BOARD #158: Poster: Exploring the Impact of Socioeconomic Status on Undergraduate Engineering Experiences

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Elizabeth is a graduate student at the University of Michigan studying Engineering Education Research. She is an NSF fellow whose research focuses on asset-based approaches towards supporting the undergraduate engineering experiences of students from low socioeconomic status (low-SES) backgrounds. Elizabeth earned her undergraduate degree from the University of Michigan with foci in Biomedical Engineering and Applied Mathematics, but also worked as a K-12 teacher for several years before beginning her graduate degree.

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Aaron W. Johnson is an Assistant Professor in the Aerospace Engineering Department and a Core Faculty member of the Engineering Education Research Program at the University of Michigan. His design-based research focuses on how to re-contextualize engineering science engineering courses to better reflect and prepare students for the reality of ill-defined, sociotechnical engineering practice. Current projects include studying and designing classroom interventions around macroethical issues in aerospace engineering and the productive beginnings of engineering judgment as students create and use mathematical models. Aaron holds a B.S. in Aerospace Engineering from Michigan and a Ph.D. in Aeronautics and Astronautics from the Massachusetts Institute of Technology. Prior to re-joining Michigan, he was an instructor in Aerospace Engineering Sciences at the University of Colorado Boulder.

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Dr. Sarah Jane (SJ) Bork is an Assistant Professor in Electrical and Computer Engineering with an emphasis on engineering education research. Dr. Bork's research has focused on examining the mental health experiences of engineering graduate students. She has studied different areas (e.g., social factors, engineering culture, etc.) using a variety of research methods (e.g., regression analysis, photovoice, factor analysis, interview data, etc.). Dr. Bork earned her doctorate degree from the University of Michigan's Engineering Education Research Program. Prior to this, she earned both a Bachelor's and Master's degree in Electrical Engineering from The Ohio State University.

Poster: Exploring the Impact of Socioeconomic Status on Undergraduate Engineering Experiences

Abstract

The purpose of this interactive poster is to examine common experiences of undergraduate engineering students from low-socioeconomic status (SES) backgrounds and investigate how these experiences compare to higher-income peers.

Engineering has long been regarded as an exclusive field, shaped by structural barriers that limit access for students from marginalized identities. These barriers, whether consciously or unconsciously created, have historically restricted opportunities for minoritized students, including those from lower socioeconomic backgrounds. While a significant amount of research has examined how identities such as race, ethnicity, or gender influence students' sense of belonging in engineering, SES has often been overlooked. As an "invisible identity," SES is inconsistently defined and often overlooked in higher education, making it difficult for these financially disadvantaged students to find community and advocate for their needs effectively. Existing literature on low-SES students in STEM often focuses on summative outcomes, such as graduation and retention rates, while neglecting the nuanced daily experiences of these students, particularly in engineering contexts. Additionally, much of this research adopts a deficit-based orientation, emphasizing barriers and challenges faced by low-SES students without acknowledging the strengths, resilience, and unique contributions they bring to these environments. These approaches fail to provide a holistic understanding of how socioeconomic factors shape students' experiences, identities, and opportunities in engineering.

Our study seeks to address this gap by investigating how socioeconomic factors impact the undergraduate engineering experience, identifying shared themes among the low-SES student body. This work is informed by Liu's Revised Social Class Worldview Model (SCWM-R), which examines how perceptions of social class develop and influence behaviors and worldviews. The survey includes multiple-choice, Likert-scale, and open-ended questions, designed to capture data on economic factors and their effects on key aspects of the college experience, such as access to resources, academic challenges, and well-being.

The survey instrument will be piloted with undergraduate engineering students at a large, historically white, research-intensive Midwestern university to ensure diverse perspectives across socioeconomic backgrounds. The instrument is organized into sections addressing themes of financial stress, access to social and academic resources, and the relational impacts of SES. Guided by the SCWM-R framework, the survey takes an asset-based approach, emphasizing the strengths and unique contributions of low-SES students in navigating higher education, rather than focusing solely on barriers or deficits.

