Evidence of intercultural competency from engineers without borders challenge projects

Pamela Abuodha
University of Wollongong, Wollongong, Australia
pamela_abuodha@uow.edu.au

Catherine Layton
University of Wollongong, Wollongong, Australia
catherine_layton@uow.edu.au

Thomas Goldfinch
University of Wollongong, Wollongong, Australia
tom_goldfinch@uow.edu.au

Abstract: *In 2010, the Faculty of Engineering at the University of Wollongong incorporated the Engineers Without Borders (EWB) Challenge into a first year design subject as a compulsory project. New tutorial activities and guest lecturers were incorporated into the subject to cover some of the broader aspects of culture and their impacts on engineering design as support to the EWB Challenge. Using NVivo to analyse a sample of students' EWB design reports, the authors then evaluated the extent to which students identified cultural issues associated with their EWB designs. This qualitative analysis coded relevant text in students' reports according to five dimensions of aboriginal culture, which are country, kinship, culture, journey and connectedness; and whether these references related to technical, social or cultural aspects of their design. The analysis found that the type of project students selected for their EWB challenge design was related to how deeply they considered cultural factors within the design. The research also indicated that the design groups' consideration of cultural factors was not necessarily reflected in their marks, or the tutors' recognition of the quality of their work. This finding has implications for assessment design where learning outcomes stipulate development of intercultural competency. Moreover this research suggests that, in setting engineering design tasks, the focus of the design project, i.e., the object or system to be designed, and not just the design context, needs to be carefully selected to maximize opportunities for students' development of intercultural competency.*

Introduction

Whilst it is increasingly important for engineers, like other professionals, to be aware of cultural differences and to interact effectively with people from other cultures (Liu, Chua and Stahl, 2010), engineers have long been stereotyped as socially inept and culturally ignorant (Goldfinch, Layton and McCarthy, 2010). In an attempt to remedy this situation, the Faculty of Engineering at the University of Wollongong incorporated the Engineers without Borders (EWB) challenge into a first year design subject, to investigate some of the broader aspects of culture and their impacts on engineering design and students' work which was started in 2009.

In 2010, the EWB challenge focused on sustainable development for the Kooma Traditional Owners Association Incorporated (KTOAI), supporting a remote Aboriginal community living in South-Western Queensland through the innovative application of engineering designs. Could we move students from a predominantly technical engineering focus to one that values and incorporates the knowledge amongst the local community and their culture? How might this be evident in students' work? These questions form the starting point of a study to evaluate and establish evidence for intercultural competency base standards among engineering students and their tutors at UoW.

Background

We were attempting to move first year engineering students across a presumed divide – from a focus on purely technical aspects of design work to recognising the importance of cultural constraints in business and community development projects alike. A recent definition of culture has it as a catch-all term representing influences from multiple sources, including the natural environment, 'socio-political factors (e.g. socio-cultural history, government and laws, religion, etc.) as well as familial and communal customs, norms, beliefs, opinions and rituals' (Masumoto, 2004, p. 276). What this means, in an everyday sense, is that "[…] we view the world through the lenses of our conceptions, interpreting and acting in accordance with our understanding of the world" (Pratt, 1992, 224) – and this can function both to advantage and to disadvantage us. To undertake the task, we focused on the notion of critical engagement, which has 3 key aspects: collaborative learning; the examination of power, how things come to be the way they are, and how to improve the situation for the most excluded; and interacting with communities in ways that emphasize self-determination, co-ownership of processes and outcomes, open participation and distributed leadership (Smyth, Angus, Down and McInerney, 2008, pp. 2-7).

Freire showed that people can be lifted out of seeing their situation as 'natural' and unchangeable, to engage in dialogue and actions that can change their world (Freire, 2007). McLaughlin and Whatman (2007) suggest there is a need to have students deconstruct their own cultural situatedness in order to appreciate the ways in which the "other" is framed, to recognise the complexities of interactions at the cultural interface, and to acquire cultural competencies (Goldfinch, Layton and McCarthy, 2010).

Deconstructing cultural situatedness is a process that can be seen to develop in stages as follows:
1. mindless adherence to one's own rules and traditions, not seeing there are differences;
2. recognising the differences, wanting to know more, and seeking simple rules of thumb;
3. seeing how others' norms and rules are comprehensible and even reasonable, and trying to behave appropriately;
4. assimilating; and
5. proactively supporting the other culture (Thomas & Inkson, 2003, p.68).

It is unlikely that a one-semester subject and a competitive project might take students beyond the third level, and this is the level at which our innovations were pitched.

