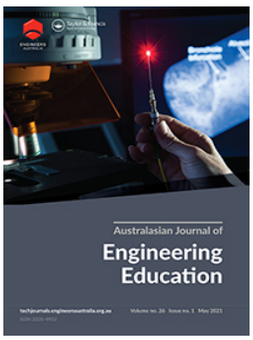
2021

REES/AAEE Special Focus On Ethics: Introduction By Guest Editor, Shannon Chance

Shannon Chance
Technological University Dublin, shannon.chance@tudublin.ie

Recommended Citation

Chance, S. (2021). REES/AAEE Special Focus On Ethics: Introduction By Guest Editor, Shannon Chance. *Australasian Journal of Engineering Education*, vol. 26, no. 1. doi:10.1080/22054952.2021.1936906



Taylor & Francis
Taylor & Francis Group

Australasian Journal of Engineering Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/teen20

REES/AAEE special focus on ethics: introduction by guest editor, Shannon Chance

Shannon Chance

To cite this article: Shannon Chance (2021) REES/AAEE special focus on ethics: introduction by guest editor, Shannon Chance, Australasian Journal of Engineering Education, 26:1, 2-6, DOI: 10.1080/22054952.2021.1936906

To link to this article: https://doi.org/10.1080/22054952.2021.1936906

Published online: 15 Jun 2021.

AUSTRALASIAN JOURNAL OF ENGINEERING EDUCATION
2021, VOL. 26, NO. 1, 2–6
https://doi.org/10.1080/22054952.2021.1936906

Taylor & Francis
Taylor & Francis Group

ARTICLE

REES/AAEE special focus on ethics: introduction by guest editor, Shannon Chance

Shannon Chance [a,b]

[a]Centre for Engineering Education, University College London, London, UK; [b]Engineering, Torrington Place, London, UK

ABSTRACT

Today, more than ever, we see the significance of ethics in developing and sustaining the built, social, and natural environments around us. We also recognise the need to develop engineering students' knowledge, skills, and values regarding engineering, innovation, design, production, and the like. Engineers' actions can have intended as well as unintended consequences, and we as a community need to become more aware of the outcomes and implications of our work. In response to the many topics presented at the REES 2019, the REEN Board selected ethics as the focus for this special issue and joined with AAEE to publish in the Association's journal.

ARTICLE HISTORY
Received 25 May 2021
Accepted 27 May 2021

KEYWORDS
Ethics; case study; ethical decision making; moral reasoning; engineering accreditation; philosophy

The Research in Engineering Education Network (REEN) governing board is delighted to present this special focus issue on ethics in engineering education and practice, organised in conjunction with the Australasian Association for Engineering Education (AAEE). REEN is a community of scholars who aim to advance the field of Engineering Education Research (EER) by helping people around the world conduct research and share findings. We provide an inclusive, independent, international forum to advance scholarly discourse on EER. To do this, REEN spearheads a bi-annual conference, known as the Research in Engineering Education Symposium (REES), and publishes special focus issues stemming from the Symposium. We also host a website and coordinate capacity-building and knowledge-sharing events to help people develop new and improved skills in education research. The REEN Board, which I am proud to Chair, is comprised of multiple representatives from each habitable continent.

In response to the many topics presented at the REES 2019, the REEN Board selected ethics as the focus for this special issue and joined with AAEE to publish in this, the Association's journal titled the *Australasian Journal of Engineering Education*. Efforts of REEN Board members Teresa Hattingh (South Africa), Andrea Mazzurco (Australia), and Valquiria Villas-Boas (Brazil) who served as Associate Editors and Sally Male (Co-cihair of the upcoming REES 2021 and Editor-in-Chief of AJEE) were instrumental in getting this high-quality collection of cutting-edge research and concept papers into print. As the lead guest Editor for this issue, I am deeply grateful to them and to the many authors and peer reviewers who contributed time and effort – and persisted despite the challenges presented by the global pandemic. I also thank Bruce Kloot and team who organised and hosted REES 2019 in Cape Town, South Africa and Adam Carberry, the previous Chair of REEN, for the work they did to make REES 2019 a success and highlight important topics.

Today, more than ever, we see the significance of ethics in developing and sustaining the built, social, and natural environments around us. We also recognise the need to develop engineering students' knowledge, skills, *and* values regarding engineering, innovation, design, production, and the like. Engineers' actions can have intended as well as unintended consequences, and we as a community need to become more aware of the outcomes and implications of our work.

