

Longitudinal Impact of Engineering Education on Sociopolitical Concern in a University System Serving Low-Income Students Of Color

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Abstract

This WIP paper intends to supplement our current understanding of political awareness and ethical disengagement among engineering undergraduates. As an integral part of the production of globally-sold technology and weaponry [1-6], engineers in the United States need to have an active and informed interest for global public welfare as well as the political applications of their work [7]. Part of developing this informed interest is supposed to occur as they get their bachelor's degree, as ABET expects graduates to be able to "recognize ethical and professional responsibilities in engineering situations" (Criterion 3: Student Outcomes) and make decisions that give weight to the global and societal impact of their work [8]. In spite of this effort, some engineering students shoo this responsibility, recognizing that unethical situations and practices exist in industry but choosing to write them off as a necessary or justifiable part of the field [9]. What's more, the importance engineering students place on public welfare in general is seen to decline as they progress through their undergraduate education [10].

This study seeks to build off of these latter two findings in an attempt to further improve the characterization of ethical and political disengagement among engineering students. Through a longitudinal mixed-methods survey given to engineering students at multiple California State University (CSU) campuses, which serve primarily working class students and Students of Color, this study will quantitatively chart how student perspectives on public welfare change over the course of their undergraduate degrees—and how those responses compare to existing data from universities primarily serving wealthy and white students. This study's survey will also employ qualitative items to gauge student perceptions on the presence of military contractor companies on their campus, particularly with respect to how this presence influences their education and goals.

Introduction

Previous literature demonstrates gradual ethical disengagement for engineering students across multiple universities [10]. However, it is worth questioning whether students in the CSU system might diverge from this trend. Two significant demographic factors validate this inquiry: student racial/ethnic identity and family income. Cech's landmark study on ethical disengagement in engineering education [10] focused on four predominantly white, wealthy universities serving wealthier students. The CSU system, on the other hand, is only approximately 20% white [11] and generally serves students far less affluent than those in Cech's study; half of undergraduate students in the system receive Pell grants [12]. It is also the largest university system in the

United States, serving nearly half a million students [13]. Because it is critically important to understand the ethical (dis)engagement of students in all engineering programs in the US, not just those that serve a small, privileged subset of the population, research within the CSU system provides an opportunity to shift our focus to marginalized populations currently overlooked by academic research.

Previous research suggests that science, technology, engineering, and mathematics (STEM) Students of Color place more value on working for social change and giving back to their communities than their white counterparts [14-16]. Given this finding, it is reasonable to question whether or not students at campuses that primarily serve Students of Color also experience this gradual disengagement found at mostly white schools [10].

Multiple reports have also been put forward to determine the relationship (if any) family income has on values of empathy and altruism—some of which claim no relationship [17] while some conclude a lower income class can contribute to unique motivations for improving public welfare, arguing a “class-compassion gap” [18, 19]. With a possible class-compassion gap in mind, comparing the two sets of universities could provide insight into the relationship between wealth and engagement.

This work-in-progress paper describes a mixed-methods survey that will be administered to undergraduate engineering students in the CSU. In addition to investigating deviations from our current understanding of ethical disengagement over time, this survey will begin to qualitatively investigate the political significance CSU engineering students place on their field, mainly through the example of its connection to the military industrial complex, a heavily political and controversial example of the social impact of engineering [7]. In this study’s goal to better understand how engineering students conceive their ethical and political responsibilities, we hope to apply our findings to further the development of engineers with the capacity for critical reflection on the macroethical impact of their work.

Framework and Approach

Our findings will be used to consider how engineering education can be improved to benefit both the engineering students and the people impacted by the students’ future work. As Cech acknowledges in the conclusion of her foundational 2013 study, engineering students go on to technologically enable incredibly powerful institutions [10, 20].

