Australian Engineering Educators' Perceptions of Indigenous Cultures and Challenges of Minority Inclusion

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INTRODUCTION

In Australia, representation of Indigenous populations within the engineering profession is very low. Evidence suggests that understanding of the needs, values and priorities of Indigenous communities is low among engineers [1, 2], although this may be changing in particular industry sectors [2]. At present, individuals who identify as Aboriginal and/or Torres Strait Islander (Indigenous) make up around 3% of the total population. Yet in undergraduate engineering education programs, numbers of Indigenous students enrolling and completing remain well below this 3% parity figure. In industry overall, Indigenous people make up only 0.13% of all University qualified

engineers [3]. Commencing numbers of identified Indigenous students are usually in the single digits among cohorts of several hundred students. Enrollment numbers in fields such as health and education are closer, and in some cases at the parity figure of 3% of total enrollments [4].

Some of the challenges faced in Australian Indigenous inclusion are not unlike those apparent for other minority and non-traditional groups. These include first-in-family to attend university, a lack of role modeling, and identifying with the profession as a minority student. However, the unique history of Australia presents some broader sociopolitical challenges. European colonization of the Australian continent since 1788 resulted in widespread dispossession of lands for Indigenous peoples and decimation of societies through introduced disease and frontier conflict. Subsequent government policies framed around 'Aboriginal protection' also resulted in direct cultural oppression, forced relocation from traditional lands, segregation, and a widespread loss of language and autonomy. With Indigenous peoples only recognized as Australian Citizens in 1967, many of these oppressive and discriminatory government policies were in place until very recently. It is argued that some still remain today [5, 6]. Distrust of public institutions, social separation, socioeconomic disadvantage and racism remain widespread. The complexities around these issues are often poorly understood among the wider Australian society.

It has been suggested that the continuing low levels of participation of Australian Indigenous people in the engineering profession may stem from negative interactions between Indigenous traditional owner groups and the engineering industry [7]. There also continues to be a low level of knowledge of western engineering practices within Indigenous communities, and the differences in knowledge systems in Indigenous cultures [8-10]. Many programs have been established to improve awareness among Indigenous communities through outreach, education, and employment programs, though not always with due attention paid to differences in knowledge and value systems [11-13]. Progressing the Indigenous inclusion agenda within Australian Engineering Education requires a clearer understanding of the current status of efforts in this area, and in particular, the preparedness of engineering educators to manage increased numbers of students from this non-traditional cohort effectively.

This paper reports on a proposed pathway to effective integration of Aboriginal perspectives (including knowledge and value systems) in engineering education, and interview research exploring engineering educators' understandings of Australian Indigenous Culture, and their views on incorporating Indigenous perspectives. Ten engineering academics from around the country were interviewed on their experiences working with Indigenous people in professional, social and educational settings.

1 A Model for Integrating Aboriginal Perspectives into Engineering Curricula

The project that has produced the research in this paper began as an exploration of issues underpinning the low numbers of Indigenous engineers and engineering students. As the work progressed, it became evident that a more complex, and quite different, problem underlies this absence. This concerns the level of understanding about appropriate engagement with Indigenous communities, and an absence of published material regarding the knowledge and capabilities of Indigenous people in relation to engineering.

A major outcome of the project was the development of a model for guiding the embedding of the perspectives of Aboriginal students and communities [14]. The model, as presented in Figure 1, emphasises the importance of recognising lack of understanding of knowledge and perspectives relating to engineering between Aboriginal and non-aboriginal Australians. To challenge this, the model invites users to begin by shifting their perspective from thinking about Indigenous peoples in terms of disparity in social, health and educational indicators to engaging with their culture as an 'enduring civilisation' [15] having its own body of knowledge about such matters as engineering the landscape for an efficient and sustainable lifestyle [16, 17].