Methodology

Our approach to examining whether students had been influenced by our innovations, and in what ways, was developed using an action research process. Action research is not a 'method' or 'procedure' for research, but a series of commitments to observe and problematise practice in the light of the principles of social enquiry (McTaggart, 1996, p. 248). It involves a cyclical process of observation, problem posing, data gathering, reflecting, planning and implementing actions – a search to improve practice rather than solve a problem.

The starting points were negotiations with the Subject Coordinator, a literature review, and the development of a framework for this teaching innovation. Then, the following innovations were made and monitored:

- new tutorial activities were developed for and incorporated in the first weeks of the subject (based on our theoretical premises);
- new ways of establishing the teams were introduced, to improve in-team collaboration and communication, monitored using SPARK^{PLUS};
- weekly team teaching meetings were used to brief tutors on, and discuss tutor and student responses to, the new material and approaches, with associated tutor guides; and
- an Aboriginal staff member accustomed to running highly successful Indigenous Awareness programs (Mr Jade Kennedy) was invited to present a guest lecture in the third week of the subject.

In July, 2010, some 8 tutors undertook a 3 hour workshop to develop their general tutoring skills and to raise their awareness of the importance of developing an inclusive learning environment. A second, subject-specific briefing provided them with an overview of the project, and tutorial guides and materials. The weekly briefings and debriefings provided us with informal feedback on the effectiveness of the approaches we were taking, with the formal evaluation of the impact of project being the examination of samples of students' final design reports.

356 students were enrolled in the subject. They worked in small, self-managed teams of 4, and also as part of a larger tutorial group team, to allow for the effective exchange of information and project enhancement. Submitted reports were marked by the tutors, with one top ranking report forwarded to the state level for EWB challenge. Samples of students' final design reports were assessed to identify any uptake of the ideas on culture contained in the tutorials, as well as in the online EWB support materials (Goldfinch, Layton and McCarthy, 2010).

Sampling and data analysis

Of the 90 reports submitted in total, 48 were available to the researchers for analysis from which 26 were selected on the basis of their themes and grades. The 48 reports were sorted into 6 themes, according to the focus of the students' projects, namely: accommodation; education; power management; water management; transport and information, communication and technology (ICT); and horticulture, food control and pest control. 13 top-ranked reports (the top report from each tutorial class, as judged by the tutor) were identified and placed in their respective themes. In themes where there were only few reports, e.g., education and horticulture, food control and pest control, all the reports were coded in NVivo. In other themes where there were many reports, e.g., water management and power management, half of the reports were coded.

Sample reports were examined to develop a preliminary list of codes (called 'nodes' in NVivo). These were: country, kinship, culture, journey, connectedness as well as community involvement, EWB, teamwork and technical issues. The first five codes were dimensions of Aboriginal culture presented in Jade Kennedy's lecture; the remainder related to the broader issues in which we were interested. We remained open to the possibility that other themes might emerge through the process of coding (Welsh, 2002). While these student reports were not considered private, care was taken to ensure students names were kept confidential beyond the research team. This approach was approved by the Human Research Ethics Committee at the University of Wollongong.

Findings

This study aimed to uncover whether, and in what ways, the teaching innovations might have influenced how students addressed the EWB challenge in 2010. We knew that the guest lecture had been extremely successful, with a full lecture theatre, and tutors and students spellbound by the unfamiliar world-view that was presented; that tutors appreciated the high levels of guidance inherent in the approach, although they had varied levels of comfort in using some of the less familiar teaching materials and working with unfamiliar ideas; that problems amongst team members were rare; and that students and tutors alike could see improvements in students' motivation and involvement. What we did not know was how and if this translated into their designs. The results of the analysis conducted to explore this point (using Nvivo 8) are reported here as percentages of text in the students' design reports devoted to a particular issue. The percentage figures represent how much of the content of a report, or group of reports discusses ideas related to the nodes outlined above: Culture, kinship, community involvement etc.

Students were provided with project topics by the EWB challenge, summarised above. The first three tutorials and one lecture in the design subject were specifically focused on cultural aspects of design. Given this, it is not surprising that the majority of students' report content, 60.9% on average from the sample of 26 analysed, focused on the technical issues that were the primary issue for the remainder of the subject, while only 7.8% referred to culture.

The report themes with the highest reference to technical issues were horticulture, food control and pest control (90.7%), followed by power management, (72.8%). Horticulture, food control and pest control barely referenced culture, only 0.4% of the report content discussed culture. Education based reports had the lowest reference to technical issues (35.1%), and the highest reference to culture (22.2%), community involvement (26.8%) and connectedness (17.5%).

