. In considering how work can be misused, intentionally or unintentionally, we recommend that after a deep engagement with the nuances of a particular theoretical framework and research context, authors make their implications as explicit as possible to avoid potential misapplications.

While the frameworks discussed advocate primary attention to aspects of culture, an analysis of power and agency is fundamental to an accurate analysis of equity. Engineering educators and education researchers must recognize their power in legitimizing the epistemic position of students, and they must reflect on how pedagogy proactively generates or does not generate emancipatory outcomes (Rodriguez, 2013). Engineering educators must come to a deeper understanding of their students' lives although many of their students live separate realities in terms of poverty, access to education, or immigration issues. As González and Moll (2002) note, most engineering educators do not live in the same neighborhoods

or communities as their students. In addition, researchers must recognize their own agency to silence or uplift the marginalized. They have the power to make choices about when to take an active role in reforming educational settings and when to document the problems or advantages of an educational culture. Acting with a recognition and humility regarding their and others' power and agency, they can embrace ambiguity, build relationships, engage in solidarity rather than voyeurism, and question institutionalized systems rather than consistently placing the blame on students.

We have made a case for deeply situating engineering education research within the appropriate historical context of the original theoretical frameworks. We find the consequences of the choice and application of theory to be particularly weighty for equity work, which requires reflection on identity, community, power, history, and the situated nature of research. Equity researchers must also resolve their own role in an inequitable system—when to engage in activism or empiricism, when to stay within the system to reform it and when to critique from the outside. We recognize this ambitious framing for theory pushes beyond our community's more utilitarian approach. While theoretical frameworks are useful, ultimately the work we are doing and the work we call others into doing is of changing hearts and decolonizing minds. If we engage deeply with equity research and critical social theory, it changes who we are and how we see the world.

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The authors have no competing interests to declare.

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