



Reimagining engineering diversity: A study of academic advisors' perspectives on socioeconomic status

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While calls to transform engineering education often revolve around pedagogy, curriculum, and student learning¹⁻⁴, there is a concomitant need to consider diversity given demographic shifts⁵. However, despite various diversity initiatives enacted in the past fifty years, participation and completion by women and minorities in engineering has improved only modestly⁶. As a result, some have questioned the almost exclusive focus on gender and ethnicity/race, increasingly turning toward social class as an additional area for exploration⁷⁻¹⁰ and another way to consider the field's "cultural competence"¹¹.

Exploring social class in undergraduate engineering is important and promising in two ways. First, it expands traditional diversity efforts focused on historically underrepresented groups (i.e., women, African-Americans, Latina/os, and Native Americans). Although there is no data presenting low- versus higher-SES student outcomes in engineering, previous research shows that socioeconomic status is an important predictor for achievement^{8,12}. Social class disadvantages, like high school poverty level, are highly correlated to ethnicity/race¹³, but exert a different force based on group membership and institution enrolled^{14,15}. Thus, more work that examines social class as a relevant component of diversity in engineering is needed.

Second, by exploring social class, engineering stakeholders will have a more nuanced understanding of the range of socio-demographic backgrounds^{7,8}. Social class is often measured by a proxy, socioeconomic status (SES), an index of parent's level of education, occupation, and income. The typically dichotomous way SES is characterized (e.g., "low SES" versus "high SES") can contribute to simplistic conceptions of social class disadvantage¹⁶, and potentially inefficient retention efforts. For example, institutional strategies related to financial aid¹⁷ or information-sharing^{18,19} seek to address economic challenges and deficits in college-knowledge, respectively. However, there is notable evidence that financial aid *alone* is not sufficient to overcome attrition risk factors^{20,21}, and furthermore institutional resources are not equally or properly accessed by all undergraduates^{19,22}. Social class theory may help explain why conceptions of diversity in engineering should be expanded, and why many engineering students are stifled when it comes to appropriating and manipulating institutional resources to fuel their academic success.

Purpose

This research seeks to qualitatively examine social class in undergraduate engineering diversity. That is, if there is uncertainty in how socioeconomic disadvantage manifests in engineering students, then how can an institution expect to identify and remove associated barriers? We used academic advisors rather than faculty, given that the advisors' incentive structure is *not* dominated by research, teaching, and service, but rather, some combination of student well-being and academic progress.

The lack of attention to social class may be especially problematic given that there is mixed evidence of engineering being associated with social mobility for disadvantaged groups, as well as the maintenance of privilege among students with professional parents^{7,23}. This study builds on that work and the research on diversity in engineering, by explaining how institutions make sense of retention and attrition using SES. Framed by Bourdieu's²⁴⁻²⁶ theory of social

reproduction and the concept of cultural capital, we explore the following research question: How do academic advisors (as institutional agents) characterize SES, and specifically socioeconomic disadvantage?

Theoretical Framework & Literature Review

Three bodies of literature contribute toward understanding how academic advisors characterize engineering students in terms of their socioeconomic background. Bourdieu's theory of social stratification and specifically the concept of cultural capital are briefly described to frame this research. Literature on social class, higher education, and academic advising provide a broad understanding of how socioeconomically disadvantaged students fare while in college and the support that they receive. A review of research in engineering education is included to further support how SES is relevant in the undergraduate engineering context.

Cultural Capital

Bourdieu's²⁴⁻²⁶ theory of social reproduction and concept of cultural capital are relevant in this research given their attention to the relationship between individual agency and institutional structure. Students enter college with varying levels of agency and support (i.e., social, financial, emotional, and familial) that influence their experiences. However, the extant research does not explain *how* institutions attempt to overcome the resulting disparities at the individual level of interaction with institutional agents. Cultural capital provides a "partial explanation for the less tangible or less immediately visible inequalities"²⁷.

According to Bourdieu, all individuals possess cultural capital (i.e., knowledge, cultural awareness, credentials, preferences, skills, abilities, and mannerisms) that are typically acquired through parents. While cultural capital in one setting is not necessarily useful in another, it does inform an individual's *habitus*, or set of dispositions, that governs interactions and preferences. Cultural capital is used as social currency that can be used to an individual's advantage in particular social settings, like undergraduate engineering. However, the disadvantages associated with first-generation, low-income, and low-SES backgrounds can result in a lower likelihood of having the relevant cultural capital necessary for successfully accessing and leveraging institutional resources and/or agents to promote their own success in engineering^{27,28}.