With this in mind, our study utilizes an explicitly social justice-focused approach that recognizes and combats systems of oppression and domination, such as racism, capitalism, colonialism, and imperialism. This social justice lens motivated the focus on military contractors present in the survey’s qualitative items, as US military contractors (namely Lockheed Martin Corp., RTX, Northrop Grumman Corp., Boeing, and General Dynamics Corp.) are understood to be some of

the largest material contributors to modern colonialism and imperialism [1-7]. Two contemporary examples of these phenomena that highlight the need for an ethically proactive and informed engineering workforce are the widespread civilian casualties and infrastructural devastation in Yemen and Palestine, caused by the military actions of Saudi Arabia and Israel, respectively. Their actions, which have been condemned by academics and human rights organizations as enacting war crimes [21-25] including genocide [26-29], have been facilitated by American technology developed and sold [2-6, 23, 24] by many of the military contractors that have a history of financial, collaborative, and/or administrative support for many CSU campuses [30-34]. It is with these preventable catastrophes in mind that military contractor presence on school campuses is seen as a potential obstacle to maximizing public welfare beliefs in engineering students.

A core aspect of this study is the comparison of its data with separate data from students belonging to a significantly different socioeconomic class and racial/ethnic demographic [10]. To guide this analysis, we will employ Critical Race Theory (CRT), which frames race and ethnicity as social constructs that can unjustly shape a person's societal mobility, including in education [35]. In line with CRT's emphasis on intersectionality, the analysis will also account for the interconnected influence of class and race/ethnicity on students' experiences. An intersectional approach treats students' identities as overlapping, creating unique experiences and viewpoints [36]. For example, survey responses from a middle-class Latino student would be informed by the experience created by both their class and ethnicity—an experience distinct from that of a middle-class student of another ethnicity or a Latino student from a different class.

Methods

Starting Fall 2025, we will annually survey engineering students from five campuses within the California State University system, all of which are predominantly Hispanic-serving institutions [11] spread across a predominantly Hispanic state [37]. We will be giving an identical survey instrument to each campus every year, including identical quantitative items, qualitative items, and demographic items (e.g., race/ethnicity, household income). We'll be surveying Cal State LA, CSU Long Beach, San Francisco State University (SFSU), CSU Northridge, and Cal Poly Pomona. Each campus has its own culture, student demographic, and relationship to industry, potentially leading to differences in student responses and therefore interesting comparisons, both between the CSU campuses and against the previously examined schools [10].

Motivating their selection for participation in this study, the CSU campuses that will be surveyed each have a unique relationship with the military industrial complex. Some campuses are very visibly connected, like CSU Long Beach where, in addition to general resource investment into the school from multiple companies [38], 7 of the 36 seats on the Engineering Dean's Advisory Council are held by representatives from RTX, Northrop Grumman, and Boeing [33]. Then there are campuses like SFSU, which out of the five CSU campuses of interest is the only one with no

current public collaboration with or support from military contractors. The gradient of extent of campus-military contractor relationship between the selected CSU campuses and previously studied student campuses [10] might enable us to recognize any disengagement influence based on contractor presence alone.

The quantitative component of the survey will have items identical to those used in Cech's previous study, which were Likert-scale items meant to gauge student public welfare considerations, social consciousness, and the cultural emphases of their university (i.e., what skills the university values from the student's perspective) [10]. Data analysis for this component will match Cech's study, where ordinary least squares regression is used to determine changes in these attitudes as students progress through their degree.

The qualitative component of the survey will focus specifically on political disengagement among engineering students, posing items pertaining to student perspectives on the responsibility engineers hold for political applications of their technology and the presence of military contractors both on their campus and in the engineering field. Student respondents will receive a brief summary of their engineering college's specific relationship with military contractors, and the general format of the qualitative section can be found in Appendix A.1. The information on each campuses' relationship to the military industrial complex is all publicly available, primarily through online donor rolls and partnership announcements [30-34, 38].

In the qualitative, open-response section of the survey, Q1 and Q2 serve to give the student respondent an opportunity to share their account of campus culture with respect to military contractors, while Q3, Q4, and Q5 will provide us student perspectives on engineering's role in society and military contractors' place in academia. Together, these qualitative questions will provide insight into how students perceive the role of engineers within current power structures and how those perceptions are shaped by academia's ties to the military-industrial complex. Student responses here could potentially help explain any differences found between Cech's quantitative findings [10] and our own, providing nuance through qualitative data that is not possible to achieve with quantitative analyses. We will employ a narrative analysis approach, in which the responses a student shares are used to uncover how they view the engineering field and their place in it.