This poster will present the initial development and content of the survey instrument. Future work will use the collected data to conduct descriptive and bivariate statistical analyses, as well as psychometric testing (e.g., item response theory) to refine the instrument and explore shared characteristics of low-SES students. By providing a nuanced understanding of how socioeconomic factors shape the undergraduate engineering experience, this work aims to inform institutional practices and support efforts to create more inclusive and equitable environments for financially disadvantaged students. The findings will guide future research and initiatives aimed at reducing institutional barriers and fostering the success and retention of low-SES students in engineering.

Introduction

Engineering is often hailed as a pathway to innovation and social mobility, yet its accessibility remains unevenly distributed, shaped by enduring systemic inequities. Wide-scale barriers rooted in social, cultural, and economic disparities have long shaped the field, disproportionately marginalizing women, racial and ethnic minorities, and many other underrepresented groups. [1]. Despite efforts to diversify the engineering workforce, these populations remain underrepresented in both academic programs and professional settings [2], [3].

Socioeconomic status (SES) is a particularly impactful yet frequently overlooked marginalized identity in higher education research and policy. Defined as an individual's or family's economic position within society, SES is often associated with measurable factors such as household income, family education, and occupational status [4], [5]. However, SES also has a subjective component, because individuals' perceptions of their own social standing—known as subjective social status—can be shaped by their personal experiences and societal context [6]. These subjective perceptions, which may not always align with objective indicators like income or education, profoundly influence behavior, sense of self, and interactions with others [7]. Beyond SES, the broader concept of social class includes not only economic resources but also cultural and social capital, along with societal perceptions of power and status [8]. Both SES and social class shape how individuals perceive themselves, navigate societal hierarchies, and interact with educational systems.

SES is considered an "invisible identity" because it is not outwardly apparent, making it difficult for others to recognize and address the unique challenges faced by low-SES individuals [4], [9], [10] . This lack of visibility often leads to limited recognition and support for financially disadvantaged students, particularly in engineering, where diversity and inclusion efforts have historically focused on more visible identities such as race and gender. Unlike these identities, SES is often stigmatized as a private matter, further marginalizing low-SES students and hindering efforts to address their needs [9], [11], [12]. Despite its significant impact on students' daily experiences and its intersections with other identities, SES continues to be deprioritized in

research and policy, leaving a critical gap in understanding and supporting this population in higher education and engineering programs.

Research indicates that students from low-SES backgrounds face unique obstacles in education, such as limited access to advanced pre-college coursework, financial constraints, and inadequate academic support systems [4], [13], [14]. In college, they often struggle to balance financial pressures and academic responsibilities, which can limit their participation in academic and extracurricular activities [12], [15]. Furthermore, the cultural values and behaviors emphasized in engineering education—such as independence, technical competence, and individualism—may conflict with the values of lower-income students, who often prioritize community, family support, and upward mobility [9]. This cultural mismatch can exacerbate feelings of alienation and reduce their sense of belonging, leading to disparities in retention and graduation rates compared to their higher-SES peers [16], [17]. However, beyond these measurable outcomes, the daily realities of financially disadvantaged students navigating engineering programs remain insufficiently understood.

Research on financially disadvantaged students has often adopted a deficit-oriented perspective, framing these students primarily in terms of their struggles or limitations while failing to address the systemic inequities underlying these challenges. This approach shifts the burden onto students, failing to hold institutions and broader societal systems accountable for perpetuating barriers [14], [18], [19], [20]. In contrast, asset-based perspectives aim to shift the narrative by highlighting the resilience, resourcefulness, and intrinsic motivation that low-SES students often demonstrate as they navigate these inequities [12], [21], [22]. However, even asset-based approaches can fall short when they overlook the structural inequities that force students to develop these traits. This study seeks to balance these perspectives, examining both how low-SES engineering students navigate systemic barriers and how these barriers operate within engineering education.

