Online Ethics Center
FOR ENGINEERING AND SCIENCE

Efficacy of Macroethics Education in Engineering

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Description

This page summarizes research into the state of incorporating macroethics into engineering and computing education for undergraduate and graduate students. It includes summaries of 35 educational case studies.

Body

The OEC Project Pages are intended to cultivate a community of practice and allow ethics researchers, educators, and practitioners to more effectively disseminate their work. This Project Page provides a detailed overview and relevant resources for an on-going science or engineering ethics project. Once you've explored this project, visit the "Projects" section under "Resources" to see more ethics projects.

Description

The goals of this collaborative project are to evaluate the various ways in which macroethics is taught in engineering and computing to undergraduate and graduate students (both in and out of the classroom), and to determine the most effective methods that can then be adopted by others.

In order for STEM disciplines to reach their full potential to benefit society, students must be prepared to engage in broad considerations of the ethical issues that face the profession. Established codes of conduct describe standards for professional behavior, but these largely relate to individual actions associated with individual projects, so-called 'micro'-ethical considerations. But engineering and computing must also consider 'macro'-ethical challenges, which consider the societal and environmental implications of technology as the collective responsibility of the profession. Macroethics includes issues such as sustainability, poverty and underdevelopment, security and peace, social justice, bioethics, nanoscience, and social responsibility. The extent to which engineering and computing students graduate with an understanding of macroethical issues is unclear and in need of organization.

This research started with a large survey of engineering and computing faculty across the U.S. This was followed by interviews of selected faculty who are effectively using a diversity of methods to teach a range of macroethical issues. This resulted in a set of 35 educational case studies that can serve as models for others. More detailed outcomes assessments were conducted for 11 of those teaching settings, including student surveys, rubric assessment of student work, and in some cases observations, student focus groups, and alumni surveys. Best practices were identified and are being propagated via faculty training workshops and online resources.

Leadership

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Recipient Organizations

- University of Colorado Boulder
- Tufts University
- Seattle University

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Relevant Links

- **Project Homepage**
- **Teaching Examples Summary Spreadsheet**
- **Two-Page Summaries of Teaching Examples**

Publications, Presentations, and Other Products

Manscripts

- Bielefeldt, A.R., M. Polmear, D. Knight, N. Canney, and C. Swan. 2019. Disciplinary Variations in Ethics and Societal Impact Topics Taught in Courses for Engineering Students. *ASCE Journal of Professional Issues in Engineering Education and Practice.* 145 (4). DOI: 10.1061/(ASCE)EI.1943-5541.0000415
- Polmear, M., A.R. Bielefeldt, D. Knight, N. Canney, and C. Swan. 2019. Analysis of Macroethics Teaching Practices and Perceptions in Engineering: A Cultural Comparison. *European Journal of Engineering Education*. https://doi.org/10.1080/03043797.2019.1593323
- Bielefeldt, A.R., M. Polmear, N. Canney, C. Swan, D. Knight. 2018. Ethics Education of Undergraduate and Graduate Students in Environmental Engineering and Related Disciplines. *Environmental Engineering Science*. 35 (7): 684-695. DOI: 10.1089/ees.2017.0308
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2018. Intersections between Engineering Ethics and Diversity Issues in Engineering Education. *Journal of Professional Issues in Engineering Education and Practice*. 144 (2). DOI: 10.1061/(ASCE)EI.1943-5541.0000360.
- Bielefeldt, A.R., N. Canney, C. Swan, M. Polmear, D. Knight. 2016. A Picture of Microethics and Macroethics Education of Biomedical Engineering Students in the United States. *Ethics in Biology, Engineering and Medicine*. 7 (1), 17-32.
- Bielefeldt, A.R., N. Canney, C. Swan, D. Knight. 2016. Contributions of Learning through Service to the Ethics Education of Engineering Students. *International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship.* 11 (2), 1-17.

Peer Reviewed Conference Papers

- Polmear, M., A. Bielefeldt, D. Knight, C. Swan, N. Canney. 2019. Exploration of the Ethics and Societal Impacts Teaching Practices of Anglo and Western European Educators. *8th Research in Engineering Education Symposium*. Cape Town, South Africa. July 10-12. 10 pp.