Indeed, in recent years, the discourse on ethics in engineering has expanded beyond issues of codes, compliance with regulations, and ethical dilemmas in the workplace. The ethics discussion now includes discipline-specific models of ethics and the application of various philosophical traditions regarding how engineering as a profession may view and respond to broader, interwoven contexts. New paradigms of ethics necessitate new empirical educational research – basic and applied – ranging from research on dispositions, decision-making processes, and systems, to the

CONTACT Shannon Chance shannon.chance@tudublin.ie; s.chance@ucl.ac.uk PhD, SFHEA (UK), BArch, MArch, PG Cert (BIM), Registered Architect (Virginia), NCARB (US), LEED-AP

PhD, SFHEA (UK), BArch, MArch, PG Cert (BIM), Registered Architect (Virginia), NCARB (US), LEED-APChair, Research on Engineering Education NetworkLecturer and Programme Chair, BSc in BIM (Digital Construction) at TU DublinVisiting Professor, University College London (UCL)Associate Editor, IEEE Transactions on Education

design and evaluation of pedagogical and curricular initiatives, and to understanding engineering ethics in the workplace. In response, REEN and AAEE issued an open call, soliciting empirical studies as well as high-quality concept papers.

We are pleased to present this set of nine manuscripts on engineering ethics. Providing authentic and contextual approaches to learning and practicing ethics is an important theme across all manuscripts in this special issue. All the studies carry relevance for engineering at large, and we think they represent a valuable contribution to the global discussion of engineering, education, and ethics.

Accreditation represents another important theme running across this special issue. In a paper titled 'Repositioning Ethics at the Heart of Engineering Graduate Attributes', Alison Joy Gwynne-Evans, Sarah Junaid, and Manimagalay Chetty (Gwynne-Evans, Junaid, and Chetty 2021) argue that *accreditation* is a primary motivator for engineering courses to include ethics, yet accreditation requirements tend to sideline ethics by limiting their impact to just one or two criteria, providing scant definition of what 'ethics' and 'integrity' entail, and requiring student awareness rather than specifying a minimum level of output or performance. The authors note that since most accreditation systems require students to demonstrate an understanding of ethics, but not ethical behaviour, 'ethical behaviour becomes the *object of study* rather than its *objective*' and this differs from other criteria. Gwynne-Evans et al. provide a model, in the form of a graphic conceptual framework, for infusing ethics across all graduate attributes required for engineering accreditation in South Africa. The requirements for student performance in South Africa are similar to most other accreditation systems around the world because they adhere to the Washington Accord. The approach proposed by Gwynne-Evans et al. helps educators reconceptualise *how* and *where* ethics fit and may be incorporated/delivered/achieved within engineering. The framework is a result of extensive analysis of literature from multiple disciplines as well as a case study of policy documents related to engineering accreditation in South Africa. Adopting this framework – which graphically illustrates how pervasive ethics are to engineering – at a national level and incorporating it into accreditation requirements could encourage quick adoption in South Africa and beyond.

Micro- and macro-ethics, and their implications for education, accreditation, practice, and professionalisation are considered in four articles of this special issue (Martin, Conlon, and Bowe 2021; Lawlor 2021; Hess et al. 2020; Chance et al. 2021). Micro-ethics have to do with an individual's obligations and responsibilities, whereas macro-ethics involve the larger community and recognise the power of a group or collection of people to chart a path towards greater responsibility by envisioning, setting standards, articulating expectations, and the like.

To integrate ethics into education, many engineering curricula around the world rely on case studies. *How*, and *how well*, this works is the subject of research conducted by Diana Adela Martin, Eddie Conlon, and Brian Bowe (Martin, Conlon, and Bowe 2021). This team has provided much needed, empirically based research on the use of case studies. Martin et al. collected interview and survey data from 23 engineering programmes located in six different institutions of higher education in Ireland. They identified case study as the primary pedagogic tool used by engineering educators to teach ethics – a finding consistent with prior research from North America. Analysing these case studies, they found 'a prevalence of individualistic hypothetical scenarios containing dilemmas set in scenarios of crisis that can be addressed through appeal to ethical theories or professional codes' but a worrisome lack of 'case studies exploring the wider mission of the engineering profession'. Thus, students typically encounter cases focused on what an individual should do (micro-ethics) but overlooking the need for collections/groups of engineers to work together to set higher standards for ethical conduct in engineering (macro-ethics). Their article, titled 'Using Case Studies in Engineering Ethics Education: The Case for Immersive Scenarios through Stakeholder Engagement and Real-Life Data', explains that more meaningful and immersive cases could involve open-ended questions and scenarios that are less hypothetical. These might involve stakeholders or external guests and use 'real' data and 'real' documents (e.g. environmental data, policy documents, court reports, community records).