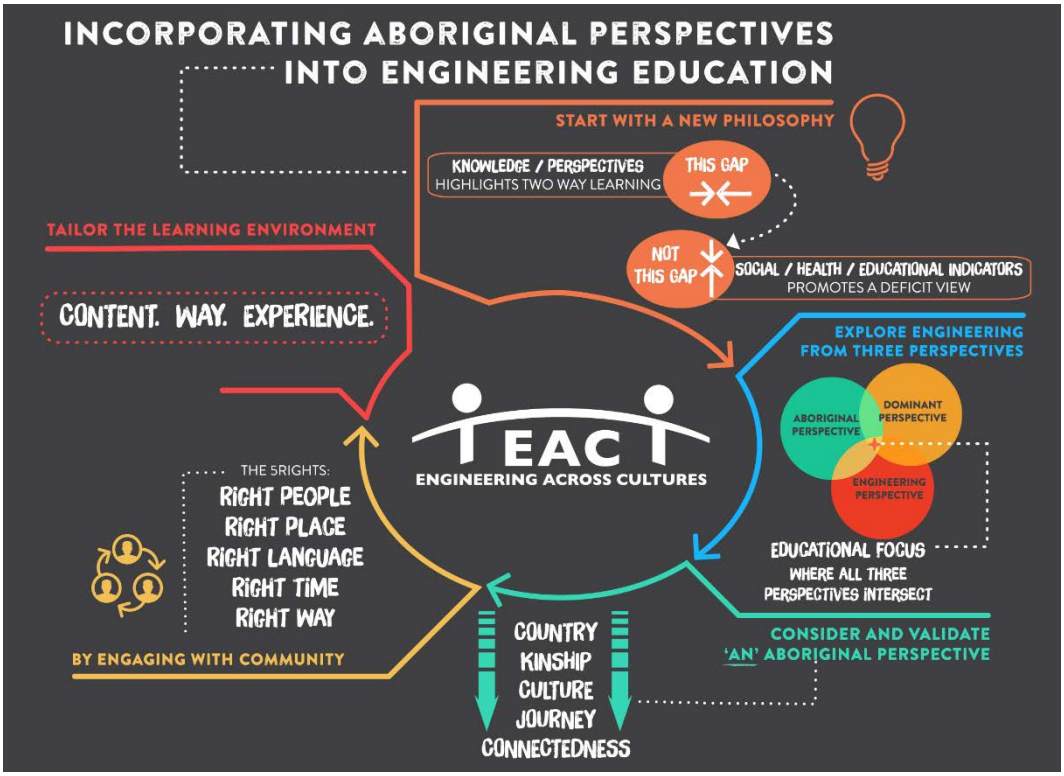

Figure 1 EAC Model

The first step involves coming to conversations with an acceptance that 'gaps' in knowledge are equally true of all parties. Little is published about pre or post-colonial Indigenous Australian engineering achievements, nor about what still might be known about such knowledges and their relevance to modern engineering practices. A key task at this moment, for all parties, therefore is to avoid falling into a 'deficit' view of Aboriginal engineering knowledge and capabilities. The weight of years of 'deficit-thinking' that is pervasive in Australian government policy may make this complicated, but it is essential for achieving progress through the ensuring collaborative process, as set out in the model. Possession of an equitable view makes it possible to explore 'engineering from three perspectives' as summarised in the Venn diagram. This invites consideration of 'education' as a place and time where the features of dominant (usually western) cultural perspectives, engineering perspectives and Aboriginal perspectives coincide, providing opportunities to explore ways of integrating Aboriginal contributions into engineering practices and engineered artefacts.

This, in turn, requires an awareness that Aboriginal perspectives in many cases involves an entirely different mindset and worldview. One such framework is offered

as a starting point and emphasises key issues of country, kinship, culture, journey and connectedness. For example, where dominant perspectives consider the 'land' as something to be owned and managed for human benefit, outcomes of negotiations on land use agreements with traditional Aboriginal custodians in mining and development projects frequently reveal an Aboriginal perspective on land that is much deeper and more interconnected, and not easily understood from a Western frame of reference. This is often referred to as 'Country'. The perspective represented in the model is emphasized as 'An', meaning the Aboriginal perspective, like any cultural perspective, differs across locations and needs to be identified and explored in context.

Exploring the Aboriginal perspective is a complex and sensitive process, where the forming and maintaining of relationships over time are critical. The model proposes a framework to guide this time and effort called the '5 rights'.

Learning who are the 'right' people to talk to is a critical step addressing the other factors that will ensure engagement is productive. This must be followed by engaging with community in the 'right' place, while using the 'right' language, which requires making the effort to listen and talk in a manner that is respectful of the community with which one is engaging. Timing is always an issue for engineers, and Aboriginal values placed on 'time' do not always sit easily with the tight schedules that engineers are comfortable. Engagement must expect elasticity in timescales, as the mutual learning that will occur is rarely appreciated in its scale at the outset.

Finally doing all this in the right 'way' involves a, sometimes intangible, process of doing things right, in a manner acceptable to the community. The research highlighted the fact that this is different in different communities and contexts, and will emerge through engagement, listening and continual reflection. The benefits of doing so are, however, worthwhile, as the research demonstrated in its approach to achieving student engagement with a local community to explore how to merge the apparently competing demands of engineering, Indigenous and local government requirements for a contested site [7].

