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POLICY BRIEF

Social Justice through Engineering Education

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About this brief

This brief summarises the key findings and recommendations from an international research project on engineering education and its contribution to sustainable human development, which was carried out from 2013 to 2015 at the University of the Free State. The brief is intended for academics and researchers in the field of engineering education, as well as lecturers and students of any engineering discipline who are interested in the contribution engineering can make to a more socially just world.

Context

If one primarily defines well-being according to its economic dimension, it is easy (and appropriate) to evaluate the work engineers do as a contribution to human flourishing. This is because transforming natural resources into means of production for industrialization and expanding infrastructure or advancing technology, are all examples of engineering outcomes that are indispensable to economic development. However, if one looks at well-being from a human development perspective, engineers' contribution to development would be evaluated differently; according to the effective freedoms *all* people have to live lives that they regard as valuable.
However, transferring the benefits of technology to society is not a straightforward task. Engineers are mainly educated to view technology as a neutral but necessary tool for development. This distances them from making moral judgements about the artefacts they help create and implement, and whether or not they diminish or enhance effective freedoms for all people. This raises some important questions about engineering education and the opportunities available to engineering students to become critical, public-good engineers who orient their skills, knowledge and effective power to promoting social justice:

Firstly, with regard to the lives people can actually live, what opportunity does each engineering student have to explore connections between engineering and historical and contemporary inequities involving power, privilege, and material resources? Secondly, with regard to 'development' what effective opportunity does each engineering student have to:

- Unearth and interrogate assumptions about development?
- Engage in critical reflection and dialogue on competing notions of human progress?
- Explore power relations and their impact on development?

Finally, with regard to reasoned values, do engineering students have effective opportunities to:

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- Interrogate embedded economic and political values in the engineering curriculum?
- Critically reflect on the relationship between learning, values, and engineering functionings?

Based on the research findings, if these opportunities are not effectively available to each engineering student, then the potential for universities to develop students' capacities for public-good engineering, and the potential for engineering to advance social justice in society, is restricted. So what can universities do?

Recommendations

What universities ought to be doing?

1. Develop future engineers' agency to initiate, create and implement engineering solutions that are consistent with social justice values - whilst they navigate personal, environmental, and social constraints, and cope with the contradictions they are likely to encounter when they enter the workplace.
2. Enhancing students' sense of determination to be and do what they have reason to value in life as well as determine their roles in society.
3. Stimulating students' desire for knowledge and helping them recognise opportunities where they can successfully apply what they learn, in their work and in their lives.
4. Providing students with opportunities for research-based learning.
5. Providing students with the necessary knowledge and skills that they need to become public-good engineers and be employable.
6. Helping students recognise how technology is ultimately the articulation of a societal purpose and that it is not neutral or 'value-free'.
7. Assisting students to develop deep, meaningful and nuanced understandings of what engineers do and the complex relationship between this and the reduction, but also perpetuation, of inequalities in society.

What data are these recommendations based on?

Methodology

Qualitative research that combines the views and experiences of engineering employers (10), lecturers (10) and masters students (18) in Germany and South Africa was carried out drawing on semi-structured interviews and focus group discussions. Public engagement in the form of seminars with professional engineering bodies and international conference presentations also informed the data collection process and interpretation of the findings. A capabilities lens was applied to the concepts of development and sustainability, resulting in a more nuanced and freedom-oriented framing of what engineering education ought to be able to achieve if we assume that engineering is *for* development.

Key findings

What do engineering students value doing and being?

- Applying engineering knowledge to help solve problems and challenges associated with sustainable human development;
- Developing their sense of confidence and exercising individual and collective agency to advance social justice;
- Developing a sense of belonging with fellow engineers, and learning to persevere in the face of individual failure; and
- Being employable and having opportunities to apply professional engineering expertise in a wide range of contexts, industries, and job positions for the sake of the public good.

What kind of engineering promotes social justice?

Engineering that:

- increases effective freedoms and enables valued functionings for all, but particularly for poor and marginalised communities;
- meaningfully engages with communities to ensure that engineered artefacts benefit them in ways they have reason to value; and
- is not carried out with disregard to the natural environment and acknowledges the boundaries of human influence on it.

What contribution does engineering education make to social justice?

Engineering education can enlarge a wide range of capabilities and functionings that are valued by students and have different degrees of relevance for public-good engineering and hence, social justice. However, it does not always do so because of the emphasis on technical skills at the expense of transversal ones. Although technical excellence is a fundamental attribute of engineering graduates, critical thinking, open-mindedness, effective communication and collaboration, and a valuing of their public good contributions are also crucial. Developing students' confidence, resilience and agency is equally important if this to happen. Neglecting development in these areas is not in the best interest of producing sensible and compassionate public-good engineers who can exercise their agency in industry to promote social justice.

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