Jeffrey Stransky, Cheryl A. Bodnar, Mathew Cooper, Daniel Anastasio, and Daniel Burkey provide an example of immersive environments that encourage authentic, high-level engagement by students in their article on 'Authentic Process Safety Decisions in an Engineering Ethics Context: Expression of Student Moral Development within Surveys and Immersive Environments' (Stransky et al., 2020). Their study engaged 148 chemical engineering seniors at three different universities in two types of intervention: case study and a 'digital immersive environment'. Ethical development achieved via the case study was assessed using the Engineering Process Safety Reasoning Instrument (EPSRI), but student responses apparently contained a 'halo effect' wherein students selected answers that sounded more correct, without deep or authentic reasoning. The authors noted that the hypothetical case study mode of presentation stripped away 'extenuating factors that might disguise ethical decisions in the real world' whereas the gaming environment allowed 'students to practice making

decisions and [to see] the ramifications associated with their choices in a safe environment'. Overall, the decisions students made in the more complex situation presented within the gaming environment called *Contents Under Pressure*, appeared more authentic and also consistent with existing theories on students' moral development. The immersive, game-type environment compelled the students to consider more factors (such as time, productivity, and personal reputation) rather than superficially recognise the primary issue or problem (with artificial ease) and then provide idealised responses based on what might score well.

Mathana Amaris Fiona Sivaraman (Sivaraman 2021) provides an additional method for assessing students' moral reasoning in a more integrated and reflective way than achieved using typical surveys. Sivaraman has assessed students' written responses to ethical dilemmas presented in various case study vignettes as well as the justifications students provided for their responses. She drew from multiple existing Ethical Decision-Making Models (EDMMs), synthesising them into a single rubric that she used to analyse students' written reflections and verbal justifications. Sivaraman's four-tiered rubric may be useful to educators who want to assess the quality of their students' responses. In this case, the students had not been coached in how to use an EDMM. Nevertheless, the reflections and justifications they provided on two ethical vignettes enabled Sivaraman to assess the sophistication of their ethical decision-making. The resulting paper, 'A 4-Tier Rubric for Evaluating Engineering Students' Ethical Decision-Making (EDM) Skills: EDM Model as a Tool for Analysing and Assessing Ethical Reasoning', can help and educator evaluate if a student is able to identify: the underlying problem or issue (tier 1); relevant factors, affected parties and consequences to those parties (tier 2); possible constraints and use these to generate a potential course of action (tier 3); and then test options with consideration for harm, defensibility, publicity, and acceptability within one's organisation or group of colleagues (tier 4).

Further investigating micro- and macro-ethics, Rob Lawlor (Lawlor 2021) asserts the case study approach is limiting because it emphasises the individual while overlooking power dynamics and broader institutional issues. Moreover, it usually lacks technical, engineering content and fails to reinforce concepts and other content using lectures and out-of-class readings. Lawlor revisits, reflects upon, and supports many points raised by Martin, Conlon and Bowe (Martin, Conlon, and Bowe 2021, 2019) in his philosophical assessment titled 'Teaching Engineering Ethics: A Dissenting Voice'. Lawlor asserts that case studies usually focus on choices made by individuals while ignoring the technical content that students of engineering value and understand. Students are typically asked to discuss the given case study in-class, but a lack of sustained engagement with the topic over time (e.g. before, during and after class) and this presents a barrier to learning. Lawlor recommends engineering ethics education be revised to include more content – e.g. readings, lectures, and the 'real' data and documents described by Martin et al. (Martin, Conlon, and Bowe 2021) that can help expose students to public policy and social ramifications of engineering decisions. Further, Lawlor recommends mirroring practices used in the education of philosophers – aligning readings, lectures, discussions, and assessments – so that students are equipped to think critically about the profession, challenge the status quo, and improve future outcomes of the engineering profession. Techniques recommended by Lawlor can help students learn new skills as well as re-consider and cultivate their values. On the other hand, 'if students are not required to do any additional work before the class (reading academic literature) or after the class (defending their views in an essay, for example)' they may find ethics lessons 'insufficiently challenging', Lawlor asserts, and unmemorable. Students must be equipped to join and shape the engineering profession, which needs to work as a collective to address the power dynamics that prevent individual engineers from stepping forward to confront problems.