The study will use Liu's Revised Social Class Worldview Model (SCWM-R) as its guiding framework. The SCWM-R provides a comprehensive lens to explore how individuals interpret and navigate the complex realities of social class [23]. It emphasizes the role of economic cultures (ECs)—the environments that shape individuals' perceptions of social class, expected behaviors, and social standing. These ECs operate at multiple levels, from personal interactions to broader societal systems, mirroring the interconnected layers of Bronfenbrenner's Ecological Model [24], [25]. The model's focus on the interplay between individual perceptions and systemic influences provides a valuable perspective for identifying patterns, challenges, and opportunities in these students' educational journeys. Using a survey informed by the SCWM-R, this study seeks to examine how socioeconomic factors shape the experiences of undergraduate engineering students, by asking the following research questions:

1. *What are common characteristics of the low-SES student experience in an undergraduate engineering program?*
2. *How do these students' experiences compare to that of their higher-income peers?*

Survey Design and Development

This study focuses on understanding the experiences of undergraduate engineering students from diverse socioeconomic backgrounds, with a particular emphasis on those from low-SES backgrounds. Conducted at a large, Midwestern, historically white, public university with a well-established engineering program, the survey aims to collect a wide range of perspectives by targeting any undergraduate engineering students. The instrument will be distributed electronically through university email lists, departmental newsletters, and online platforms frequently accessed by these students. Additionally, the survey will be designed to function as both a data collection tool and a recruitment instrument for future studies focusing on the low-SES student experience, maximizing its utility for understanding the perspectives of this population.

The survey instrument (see Appendix) was developed using the Revised Social Class Worldview Model (SCWM-R) as its theoretical foundation, in an attempt to capture the more complex dimensions of social class. The SCWM-R framework emphasizes the nuanced nature of social class, incorporating both measurable factors, such as income and parental education, and subjective experiences, such as perceptions of class mobility, stigma, and financial stress. The SCWM-R framework emphasizes three critical dimensions—*cognitive, affective*, and *behavioral*—which are integrated into the survey to explore how students perceive, experience, and navigate their socioeconomic identities within engineering education [23].

The *cognitive domain* examines how students understand and conceptualize their socioeconomic status (SES) and its influence on their academic and personal experiences. It explores students' awareness of their economic background, their perceptions of social class, and how these factors shape their educational journey. The *affective domain* focuses on the emotional impacts of SES, particularly how financial stress and social stigma affect students' well-being, sense of belonging, and ability to engage in campus life. It provides insight into the psychological toll of navigating higher education while managing financial constraints and the challenges of class-related exclusion. The *behavioral domain* addresses the practical aspects of how SES influences students' actions and decisions, including their access to resources, coping mechanisms, and ability to balance academic, work, and extracurricular commitments [23]. Figure 1 below provides a few examples of survey questions, their associated domains within the SCWM-R framework, and how they align with the framework's principles.

Figure 1. SCWM-R Domains and Sample Survey Items

Domain	Sample Question	Alignment to Domain
Cognitive	How would you describe your economic background growing up?	Assesses students' awareness and conceptualization of their socioeconomic status (SES)
	What is your household's annual income?	Measures an objective indicator of students' SES to better understand how they recognize and relate to their economic position
	Did any members of your family, aside from your parents, attend college?	Explores intergenerational influences on social mobility
Affective	"Finance-related stress makes it challenging for me to focus on my academic studies and coursework."	Examines the emotional impact of financial stress
	"I often feel excluded from campus activities due to my SES."	Captures the emotional experience of exclusion or stigma related to socioeconomic status
Behavioral	"Do you have sufficient access to the following resources (e.g., computer, food, transportation)?"	Assesses students' access to basic resources
	"I regularly have to prioritize paid work over academic or extracurricular activities due to time constraints."	Examines how SES influences students' decisions and behaviors, particularly in balancing academic demands with financial responsibilities
	"How comfortable do you feel in professional settings, like career fairs or networking events?"	Measures students' comfort level in professional environments, offering insights into how SES influences their behavior and self-perception in these contexts

The survey also incorporates elements of economic cultures (ECs) from the Revised Social Class Worldview Model (SCWM-R) to examine how financial systems and social contexts shape students' experiences. For example, the question *"Please indicate the approximate percentage of each source you are using to finance your college education"* assesses the financial strategies students employ, such as reliance on loans, scholarships, or family contributions. Additionally, questions like *"How often do financial concerns prevent you from participating in professional opportunities (e.g., internships, networking events)?"* highlight barriers to accessing resources and opportunities essential for academic and career success. The survey also addresses how students navigate cultural norms and expectations tied to social class, examining areas such as comfort in professional settings and familiarity with the "unwritten rules" of succeeding in college [23].