- Polmear, M., A. Bielefeldt, D. Knight, N. Canney, C. Swan. 2019. Hidden Curriculum Perspective on the Importance of Ethics and Societal Impacts in Engineering Education. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*. Best paper Technological Literacy & Philosophy of Engineering Division.
- Bielefeldt, A.R., D. Zhao, A. Kulich, M. Polmear, N.E. Canney, C. Swan, D. Knight. 2019. Student Views on their Role in Society as an Engineer and Relevant Ethical Issues. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*. Best paper Ethics Division and PIC IV.
- Bielefeldt, A.R., M. Polmear, D. Knight, N. Canney, C. Swan. 2019. Institutional Variations in Ethics and Societal Impacts Education: Practices and Sufficiency Perceptions Among Engineering Educators. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*.
- Canney, N.E., A.R. Bielefeldt, M. Polmear, C. Swan, D. Knight. 2019. Development of an ethics survey based on the four-domain development diagram. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*.
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2018. Education of Electrical Engineering Students about Ethics and Societal Impacts in Courses and Co-curricular Activities. ASEE/IEEE Frontiers in Education (FIE) Conference. San Jose CA, Oct. 4-6. 9 pp.
- Knight, D., M. Polmear, A. Bielefeldt, N. Canney, C. Swan. 2018. Exploring the Range of Methods used to Assess Engineering Students' Education on Ethical and Societal Impact Issues. ASEE/IEEE Frontiers in Education (FIE) Conference. San Jose CA, Oct. 4-6. 8 pp.
- M. Polmear, A.R. Bielefeldt, D. Knight, N. Canney, C. Swan. 2018. Faculty Perceptions of Challenges to Educating Engineering and Computing Students About Ethics and Societal Impacts. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*. 18 pp. Best Paper Engineering Ethics Division, Best Paper PIC IV. https://peer.asee.org/30510
- Bielefeldt, A.R., M. Polmear, D. Knight, N. Canney, C. Swan. 2018. Ethics and Societal Impacts Education of Chemical Engineering Undergraduate and Graduate Students: Results of a National Survey. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*. 15 pp. https://peer.asee.org/30442
- Bielefeldt, A.R., M. Polmear, D. Knight, N. Canney, C. Swan. 2018. Effective Ethics Education: Examining Differing Faculty Perspectives. *American Society*

for Engineering Education (ASEE) Annual Conference & Exposition. 20 pp. https://peer.asee.org/30355

- M. Polmear, A.R. Bielefeldt, D. Knight, N. Canney, C. Swan. 2018. Faculty Perceptions of the Most Effective Settings and Approaches for Educating Engineering and Computing Students About Ethics and Societal Impacts. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*. 19 pp. https://peer.asee.org/30511
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2017. "An Overview of the Microethics and Macroethics Education of Computing Students in the United States." ASEE/IEEE Frontiers in Education (FIE) Conference. Oct. 18-21. Indianapolis, IN.
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2017. "Institutional Differences in the Education of Engineering and Computing Students about Ethics and Societal Impacts." Christian Engineering Conference. June 28-30, Cedarville, OH. 19 pp. p. 53-71. https://digitalcommons.cedarville.edu/christian_engineering_conference/2017/curriculur
- Polmear, M., D. Knight, A. Bielefeldt, C. Swan, N. Canney. 2017. "Analysis of Macroethics Teaching Practices and Perceptions in Engineering: Results of an International Survey." REES 2017 – Research in Engineering Education Symposium. July 6-8, Bogota Columbia. 8 pp.
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2017. "Incorporation of Ethics and Societal Impact Issues into Senior Capstone Design Courses: Results of a National Survey." American Society for Engineering Education (ASEE) Annual Conference and Exposition Proceedings. June 25-28. Columbus, OH. 19 pp. https://peer.asee.org/28516
- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2017. "Incorporation of Ethics and Societal Impact Issues into First Year Engineering Courses: Results of a National Survey." American Society for Engineering Education (ASEE) Annual Conference and Exposition Proceedings. June 25-28. Columbus, OH. 15 pp. Selected as Best Paper of First-Year Programs Division. https://peer.asee.org/28515
- Canney, N., E. Simon, A.R. Bielefeldt, M. Polmear, D. Knight, C. Swan. 2017. "Challenges and Opportunities: Faculty Views on the state of Macroethical Education in Engineering." American Society for Engineering Education (ASEE) Annual Conference and Exposition Proceedings. June 25-28. Columbus, OH. 12 pp. https://peer.asee.org/28022