A process like that recommended by Lawlor (Lawlor 2021) is described by Justin L. Hess, Sharon Miller, Steven Higbee, Grant A. Fore, and Joseph Wallace in their exploration of 'Empathy and Ethical Becoming in Biomedical Engineering Education: A Mixed Methods Study of an Animal Tissue Harvesting Laboratory' (Hess et al. 2020). They provide an approach for helping students recognise issues in practice environments, which they say is needed to overcome the human-centric nature of biomedical engineering where animal testing is a normative aspect that needs to be continually monitored and kept in check. To help students develop critical awareness of the discipline's professional norms, the authors describe a process wherein students, alongside harvesting animal tissue, view a video on animal euthanasia, then reflect in writing, and subsequently discuss their experiences and reflections in class. Reflection and discussion help students grapple with emotions encountered in a complex ethical and visceral experience. Interestingly, the quantitative instrument the researchers used did not detect an improvement in students' empathetic tendencies whereas qualitative assessment of student reflections *did* show positive change over time – as a result the researchers identified a human-centric bias within the quantitative instrument, which emphasised relationships between people and overlooked relationships between human and non-human beings. The ability to identify and

rectify this type of invisible and normative bias is what the researchers hope to cultivate in students. Like Martin et al. (Martin, Conlon, and Bowe 2021) and Lawlor (Lawlor 2021), Hess et al. aim to help students become critical thinkers, reflective practitioners, and advocates for change.

Giovanni Frigo, Florian Marthaler, Albert Albers, Sascha Ott and Rafaela Hillerbrand also emphasise the role of reflection in 'Training Responsible Engineers: Phronesis and the Role of Virtues in Teaching Engineering Ethics' (Frigo et al. 2021). Frigo et al. incorporate 'everyday wisdom', or phronesis, into a wide range of educational activities so that students learn to bridge social and technical issues – and build, reflect upon, and navigate their value systems. The authors provide an example case wherein students are supported in dealing with uncertainty and considering virtues in the process of product design/development. Frigo et al. recommend an integrated approach, wherein students learn to recognise, reflect upon and discuss ethics issues during the innovation/design process. This type of integrated approach involving complex decision-making (e.g. situated in the design studio), may prove more powerful and effective than teaching ethics in the stand-alone format most common across engineering curricula today. Focusing on virtues, these authors also recommend that educators focus increased attention on developing students' personal character and helping students learn to deal with uncertainty. The authors suggest 'that by integrating ethics into a practical lab course and intertwining the habituation of virtues with the practice of other central engineering skills, teachers may be better able to help prospective engineers understand that ethics is not separate from engineering practice, but an integral part of it as well as of their lives'. Like Lawlor (Lawlor 2021), Frigo et al. advocate delivering ethical and technical content together.

Similarly advocating an authentic approach to teaching ethics, Madeline Polmear, Anh D. Chau, and Denise R. Simmons (Polmear, Chau, and Simmons 2020) highlight the role that informal, out-of-class, or extra-curricular activities play in students' ethical development. Their analysis of student surveys, reported in 'Ethics as an Outcome of Out-of-class Engagement across Diverse Groups of Engineering Students', uncovered correlations between extra-curricular activities and learning ethics. Engagement in service and military activities were primary across the sample group, but *where* and *how* students perceived they had encountered ethics varied by race and ethnicity. As a result of analysis, the research team recommended making better and more purposeful use of extra-curricular activities in engineering, to help extend the benefits of formal education activities related to ethics. Informal activities help drive formal lessons home, increasing a student's interest and emotional engagement in moral reasoning. Because extra-curricular activities do not count towards accreditation, Polmear et al. point out, such activities have received little attention in the education literature. Yet encouraging students to participate can have multiple benefits. It is crucial for engineering to provide 'socialisation opportunities that establish a commitment to safety and welfare'. The activities students self-select beyond the classroom provide avenues for them to practice new skills and contextualise various abstract concepts they have learned. Educators can help make the most of these activities by providing input on extra-curricular offerings – to reach a wide variety of students and increase the impact of lessons and experiences involving moral reasoning.

Out-of-class learning was certainly important in developing ethical reasoning skills described by civil engineers who provided interviews for my own team's research study (Chance et al. 2021). In 'Above and Beyond: Ethics and Responsibility in Civil Engineering' we – Shannon Chance, Rob Lawlor, Inês Direito, and John Mitchell – asked civil engineers how they had learned about ethics and found that although lessons of codes and professional practice were likely present in their formal engineering curricula, they were unmemorable. Rather, they learned about global responsibility via extracurricular engagement, early employment activities, and preparations for Chartership. The nine London-based nine civil engineers we interviewed described making decisions related to 'global responsibility' daily, but they did not associate these decisions with the term 'ethics'. And although they saw protecting health and safety of individuals working on construction sites as a primary obligation of engineers, they perceived much less specificity and support (from clients, supervisors, and society) for protecting health, safety, and wellbeing of the environment and the public. The profession, it seems, has not specified clearly enough what it expects from individual engineers and engineering firms regarding social and environmental sustainability. This leaves an unreasonable onus on any individual who discovers a problem. Highlighting supports for whistleblowers could be one avenue for addressing problems. Providing clear definitions and measures (regarding, e.g. embodied carbon, impact on Sustainable Development Goals, greenwash versus truth in advertising) could also help. We recommend studying how, in the UK, job-site safety was improved dramatically and applying such techniques more broadly across engineering – so that protecting social and environmental sustainability become obligations of individuals as well as the engineering profession overall.