Social Class, Higher Education, and Engineering Education Research

There is a growing body of work on the role of social class in higher and engineering education research, but thus far most of it is descriptive and quantitative^{7,8,29-33}. That body of work concludes that there are significant differences in how students from the highest and lowest social class strata prepare for, enter, and experience college. In engineering education, research often focuses on low-income students and the challenges that result from attending high poverty schools (e.g., lower likelihood of college prep math/science curriculum and exposure to engineering as a career option), but less frequently examines these students' experiences in undergraduate engineering programs. Further confirming the importance of SES in engineering education are findings that indicated that SES reduces the effect of ethnicity/race in predicting engineering access, persistence, and completion^{8,34}.

Qualitative research can shed more light onto the mechanisms that promote/prevent successful navigation of college using social class theory, but this type of research design has yet to

substantially permeate engineering education³⁵. Recent qualitative work suggests that SES moderates motivation and preparation for pursuing engineering, and the composition and effect of support networks^{36,37}.

Academic Advising

Academic advising is considered critical to retention^{38–40}, yet the related research is dominated by student perspectives and rarely addresses engineering. Work that does focus on engineering-related fields often characterizes the advisor responsibility/ability to help students⁴¹ or operationalization⁴², largely omitting advisor perspectives on improving retention. Deil-Amin and Rosenbaum's²² work concluded that advisors recognize cultural capital as an important student asset, however, further explanation was not provided.

Summary

Despite the various insights, extant research on social class in undergraduate engineering is limited in four ways. First, much of the work focuses on extremes (e.g., the most versus least privileged), and ignores students in the “middle,” who more closely represent the majority in engineering^{8,43}. Second, existing work tends to focus on students without consideration of specific academic disciplinary contexts. Engineering and other STEM-related fields have unique environments and climates that are well-documented^{44–46}. Third, the focus on student disadvantage rarely incorporates attention to staff perspectives, despite their first-hand interaction with students. Finally, quantitative research fundamentally does not explain *how* institutions help students from various socioeconomic strata navigate colleges and universities³⁵.

Bourdieu's theory of social reproduction and concept of cultural capital provide an opportunity to consider how institutions recognize socioeconomic disadvantage, perceive cultural capital, and how that might enhance the literature on diversity and retention strategies in engineering education.

Research Design

Participants & Data Collection

This qualitative study will include interviews of 16 staff academic advisors at 8 of the 11 public institutions in the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD)⁴⁷.

Using publicly available information, we sent email requests for participation using purposive, and then snowball sampling to enhance our sample⁴⁸. As of January 2013, 34 advisors were contacted, and 16 responded affirmatively (response rate of 47%). All interviews were conducted and transcribed. The semi-structured interviews last approximately 60 minutes. The data and results presented here are preliminary.

Data Analysis

Audio-taped interviews were transcribed verbatim and analyzed in two stages. First the data were coded focusing specifically on social class (e.g., participant definitions of socioeconomic disadvantage) and elements of Bourdieu's notion of cultural capital. Second, we coded the data

by protocol question, which also allowed for alternative themes and subthemes to emerge. To ensure validity, we employed a peer debriefing process, where at least two project team members analyzed significant portions of the data for agreement.

Findings

The preliminary data analysis yielded three assertions, all of which are presented below illustrated by quotes from the interviews.

Assertion 1) Academic advisors were largely unable to articulate a coherent definition of SES. As Lareau and Conley¹⁶ note, terms like, low-SES, low-income, first-generation, and disadvantaged were often confounded, despite advisors acknowledging their differences when probed. For example, when asked to characterize low-SES students, Martha (all names are changed for privacy) states:

Single parent household ... always. Living with someone who's not a parent...always. Um... letting me know they're first generation ... pretty much always.

While these descriptors are appropriate and relevant given the extant research¹⁶, assuming this manifests in a consistent pattern can complicate how advisers perceive students and their needs. Ann recounts an experience with first-generation students:

...they were indignant, you know. They were all over the place. I mean some of them came in to me and looked like... and they were first generation students... they were very well off, you know... And they'd be like 'No. I can afford my own tutoring. I drive a Lexus.'