Future Work and Conclusion

With Institutional Review Board (IRB) approval secured for the survey instrument, we will annually distribute the survey to each of our target campuses starting during the Fall 2025 semester.

Through this study, we hope to refine the current understanding of ethical disengagement and depoliticization among engineering students. If our collected perspectives challenge the existing

understanding of disengagement, then future research awaits on examining the differences in students' critical consciousness, especially when considering social groups of varying social power. If the student perspectives gained from this longitudinal survey further confirm the current conception of a "culture of disengagement" [10], then following research can investigate the mechanisms by which disengagement can transcend these campuses and the various students they support. The results of this study will better position the field of engineering to confront the factors in its educational programs that contribute to student disengagement.

Acknowledgements

For enabling this study and reviewing this paper, the authors of this paper sincerely thank the rest of the macroethics research team: Aaron, Betsy, Beyonce, Aria, Em, and Léa.

References

- [1] SIPRI, "The SIPRI Top 100 arms-producing and military services companies in the world, 2023," <https://www.sipri.org>. [Online]. Available: <https://www.sipri.org/visualizations/2024/sipri-top-100-arms-producing-and-military-services-companies-world-2023>. [Accessed: Jan. 21, 2025].
- [2] Investigate, "RTX Corp," <https://investigate.afsc.org>. [Online]. Available: <https://investigate.afsc.org/company/rtx>. [Accessed: Jan. 21, 2025].
- [3] Investigate, "Boeing Co," <https://investigate.afsc.org>. [Online]. Available: <https://investigate.afsc.org/company/boeing>. [Accessed: Jan. 21, 2025].
- [4] Investigate, "Northrop Grumman Corp," <https://investigate.afsc.org>. [Online]. Available: <https://investigate.afsc.org/company/northrop-grumman>. [Accessed: Jan. 21, 2025].
- [5] Investigate, "Lockheed Martin Corp," <https://investigate.afsc.org>. [Online]. Available: <https://investigate.afsc.org/company/lockheed-martin>. [Accessed: Jan. 21, 2025].
- [6] Investigate, "General Dynamics Corp," <https://investigate.afsc.org>. [Online]. Available: <https://investigate.afsc.org/company/general-dynamics>. [Accessed: Jan. 21, 2025].
- [7] A. W. Johnson, C. L. Bowen, C. C. Cruz, and R. B. Rodriguez, "Ethical Issues In Mechanical And Aerospace Engineering," in *The Routledge International Handbook of Engineering Ethics Education* (1st ed.). Routledge, 2024, pp. 269–284. [Online]. Available: <https://doi.org/10.4324/9781003464259-19>.

- [8] ABET, “Criteria for Accrediting Engineering Programs, 2022-2023,” <https://www.abet.org/>. [Online]. Available: <https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/>.
- [9] E. A. Strehl, M. Ennis, A. W. Johnson, and C. L. Bowen, “Work in Progress: Undergraduate Student Perceptions of Macroethical Issues in Aerospace Engineering,” presented at the ASEE 2023 Annual Conference & Exposition, 2023. Available: <https://peer.asee.org/work-in-progress-undergraduate-student-perceptions-of-macroethical-issues-in-aerospace-engineering>.
- [10] E. A. Cech, “Culture of Disengagement in Engineering Education?,” *Science, Technology, & Human Values*, vol. 39, no. 1, pp. 42–72, Sep. 2013, doi: <https://doi.org/10.1177/0162243913504305>.
- [11] “Workbook: Enrollment Dashboard,” Calstate.edu, 2023. [Online]. Available: https://tableau.calstate.edu/views/SelfEnrollmentDashboard/EnrollmentSummary?iframeSizedToWindow=true&%3Aembed=y&%3AshowAppBanner=false&%3Adisplay_count=no&%3AshowVizHome=no. [Accessed: Jan. 21, 2025].
- [12] A. Beall, “Funding Your CSU Education,” Calstate.edu, Oct. 16, 2023. [Online]. Available: <https://www.calstate.edu/csu-system/news/Pages/Funding-Your-CSU-Education.aspx>. [Accessed: Jan. 21, 2025].
- [13] “Enrollment,” www.calstate.edu, 2023. [Online]. Available: <https://www.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment>. [Accessed: Jan. 21, 2025].
- [14] J. C. Garibay, “STEM Students’ Social Agency and Views on Working for Social change: Are STEM Disciplines Developing Socially and Civically Responsible students?,” *Journal of Research in Science Teaching*, vol. 52, no. 5, pp. 610–632, Feb. 2015, doi: <https://doi.org/10.1002/tea.21203>.
- [15] K. D. Gibbs and K. A. Griffin, “What Do I Want to Be with My PhD? The Roles of Personal Values and Structural Dynamics in Shaping the Career Interests of Recent Biomedical Science PhD Graduates,” *CBE—Life Sciences Education*, vol. 12, no. 4, pp. 711–723, Oct. 2013, doi: <https://doi.org/10.1187/cbe.13-02-0021>.