This localized implementation of the survey instrument will allow for the identification of trends and patterns that are meaningful within the specific institutional context of this engineering program. While the results are not designed to be extrapolated to a broader scale due to the subjective and context-dependent nature of SES, the survey can be applied in other institutional settings to develop additional localized understandings of the SES-related challenges faced by students.

Future Works

The analysis plan for this study will focus on examining the relationships between socioeconomic status (SES) and the experiences of undergraduate engineering students. The analysis of this survey will begin with descriptive statistical methods, such as calculating means

and standard deviations, to summarize the data and provide an overview of trends across the sample. Bivariate analyses, including t-tests and Analysis of Variance (ANOVA), will then be conducted to identify significant differences in experiences between low-SES students and their higher-income peers, particularly in areas such as academic engagement, well-being, and access to resources. Following these initial explorations, psychometric analyses using Item Response Theory (IRT) will assess the reliability and validity of survey items. This step will help refine the instrument and ensure it accurately captures the shared characteristics and unique experiences of low-SES engineering undergraduates. Together, these analytical approaches aim to provide a comprehensive understanding of the complex relationships between SES and the undergraduate engineering student experience.

Conclusion

Findings from this study will highlight how low-SES students perceive their access to resources, navigate academic challenges, and maintain well-being within the demanding environment of engineering undergraduate programs. By emphasizing formative experiences rather than purely summative metrics, the research seeks to center the voices of financially disadvantaged students and uncover strategies they use to navigate systemic barriers. Ultimately, the insights gained aim to inform institutional policies and practices that foster inclusivity and equity, contributing to broader efforts to create a more just and accessible engineering field. The study's findings will provide actionable recommendations to improve resource allocation, support mechanisms, and campus environments for low-SES students.

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Appendix

Survey Instrument Questions

1. How would you describe your economic background growing up?
    a. Lower-income
    b. Working class
    c. Lower-middle class
    d. Middle-class
    e. Upper middle-class
    f. Upper-class
    g. Prefer not to answer

2. What is your household's annual income?
    a. Less than $20,000
    b. $20,000 - $39,999
    c. $40,000 - $59,999
    d. $60,000 - $79,999
    e. $80,000 - $99,999
    f. $100,000 - $149,999
    g. $150,000 or higher
    h. Not sure

3. Did you attend any schools designated at Title I during your K-12 education?
    a. Yes, I attended Title I schools for most or all of my education
    b. Yes, I attended Title I schools for some of my education
    c. No, I did not attend any Title I schools during my education
    d. Not sure or not applicable

4. Were you eligible for free or reduced-price lunches while attending school (K-12)?
    a. Yes, free lunches
    b. Yes, reduced-price lunches
    c. No
    d. Not sure or not applicable

5. What is the highest level of education completed by your **primary** parent, guardian, or caregiver?
    a. 8th grade or lower
    b. Between 9th or 12th grade (but no high school degree)
    c. High school degree
    d. Some college (but no college degree)

e. Associate's degree
f. Bachelor's degree
g. Master's degree
h. Doctoral degree
i. Don't know or not applicable

6. What is your **primary** parent's or guardian's current employment status? (Check all that apply):
    a. Employed full-time
    b. Employed part-time
    c. Unemployed and looking for work
    d. Unemployed and not looking for work
    e. Self-employed
    f. Retired
    g. Not Sure or Not Applicable
    h. Other (please specify):
    i.
7. What is the highest level of education completed by your **secondary** parent, guardian, or caregiver?
    a. 8th grade or lower
    b. Between 9th or 12th grade (but no high school degree)
    c. High school degree
    d. Some college (but no college degree)
    e. Associate's degree
    f. Bachelor's degree
    g. Master's degree
    h. Doctoral degree
    i. Don't know or not applicable

8. What is your **secondary** parent's or guardian's current employment status? (Check all that apply):
    a. Employed full-time
    b. Employed part-time
    c. Unemployed and looking for work
    d. Unemployed and not looking for work
    e. Self-employed
    f. Retired
    g. Not Sure or Not Applicable
    h. Other (please specify):

9. Did any members of your family, aside from your parents, attend college? (Select all that apply):
    a. Yes, my immediate family (e.g., siblings) attended college.
    b. Yes, my extended family (e.g., grandparents, aunts, uncles) attended college.
    c. No, none of my family members attended college.
    d. I am not sure about the educational background of my extended family.