The economic assumptions associated with students considered socioeconomically disadvantaged can be quite diverse. In fact, the expansion of credit has helped convolute the material items associated with socioeconomic disadvantage¹⁶, where some students do not own cars and cannot afford tutoring, while others can.

In addition to associating socioeconomic disadvantage with a lack of money, advisers also mentioned ethnic/racial minority group membership. Low-SES students were often identified via their participation in financial aid programs like federal Pell Grant or privately funded Gates Millennium Scholarship (GMS) Program that specifically target students from low-income families. It is important to note that the GMS has a low-income threshold, but also specifically supports underrepresented minority students⁴⁹. Despite the relationship between ethnicity/race and SES, the following exchange demonstrates the challenge of moving away from a purely income-based understanding of SES:

Interviewer: So outside of financial aid does your institution have any specific programs that are aimed to help students from low socioeconomic backgrounds?

June: Yea. So... um... well, I guess... I think of it as separate from financial aid. The Institution has a guarantee that if a student comes in with a certain level of family income or below that they will, um... guarantee to make up the difference between whatever scholarships and financial aid the student receives
...

Although socioeconomically disadvantaged students were historically ethnic/racial minorities, some advisers recognized having a sizable population of White students from backgrounds that

they recognized as disadvantaged. In fact, unlike other demographic groups, social class is often invisible, requiring self-identification, which may be challenging. Ann states:

Kids rarely self-identify unless there's something they need... from their academic advisor.

When asked about recognizing low-SES students, some advisers mentioned having access to financial aid information. However as Elizabeth said, this information is not necessarily at their fingertips, particularly the extent of a student's financial need:

It could be loans, it could be grants, it could be scholarships. So I know from those students... because that's indicated on their advising information...that they obviously have great need...um...but ... but not unless I push it, you know, actually looked it up... I wouldn't necessarily know if there was somebody who was sort of in-between...you know, needing a 100% ...needing maybe a quarter or something.

In addition, low-SES students are often reluctant to identify as such. Martha explains:

I think SES adds one more layer of 'I don't want to stick out. I don't want to look like a fool. I don't want anybody to know.'... so they might be the most hesitant to ask questions.

While, academic advisers tended to emphasize the "economic" aspect of SES, and an ethnic/racial component of generalizations about SES, their responses illustrate a dissonance. For one, their responses show that SES might be related to minority group membership, but that it can also be invisible. And while they perceived socioeconomic disadvantage was related to money, they did know students who seemed to have expensive material items that seemed relatively poor on paper.

Assertion 2) Advisers associated inadequate college preparation with socioeconomically disadvantaged students, including academic preparation and especially the ability to navigate the university system. However, like the economic aspect of SES, advisers acknowledged a range of preparation among low-SES students:

Sometimes they are sort of under-prepared students and sometimes they're just top...you know... top of the heap I mean as far as the preparation and kind of credits they have coming in ...but I would say more of them are probably not as prepared. (Elizabeth)

Besides academic preparation, talking to faculty was one area where advisers felt low-SES students struggled:

I think students in that situation are much more in awe of faculty members. They are much less likely to go talk to them. Um... you know... I'd always say 'It's their job. Go talk to them.' And they'd be like 'No. No. They don't want to hear from me. They're not interested' (Ann)

I have the impression that ...they're intimidated ...um... by faculty and one of the things I ask my students to do is to make sure that they talk to the faculty, each of their professors three times in the semester...at least once in their office hours and two more times either with an email question or after class or something so that they stand out in a crowd. Because one of their success strategies is to have the connection with the professor, letting the professor know that they're serious students. (Catherine)

In a related fashion, navigating the university system was another area of difficulty.

There are questions which show that they are completely ...um... unused to dealing with ...um... a, a, a large campus. Like this is a bureaucracy ... and if you're not used to dealing with a bureaucracy ... what's a withdrawal date, what's a drop date, what's a syllabus...all that stuff. (Martha)

We have students, you know, they'll come in and I'll sometimes mention that 'I see that you did really poorly that semester. Did you try to get a withdrawal?' 'Oh, I didn't know I could get a withdrawal.' ...some students just never assume that there's any sort of exceptions to anything ...I would say that less privileged students probably don't ask for exceptions or don't know that they can ask (Elizabeth)

Not surprisingly, the engineering staff advisers noted that academic preparation is important, but they also felt low-SES students had trouble navigating the university.