For engineering educators this means that knowledge 'content' is only part the equation. Tailoring the learning environment to provide effective and relevant educational experiences for engineering students requires modelling of the 'right way' discovered through prior engagement with Aboriginal groups.

The above is an explanation of what the model is intended to represent. It is deliberately lacking specific detail as the learning and the value is in individuals following the path, building the relationships and the learning for themselves. The research team needed to understand if and how this was interpreted by the intended users, engineering academics. To do this an evaluation was undertaken of how engineering educators understand the model, and their base-level experiences with Indigenous communities and cultures…

2 Method

In December 2015 a workshop entitled *Shifting Perspectives – Changing direction. Integrating Aboriginal Engineering into Modern Engineering Curricula* was held at the annual Australasian Association for Engineering Education conference. 20 participants at the workshop indicated they would be willing to be interviewed. When contacted some time later, in February 2016, 10 of them agreed to an interview. These 10 represented all levels from Associate Dean Teaching and Learning to tutor and

included one person from outside the university sector. They came from ten different institutions around the country and had a variety of previous experience with Indigenous people or communities. All were non-Indigenous. The interviews began with an electronic 'pile sort' exercise where interviewees were asked to respond to sets of images on the basis of how relevant they were to considerations of "Aboriginal Perspectives" in engineering projects. Follow-up questions were used during and after this exercise with the following protocol as a guide, the intent behind each question is included in *italics*:

- What is your understanding of the term "Aboriginal perspectives"?
  Sets a baseline to understand the participant's level of understanding of Aboriginal cultures and heritage etc. Further prompts may include: Aboriginal culture/heritage/knowledge/politics/history.
- What do you see as the relationship between Aboriginal perspectives and your field of engineering?
  Seeks participant's understanding of current issues in relation to Aboriginal participation and interaction with the engineering profession. This may have been addressed during the pile sort.
- In the context of engineering education, what is your experience with Aboriginal perspectives?
  Seeks participant's experiences in education, curriculum design, engagement etc. This may have been addressed during the pile sort.
- How do you believe Aboriginal perspectives could be incorporated into engineering education?
  Seeks participant's opinions of Aboriginal perspectives in engineering curricula and what steps could or should be taken?

Finally, respondents were asked to walk though the project's proposed model (Figure 1), using this protocol:

- Please study the 'EAC' model, proposed as a strategy for incorporating Aboriginal perspectives in engineering education. Working your way around the cycle, please explain aloud your interpretation of each element of the model.

  Participants may need to be prompted as they work their way through the model to continue stating aloud their interpretations and understandings. This activity seeks to gather participants feedback on a model and evaluate its portability.

Interviews were analysed to the thematic level using the constant/comparative method. The research was approved by the University of Wollongong Human Research Ethics Committee.

3 Results

3.1 Pile Sort

The results of the pile sort showed that for most people (80-90%) mention of "Aboriginal perspectives" was associated in their minds with low socio-economic conditions, remote location, and traditional technology such a boomerangs. The one exception to this pattern was in the area of electronic technology. Most respondents (90%) expected Aboriginal people to have smart phones and 100% of respondents expected to see solar power facilities in Aboriginal settings. This last finding may be a result of the common association between "Aboriginal" and "remote". Some respondents noted existing connections with Aboriginal colleagues, friends, and

students living in major cities, yet still maintained a focus on remote Aboriginal communities.

3.2 Interviews

Social distance

The sense of what may be called social distance was also very evident in the interviews. Not only was the most immediate response to a mention of Aboriginal perspectives an assumption about remote locations, but every respondent expressed some degree of remoteness from Aboriginal issues when it came to incorporating them into the curriculum. This was true even for one respondent who had Aboriginal family members. That person could talk about the proper way to set up consultations with Aboriginal people but admitted that in their own teaching they used third party intermediaries (with mixed success) since “it’s hard to do when you don’t have the contacts yourself”. Herein lies the sense of distance. Members of mainstream society generally have very little contact with or understanding of Indigenous people. There is a tendency to assume that the problem is how to help Indigenous people fit into mainstream ways of doing things rather than asking what mainstream approaches might learn from Indigenous perspectives. As one respondent said “they have trouble fitting into global systems” and it’s our job to integrate ‘them’ better. Although one respondent could identify the need to align values between Indigenous and non-indigenous participants when carrying out projects in Indigenous Australia or introducing students to such projects, for most people the assumption was that engineering goals, ways of working and organisation were a given and Indigenous perspectives had to fit into university and disciplinary assumptions.