10. What is your major (or intended major)?
    a. Aerospace Engineering
    b. Biomedical Engineering
    c. Chemical Engineering
    d. Climate Science & Meteorology
    e. Civil Engineering
    f. Computer Engineering
    g. Computer Science
    h. Data Science
    i. Electrical Engineering
    j. Engineering Physics
    k. Environmental Engineering
    l. Industrial & Operations Engineering
    m. Materials Science & Engineering
    n. Mechanical Engineering
    o. Naval Architecture & Marine Engineering
    p. Nuclear Engineering & Radiological Sciences
    q. Robotics
    r. Space Sciences & Engineering
    s. Other (Please Specify):

11. What degree program are you currently enrolled in?
    a. Bachelor's
    b. Joint Bachelor's / Master's
    c. Other (please specify):

12. What term did you begin your academic program at the University of X? *[Ex: Fall 2022, Winter 2024]*

13. Have you previously attended any other college or university before enrolling at X?
    a. Yes, I transferred from another 4-year institution
    b. Yes, I transferred from a 2-year institution
    c. No, this is my first college or university experience

14. Please use the slider to indicate your current *cumulative* GPA:

15. In the past year, which of the following, if any, has affected your academic performance? (Select all that apply):
    a. Anxiety / stress
    b. Depression / Sadness / Other Mental Health Concerns
    c. Eating / body image concerns
    d. Attention disorder or learning disability (e.g., attention deficit disorder, attention deficit hyperactivity disorder, learning disability)
    e. Alcohol / substance use
    f. Physical health concerns
    g. Financial concerns
    h. None

16. Do you have significant family responsibilities that impact your ability to focus on your studies?
    a. Yes
    b. No
    c. Not sure
        i. **Follow-Up: Please describe the familial responsibilities that impact your ability to focus on your academics (e.g., caregiving, supporting financially) :** *(if Yes)*

17. Please indicate how much you agree with the following statements about **socioeconomic status (SES)**? (*Likert-scale from strongly disagree to strongly agree, including 'N/A'*).
    a. I am confident that I will be able to finish my degree no matter what challenges I may face.
    b. Finance-related stress makes it challenging for me to focus on my academic studies and coursework.
    c. I see myself as a valued member of the engineering community at my institution
    d. My ability to attend office hours or seek academic support is impacted by my SES/first-generation status
    e. I feel just as capable as my classmates with my academic coursework, regardless of my SES.

18. If you feel comfortable, please share any other ways your college academic experiences have been affected by your **socioeconomic status (SES)**:

19. Which of the following best describes your current housing situation **during this academic year**?
    a. Live in home owned by yourself or family member
    b. Rent a home/apartment
    c. Live in on-campus housing (i.e. dormitories)
    d. Live with relatives or friends (not paying rent)
    e. Live in a shelter
    f. Temporarily housed (e.g. couch surfing)
    g. Currently unhoused
    h. Other (please specify):

20. Do you have sufficient access to the following resources to meet your needs? (Check all that apply)
    a. Computer or laptop
    b. Cell phone and/or phone data plan
    c. Reliable internet connection
    d. Quiet place to study
    e. Nutritious and healthy food options
    f. School supplies (e.g., notebooks, pens, etc.)
    g. Transportation
    h. Academic support services
    i. Healthcare services
    j. Other (please specify):
    k. None of the above

21. Please indicate the *approximate* percentage of each source you are using to finance your college education:
    a. Scholarships (Merit-Based, Need-Based, etc.) : _____
    b. Grants : _____
    c. Federal Student Loans : _____
    d. Private Student Loans : _____
    e. Work Study Programs : _____
    f. Family Support : _____
    g. Personal Savings : _____
    h. Other (please specify): : _____
    i. Total : _____

22. Approximately how much student loan debt do you expect to accumulate, if any, while in college?
    a. None

b. Less than $5,000
c. $5,000 - $9,999
d. $10,000 - $24,999
e. $25,000 - $49,999
f. $50,000 - $74,999
g. Greater than $75,000
h. Not sure