Assertion 3) Advisers described the different roles families play for low-SES students. They talked with students whose parents have little to no 'college knowledge', who feel obligated to succeed to help their families, or students who had family problems that distracted their academic progress.

June recounts a student's description of parental interaction:

'Well, I'll go and talk to my dad but he doesn't understand. He's never been to college so he doesn't realize what that means when I say 'Oh, this is so hard' or you know 'I'm struggling with my mid-terms.' ...'My dad doesn't really know what type of advice to give me.'

Ann recognized the value in having access to family members familiar with higher education:

People with higher socioeconomic status would probably just be more comfortable in a higher education setting because they'd be... you know...have family members who have been through it.

Several of the participants recounted conversations with students where the student expressed the desire to succeed to help her or his family:

It seems like their motivation is very high to pursue engineering because many of them know that it will make a big difference in their family's lives (June)

You always have students who are... very motivated and really want things to work out right and understand that...um... you know, that they're getting a scholarship so they can succeed and their family's counting on them. (Ann)

Many of my students come in and say they are the first person in their whole family ...To go to college and they are the role model and they want to do well and they want to help their family and their... one of their goals... every single one of my students' top goal is to graduate college...and many of them say 'to take care of my family, to help my brothers and sisters, to buy my mom a house.' (Catherine)

Dealing with family problems and instability or needing to support their families was another issue that advisers felt low-SES students dealt with. In fact, several participants described students dealing with family members who were incarcerated:

There are some students with really difficult stories as far as... they're the sole support for their family...pretty horrific situations that I just couldn't have imagined going through when I was their age. (Elizabeth)

Her family was very poor and she has several brothers and sisters and her one brother's in jail for stealing and her family has had to move from place to place because the parents couldn't hold a job and they had to keep moving to find jobs and they had basic level jobs and when she was a senior in high school she decided that she was not going to live this way and she took it upon herself that she needs to help her family. (Catherine)

I have had students come in and say ‘Well, I ... I’m doing really poorly academically because, you know, my mother’s boyfriend has been in jail again for... for, you know, making meth in our basement...and my little sister’s in foster care again. (Ann)

She’s not doing very well this semester but... um... she also has these issues with a brother who was just put in jail and things like that. (Ann)

As the definition of SES suggests, advisers felt that parents and families do matter, but the complexity of their role in students’ lives cannot be captured in simple economic terms.

Discussion

Although they often were not able to clearly define socioeconomic status, the undergraduate engineering advisors in this study recognized a lack of cultural capital in students they perceived as being low-SES. Advisers identified low-SES students easily as those with low-incomes, with poor academic preparation, and as students who struggled to navigate the university to promote their own success. However, they also recognized that some of their expectations and assumptions about low-SES students were not always accurate (e.g., when considering financial need versus material items) or simple (e.g., parents and family matter in both positive and negative ways). The advisers in this study provide a preliminary understanding of how institutions of higher education and engineering schools in particular may perceive SES. In fact, the advisers provided responses about their perceptions of socioeconomic disadvantage in line with Bourdieu’s conception of social class status and cultural capital, but also the oft-used proxy, SES. In acknowledging the potential economic, familial, ethnic/racial, informational, attitudinal, and behavioral components of SES and socioeconomic disadvantage, these advisers highlight the need for institutions to reconsider diversity within their undergraduate engineering population, and the diversity of meanings associated with SES. The complexity and range of experiences the advisers associated with low-SES students demonstrate the shortcoming of dichotomous conceptions of SES.

This work may be helpful for stakeholders seeking to understand why academically qualified and privileged minority students struggle in engineering, but also why seemingly advantaged non-minorities also face challenges. Furthermore, it may help institutions think more about socioeconomic disadvantages and facilitate opportunities for support beyond financial aid or minority group programming.

Conclusion

Research on diversity in engineering has been dominated by work on women and historically underrepresented ethnic/racial minorities. However, data suggest that focusing solely on those demographic traits has not produced expected outcomes. Building on the growing evidence that social class also matters in engineering, this research concludes that that diversity in engineering should be reimagined. More explicit attention to cultural capital and the continuum of social class disadvantage can enable engineering schools to produce better-informed retention strategies and transform engineering education.

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