- [16] E. McGee and L. Bentley, “The Equity Ethic: Black and Latinx College Students Reengineering Their STEM Careers toward Justice,” *American Journal of Education*, vol. 124, no. 1, pp. 1–36, Nov. 2017, doi: <https://doi.org/10.1086/693954>.
- [17] T. Smith, “Altruism in Contemporary America: A Report from the National Altruism Study,” National Opinion Research Center at the University of Chicago, Jun. 2003. [Online]. Available: <https://gss.norc.uchicago.edu/content/dam/gss/get-documentation/pdf/reports/topical-reports/TR34%20Altruism%20in%20Contemporary%20America%20A%20Report%20from%20the%20National%20Altruism%20Study.pdf>.
- [18] J. S. Mattis et al., “The Social Production of Altruism: Motivations for Caring Action in a Low-Income Urban Community,” *American Journal of Community Psychology*, vol. 43, no. 1–2, pp. 71–84, Jan. 2009, doi: <https://doi.org/10.1007/s10464-008-9217-5>.
- [19] P. K. Piff and J. P. Moskowitz, *The Class–Compassion Gap*. Oxford University Press, 2017, pp. 317–330. doi: <https://doi.org/10.1093/oxfordhb/9780190464684.013.24>.
- [20] A. D. Zimmerman, “Toward a More Democratic Ethic of Technological Governance,” *Science, Technology, & Human Values*, vol. 20, no. 1, pp. 86–107, Jan. 1995, doi: <https://doi.org/10.1177/016224399502000105>.
- [21] E. Levitz, “The U.S. Is Giving Israel Permission for War Crimes,” *Intelligencer*, Oct. 13, 2023. [Online]. Available: <https://nymag.com/intelligencer/2023/10/the-u-s-is-giving-israel-permission-for-war-crimes.html>. [Accessed: Jan. 21, 2025].
- [22] Médecins Sans Frontières, “Indiscriminate Violence and the Collective Punishment of Gaza Must Cease,” Médecins Sans Frontières (MSF) International, Oct. 12, 2023. [Online]. Available: <https://www.msf.org/indiscriminate-violence-and-collective-punishment-gaza-must-cease>. [Accessed: Jan. 21, 2025].
- [23] D. J. Craig, “War Atrocities in Yemen Linked to US Weapons,” *Columbia Magazine*, 2022. [Online]. Available: <https://magazine.columbia.edu/article/war-atrocities-yemen-linked-us-weapons>. [Accessed: Jan. 21, 2025].
- [24] P. Motaparthi and T. Wilson, “US Military Support to the Saudi-Led Coalition in Yemen