I hope that you enjoy reading and learning from the manuscripts in this collection, and that you discover new perspectives, provocative insights, and new ideas for implementation. I also hope you are inspired to generate new empirical research on engineering ethics education, and to attend REES. Finally, I would like to reiterate my thanks to the amazing and dedicated Associate Editors, peer reviewers, and REEN Board members who supported this project and helped see it to a successful completion.

Warm Regards,

Disclosure statement

No potential conflict of interest was reported by the author.

Notes on contributor

Shannon Chance, PhD, SFHEA, LEED-AP, is a Registered Architect holding Bachelor's and Master's degrees in Architecture from Virginia Tech and a PhD in Higher Education from William and Mary. She is Lecturer and Programme Chair (Honours BSc in Digital Construction) at Technological University Dublin. She is also a Visiting Professor at University College London, Chair of the Research in Engineering Education Network (REEN), and Associate Editor of*IEEE Transactions on Education*. In the past, she has served as Professor of Architecture in the USA, Fulbright Fellow to Ireland, and Marie Curie Research Fellow to both Ireland and the UK.

ORCID

Shannon Chance http://orcid.org/0000-0001-5598-7488

References

Chance, S., R. Lawlor, I. Direito, and J. Mitchell. 2021. "Above and Beyond: Ethics and Responsibility in Civil Engineering." *Australasian Journal of Engineering Education*. DOI: 10.1080/22054952.2021.1913882

Frigo, G., F. Marthaler, A. Albers, S. Ott, and R. Hillerbrand. 2021. "Training Responsible Engineers. Phronesis and the Role of Virtues in Teaching Engineering Ethics." *Australasian Journal of Engineering Education* 1–13. doi:10.1080/22054952.2021.1889086.

Gwynne-Evans, A. J., S. Junaid, and M. Chetty. 2021. "Repositioning Ethics at the Heart of Engineering Graduate Attributes." *Australasian Journal of Engineering Education*. DOI:

Hess, J. L., S. Miller, S. Higbee, G. A. Fore, and J. Wallace. 2020. "Empathy and Ethical Becoming in Biomedical Engineering Education: A Mixed Methods Study of an Animal Tissue Harvesting Laboratory." *Australasian Journal of Engineering Education* 1–11. doi:10.1080/22054952.2020.1796045.

Jeffrey Stransky, C. A., M. C. Bodnar, D. Anastasio, and D. Burkey. 2020. "Authentic Process Safety Decisions in an Engineering Ethics Context: Expression of Student Moral Development within Surveys and Immersive Environments." *Australasian Journal of Engineering Education*. doi:10.1080/22054952.2020.1809881.

Lawlor, R. 2021. "Teaching Engineering Ethics: A Dissenting Voice." *Australasian Journal of Engineering Education*. doi:10.1080/22054952.2021.1925404/TEEN-2020-0037

Martin, D. A., E. Conlon, and B. Bowe. 2019. "The Role of Role-play in Student Awareness of the Social Dimension of the Engineering Profession." *European Journal of Engineering Education* 44 (6): 882–905. doi:10.1080/03043797.2019.1624691.

Martin, D. A., E. Conlon, and B. Bowe. 2021. "Exploring the Use of Ethics Case Studies in Engineering Professional Formation Modules: The Case for Immersive Scenarios and Active Stakeholder Engagement." *Australasian Journal of Engineering Education*. DOI:

Polmear, M., A. D. Chau, and D. R. Simmons. 2020. "Ethics as an Outcome of Out-of-class Engagement across Diverse Groups of Engineering Students." *Australasian Journal of Engineering Education* 1–13. doi:10.1080/22054952.2020.1836752.

Sivaraman, M. A. F. 2021. "A 4-tier Rubric for Evaluating Engineering Students' Ethical Decision-making (EDM) Skills: EDM Model as A Tool for Analyzing and Assessing Ethical Reasoning." *Australasian Journal of Engineering Education* 1–16. doi:10.1080/22054952.2021.1909811.