Curriculum Changes

Even where people were prepared to consider changes in the engineering curriculum this rarely went further than including some Indigenous content. Given the responses to the pile sort exercise it is no surprise that the kind of content envisaged included historical studies of remote or discarded lifestyles, or humanitarian engineering-type projects for remote communities. Eight out of the ten respondents briefly considered the use of an “indigenous project” in the curriculum but none of them felt that they could make the necessary contacts in an Aboriginal community to set up such a project. For most the solution would be to work through third parties such as the local Indigenous unit within their university or to use other people’s contacts. However, there was little enthusiasm for this approach, in some cases because of mixed success in the past and in others because they saw it as a lot more work which would be neither supported nor rewarded by their institution. One respondent questioned whether the aim was to broaden understanding of Aboriginal perspectives or to work with Aboriginal communities. If the former, some of the problems about having the right relationships disappear but, as several people remarked there was likely to be resistance to any shift in mainstream understandings – its ‘them’ who have to change, if only because the discipline is dominated by people who have no interest in or likelihood of working with Indigenous communities and their concerns.

Wider Applications

One respondent reported that their class was 95% Chinese students, who were felt to have limited awareness of and interest in Indigenous Australian matters. Several respondents separated exploration of Indigenous perspectives from broader issues of intercultural competence, though others noted it as a specific application of a broader

skill set. This suggests that the challenges associated with integrating Aboriginal perspectives are seen by some as only relevant to students likely to work with Aboriginal communities, and may not be transferrable to other national and international contexts.

Experiences and Relationships

Respondents also had varying knowledge of, and experience with, Aboriginal cultures. Experiences ranged from tourism to extended work within Aboriginal communities, however, how respondents described their level of knowledge appeared inconsistent with actual experience. Most participants stated a very low level of knowledge and experience.

All participants noted the importance of building relationships with Aboriginal people and communities as a way forward. The original hypothesis was that respondents with greater knowledge of or experience with Indigenous communities would have greater insights into how to incorporate Indigenous perspectives into engineering but this proved to be not exactly true. The two most experienced respondents in terms of personal contact with Indigenous people could appreciate that using third party intermediaries was not ideal, but they could offer no better solution. Another respondent with experience in an indigenous education unit readily identified that there is likely to be severe resistance to any attempt to reduce the social distance between Indigenous and non-indigenous worlds. Although they also said that working through Indigenous intermediaries to contact Indigenous communities was necessary, they also remarked that “you deal with resistance by naming it”.

Motivations

In terms of general motivations for why they were interested in this topic at all, most people were vague. Some saw it as a social justice issue, making the experience of engineering education more inclusive for some and more broadening for others. One said “Aboriginal heritage is an important part of Australia and we mustn’t forget it” as though Aboriginal people had somehow ceased to be. Another commented that a lot of non-Indigenous people felt uncomfortable about Australia’s post-contact history and current Aboriginal issues and ideas. They noted the complex history and current politics, and a desire to ‘help’ Aboriginal people. No-one discussed the potential for indigenous perspectives to add anything to engineering. This indicates a broad level of good-will among respondents, but a prevailing ‘deficit-view’ relating to addressing socio-economic disparities over two-way sharing of knowledge.

4 Discussion and Conclusion

The findings of this study shed light on the consequences of a historical disconnect between engineers and Indigenous Australia. Awareness of Indigenous cultures and history appears to be limited among engineering educators, although there is a level of good-will towards changing this. Of critical importance was the lack of long-term professional and/or personal relationships (with a few exceptions) between the engineering educators in this study and Indigenous Australians. Indigenous cultures are widely reported to place a high degree of importance on personal relationships and context-specific approaches to engagement [18-20]. This presents challenges moving forward as fundamental understandings of culture, history and politics, as well as connections between Indigenous communities and engineering schools and academics are basic at best, and at the individual level.

A key challenge lies at the first stage of the model presented in figure 1, 'Start with a new philosophy'. It was apparent that the understandings that do exist among most participants are focused on improving socio-economic conditions for Aboriginal people, without the recognition of how this may impact on current ways of doing, seeing and thinking in engineering. There is a significant focus currently on global competencies and the need to understand and appreciate other value systems and ways of working in overseas locations. This sets a precedent for reimagining current engineering practices with reference to Indigenous populations, however, recognition that different value systems exist domestically is needed.

The low representation of Indigenous people within engineering academia and Industry means that a concerted effort must be made to bridge the divide. Relationships, collaborations and policies that have been established in other fields where Indigenous representation is higher may serve as a template to be adapted to the engineering context. However, it is clear that a long-term commitment to Indigenous inclusion within Engineering education is required, and an understanding that there is much to be learned and understood about Indigenous culture, history and politics and their relationship to the field of engineering.

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