- amid Civilian Toll: Mapping the Connections,” Just Security, Jun. 04, 2022. [Online]. Available:
<https://www.justsecurity.org/81754/us-military-support-to-the-saudi-led-coalition-in-yemen-amid-civilian-toll-mapping-the-connections/>. [Accessed: Jan 21, 2025].
- [25] B. V. Esveld, “The UN’s Timid Responses to War Crimes against Children,” Human Rights Watch, Apr. 10, 2020. [Online]. Available:
<https://www.hrw.org/news/2020/04/10/uns-timid-responses-war-crimes-against-children>. [Accessed: Jan. 21, 2025].
- [26] J. S. Bachman, “A ‘Synchronised Attack’ on Life: the Saudi-led Coalition’s ‘Hidden and Holistic’ Genocide in Yemen and the Shared Responsibility of the US and UK,” *Third World Quarterly*, vol. 40, no. 2, pp. 298–316, Jan. 2019, doi:
<https://doi.org/10.1080/01436597.2018.1539910>.
- [27] L. Drysdale, “Yemen: Genocide Emergency,” Genocide Watch, Nov. 02, 2022. [Online]. Available: <https://www.genocidewatch.com/single-post/yemen-genocide-emergency>. [Accessed: Jan. 21, 2025]
- [28] Al Jazeera, “Who Accuses Israel of Committing Genocide in Gaza?,” Al Jazeera, Dec. 06, 2024. [Online]. Available:
<https://www.aljazeera.com/news/2024/12/6/who-accuses-israel-of-committing-genocide-in-gaza>. [Accessed: Jan. 21, 2025]
- [29] Amnesty International, “Amnesty International Concludes Israel Is Committing Genocide against Palestinians in Gaza,” Amnesty International, Dec. 05, 2024. [Online]. Available:
<https://www.amnesty.org/en/latest/news/2024/12/amnesty-international-concludes-israel-is-committing-genocide-against-palestinians-in-gaza/>. [Accessed: Jan. 21, 2025]
- [30] Cal State LA, “ECST 2021 Donor Honor Roll | Cal State LA,” Calstatela.edu, 2021. [Online]. Available: <https://www.calstatela.edu/ecst/ecst-2021-donor-honor-roll>. [Accessed: Jan. 21, 2025].
- [31] Cal State LA, “ECST 2020 Donor Honor Roll | Cal State LA,” Calstatela.edu, 2020. [Online]. Available: <https://www.calstatela.edu/ecst/ecst-2020-donor-honor-roll>. [Accessed: Jan. 21, 2025].
- [32] Cal Poly Pomona, “Meet Our Donors,” Cpp.edu. [Online]. Available:
<https://www.cpp.edu/engineering/giving/donors.shtml>. [Accessed: Jan. 21, 2025].

- [33] CSU Long Beach, “Dean’s Advisory Council,” Csulb.edu. [Online]. Available: <https://www.csulb.edu/college-of-engineering/deans-advisory-council>. [Accessed: Jan. 21, 2025].
- [34] CSUN, “CSUN’s Connection to Local Industry Leaders,” California State University, Northridge. [Online]. Available: <https://www.csun.edu/economicimpact/csuns-connection-local-industry-leaders>. [Accessed Jan. 22, 2025].
- [35] G. Ladson-Billings, “Just What Is Critical Race Theory and What's It Doing in a Nice Field like education?,” *International Journal of Qualitative Studies in Education*, vol. 11, no. 1, pp. 7–24, Jan. 1998, doi: <https://doi.org/10.1080/095183998236863>.
- [36] S. Cho, K. W. Crenshaw, and L. McCall, “Toward a Field of Intersectionality Studies: Theory, Applications, and Praxis,” *Signs: Journal of Women in Culture and Society*, vol. 38, no. 4, pp. 785–810, Jun. 2013, doi:<https://doi.org/10.1086/669608>.
- [37] H. Johnson, E. McGhee, and M. Cuellar Mejia, “California’s Population,” Public Policy Institute of California, Jan. 2024. [Online]. Available: <https://www.ppic.org/publication/californias-population/>. [Accessed: Jan. 22, 2025].
- [38] CSU Long Beach, “Partnerships,” Csulb.edu. [Online]. Available: <https://www.csulb.edu/space-beach-initiative/partnerships>. [Accessed: Jan. 22, 2025].

Appendix

A.1: Qualitative component of survey. Each campus will have their survey briefly share examples of their respective relationship with contractors.

“[Name of University’s Primary Engineering College] is in part supported by [list of college’s premiere corporate military sponsors/supporters], among other aerospace and military contractors. This support appears in [financial support, administrative support, curricular support, etc.].”

- *Q1: How would you describe the general attitude on your campus or among your peers toward working for military contractors?*
- *Q2: In what ways have the presence of these corporations on your campus influenced your education, career options, or goals?*
- *Q3: Are ethical problems present when military contractors support engineering programs? Explain.*

- *Q4: In your perspective, do engineers working under these corporations hold responsibility for the applications of their technology? Why?*
- *Q5: To what extent is engineering a political job/field?*