23. Are you currently employed while attending college?
    a. Yes, a **part-time position** that **relates** to my academic studies
    b. Yes, a **part-time position** that **does not relate** to my academic studies
    c. Yes, a **full-time position** that **relates** to my academic studies
    d. Yes, a **full-time position** that **does not relate** to my academic studies
    e. No

24. Approximately how many hours per week do you work?
    a. Less than 10 hours
    b. 11 - 20 hours
    c. 21 - 30 hours
    d. 31 - 40 hours
    e. More than 40 hours
    f. Not sure or not applicable

25. Do you receive support for any of these personal expenses?
    a. Rent or mortgage
    b. Utilities (e.g. electricity, water, gas)
    c. Food and groceries
    d. Transportation
    e. Medical expenses
    f. Educational expenses (e.g., tuition, loans, supplies)
    g. Childcare
    h. Other (please specify):

26. Have you or your family received any of the following forms of financial assistance during your time at X? (Check all that apply)
    a. SNAP (Supplemental Nutrition Assistance Program)
    b. TANF (Temporary Assistance for Needy Families)
    c. Medicaid or CHIP (Children's Health Insurance Program)
    d. Housing assistance (e.g., Section 8)
    e. Not sure

f. None of the above

27. Please indicate how much you agree with the following statements about **socioeconomic status (SES)**? (*Likert-scale from strongly disagree to strongly agree, including 'N/A'*).
    a. I feel that I am often living "paycheck to paycheck" while in college.
    b. I think that there are enough scholarships or financial support opportunities available to students from low-SES backgrounds on my campus.
    c. I regularly have to prioritize paid work over academic or extracurricular activities due to time constraints
    d. I often have to forego purchases on non-essential items (eating out, vacations, etc.) because of my SES
    e. I do not typically worry about how I will cover my basic living expenses while in college

28. Please indicate how much you agree with the following statements about **socioeconomic status (SES)**? (*Likert-scale from strongly disagree to strongly agree, including 'N/A'*).
    a. I often feel excluded from campus activities due to my SES
    b. I feel that my engineering professors are understanding of the financial challenges faced by students
    c. I think that my socioeconomic background affects how my peers on campus perceive me
    d. I believe that there are insufficient resources available to help students from low-SES backgrounds on my campus
    e. I think that there is a stigma associated with being from a low-SES background on campus.
    f. I hear and see discussions about SES and economic diversity on campus
    g. I feel that my needs are adequately reflected in campus resources and support services for lower-income students.
    h. I believe that there is an underlying bias in how low-SES students are treated on campus.
    i. I believe that there is a lack of awareness amongst university staff and faculty about the financial struggles of low-SES students.
    j. I feel that I am financially "worse off" than the majority of students on my college campus

29. Please indicate how much you agree with the following statements about **socioeconomic status (SES)**? (*Likert-scale from strongly disagree to strongly agree, including 'N/A'*).
    a. I often feel overwhelmed by the financial demands of engineering.
    b. I believe my SES has affected my ability to participate in engineering professional development opportunities (e.g., internships, networking)

c. My mental health and emotional well-being has been affected by my SES
    i. **Follow-Up: If you feel comfortable, please share in what ways your emotional well-being or mental health has been negatively impacted by your socioeconomic status (SES):** *(if Strongly Agree or Agree)*
d. I feel that my SES will not affect my career prospects in engineering after graduation.
e. I think that my SES have negatively impacted my relationships (with friends, mentors, peers, etc.) while on campus
f. I often struggle balancing my personal, professional, and academic demands due to my SES
g. I feel that my free time is more restricted than peers because of my SES
h. I believe that there are barriers to participating in extracurriculars on campus for students from low-SES backgrounds.
i. I believe that my financial responsibilities limit the amount of time I can dedicate to personal wellness and self-care in college.
j. My physical well-being (e.g., health, nutrition, sleep) has been negatively impacted by my SES
    i. **Follow-Up: If you feel comfortable, please share in what ways your physical well-being has been negatively impacted by your socioeconomic status (SES):** *(if Strongly Agree or Agree)*

30. If you feel comfortable, please share any other ways your college social experiences have been affected by your socioeconomic status (SES):