- Bielefeldt, A.R., M. Polmear, D. Knight, C. Swan, N. Canney. 2017. Ethics Across the Curriculum? Integrating Ethics and Societal Impact Topics into Core Engineering Courses. Proceedings of the American Society for Engineering Education (ASEE) Rocky Mountain Section Conference. Sept. 22-23. Provo, UT. 15 pp.
- Knight, D., A. Bielefeldt, N. Canney, C. Swan. 2016. “Macroethics Instruction in Co-curricular Settings: The Development and Results of a National Survey.” Frontiers in Education (FIE) Conference. Oct. 12-15. Erie, PA. 4 pp.
- Bielefeldt, A.R., N.E. Canney, C. Swan, D. Knight. 2016. “Efficacy of Macroethics Education in Engineering.” American Society for Engineering Education (ASEE) Annual Conference and Exposition Proceedings. June 26-29. New Orleans, LA. DOI: 10.18260/p.26919. 21 pp. https://peer.asee.org/26919
- Bielefeldt, A.R., D. Knight, C. Swan, N. Canney. 2016. Macroethics Education in Engineering and Computing Courses. Proceedings of the American Society for Engineering Education (ASEE) Rocky Mountain Section Conference. Sept. 30-Oct. 1. Cedar City, UT. 13 p.

Workshops

- Polmear, M., A.R. Bielefeldt, N.E. Canney, C. Swan. 2019. Integrating Ethics and Societal Impact Topics into Engineering Education – Actionable Ideas for Macroethics Topics, Teaching Methods, and Assessment. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Workshop U212W. June 15. Tampa FL.
- Polmear, M. and A.R. Bielefeldt. 2019. Integrating Ethics and Societal Impacts into Engineering Courses: Opportunity to Develop Actionable Ideas. American Society for Engineering Education (ASEE) Rocky Mountain Section Conference. May 19-21. Laramie WY.
- M. Polmear, A.R. Bielefeldt, D. Knight. 2018. Workshop: Integrating Ethics and Societal Impact Topics into Engineering Education: Actionable Ideas for Macroethics Topics, Teaching Methods, and Assessment. American Society for Engineering Education (ASEE) Zone IV Conference. March 25-27. Boulder, CO.

Posters

- Zhao, D., A. Bielefeldt, M. Polmear, D. Knight, C. Swan, N. Canney. 2019. Rubric Assessment of Ethics and Societal Impacts Content of Student Assignments. American Society for Engineering Education (ASEE) Rocky Mountain Section

Conference. May 19-21. Laramie WY.
- Lewis, J.W., M. Polmear, A.R. Bielefeldt, D. Knight. 2018. An Insight into the Techniques and Activities Faculty Utilize to Introduce Ethical Concepts through Co-Curricular Environments. Poster. American Society for Engineering Education (ASEE) Zone IV Conference. Mar. 25-27. Boulder, CO.
- Bielefeldt, A.R., M. Polmear, D. Knight, N. Canney, C. Swan. 2017. Ethics Education in Environmental Engineering. Poster. Association for Environmental Engineering & Science Professors (AEESP) Biennial Conference. June 20-22. Ann Arbor, Michigan.

Rights

Use of Materials on the OEC

Resource Type

Projects

Parent Collection

STEM Ethics Projects (2017-Present)

Topics

Goals of Ethics Education
Evaluation and Assessment
Pedagogical Approaches

Discipline(s)

Teaching Ethics in STEM
Engineering
Authoring Institution
University of Colorado Boulder