The analysis indicates that the type of project students selected for their EWB challenge design was related to how deeply they considered cultural factors within the design. To help the reader appreciate to what extent the theme chosen actually affected students' cultural references, extracts from report abstracts are provided from two themes; horticulture and education:

Horticulture: '*Traditional Australia Regeneration Project (TARP) is a low cost, simple design concept that will assist the indigenous Kooma Nation to re-establish a sustainable biodiversity of indigenous native flora for a market garden, through the use of early stage hydroponic propagation. This report considers and evaluates three hydroponic propagation techniques: Nutrient Film Technique (NFT), Intermittent Nutrient Film Technique (INFT) and the Ebb and Flow Technique (EFT).*'

Education: '*[…] design a local Museum, which could provide jobs for locals, become a main form of education to both the children and adults living in Kooma, and would be an outward appearance of expression about their culture and their pride of it. It would also be an attractive tourist facility that would allow the locals of Kooma to engage and introduce their long-living culture and heritage to others that are not familiar with it*'.

The research also indicated that the design groups' consideration of cultural factors was not necessarily reflected in their marks, or the tutors' recognition of the quality of their work. At the end of semester, tutors were asked to forward what they regarded to be the best EWB challenge report for consideration by the subject lecturers. This selection was a judgement by the tutors and not necessarily depended on the final mark awarded for the report. Of the 13 top-ranking reports, 11 contained a high proportion of references (79.0% on average) to technical engineering aspects and few references (3.4% on average) to Aboriginal cultural aspects. In comparison, over a third of the other reports made relatively fewer references (48.1 %) to technical engineering aspects, and more than double the references (8.5%) to Aboriginal cultural aspects. Moreover, references to community involvement and connectedness were low in the highly ranked reports (6.3% and 1.1 %, respectively), as compared to higher values of these references in the other reports, 12.2% and 7.3%, respectively.

Discussion

This study forms part of a larger project aiming to establish baselines for intercultural competence education for engineering students. Other than stereotypes about incompetence, little is known about students' and tutors' starting points, nor yet about how best to integrate Graduate Qualities such as those associated with intercultural competence, in curricula. This study has shown that cultural awareness still remains a relatively new topic among engineering students and tutors, and that the approach taken needs further development and investigation.

The findings support the initial view that, although there is need to effectively communicate across cultures, this ability may be lacking among engineers (academics and students alike). The low percentage of references to culture in the reports examined (3-9%) could be attributed to several factors: the materials and timeframe themselves being an inadequate trigger for change; the tutors' lack of familiarity with, and capacity to effectively tutor, cross-cultural material; students' limited understanding of the demands; the demands of the EWB project itself not sufficiently targeting cultural issues; and assessment criteria at the local and national level that failed to adequately recognise cultural aspects of the designs.

The materials and timeframe: the materials aimed to help students practice adopting different perspectives, and were designed to elicit and explore cultural assumptions in a concrete and accessible way, but they were solely for the first three weeks of session. Integration across the session is likely to prove a more powerful and simultaneously sustainable approach.

Tutors' familiarity with cross-cultural work and/or Aboriginal culture: this aspect was not explicitly monitored in this study, but it was clear from our informal feedback sessions that most tutors had not had direct contact with Aboriginal culture. Moreover, because of many differences among the Aboriginal communities related to space and place in particular, one guest lecture is no substitute for direct contact with Kooma Traditional Owners. Also, there is a possibility that those marking the reports felt more confident about assessing technical aspects in largely technical projects.

Students' limited understanding of the demands: Students seem to have understood the demand the EWB imposed on them in terms of considering Aboriginal culture. The findings presented here shows the choice of theme may have played a role as to whether the students were able to adapt what they learnt from one cultural-based lecture and three tutorials into their EWB challenge projects. However, it is not clear whether the theme chosen led students to further consideration of cultural issues, or students' prior interest in cultural issues led them to consider a theme they could relate to culture more easily. Further investigation of the relationship between selected project themes and consideration of non-technical issues is needed,

EWB challenge insufficiently recognising the demands: One of the 4 aims of the EWB was to develop an appreciation of some of the complexities of working cross-culturally (EWB, 2010). 3 out of 21 (14.3%) judging criteria were related to working cross-culturally. With reference to culture having a weighting of only 14.3% of the students' assessment criteria, could this lead students to focus their effort more on the technical aspects of their projects at the expense of cultural issues?

Inadequate assessment criteria: It is possible that more marks were allocated for teams developing a sound innovative good piece of engineering work than was the case for engineering designs that took Aboriginal culture into account. Or perhaps the concept of culture was insufficiently integrated in the marking scheme for tutors to take this into account? This finding has implications for future assessments in this subject. The study suggests that our intervention had limitations that are being addressed in our approach to the 2011 EWB challenge.

Conclusion

This research has shown that students' choice of technical design focus is related to their consideration of issues around culture, community involvement and so on. In setting engineering design tasks to develop intercultural competency, the focus of the design project, i.e., the object or system to be designed, and not just the design context, needs to be carefully considered. The ultimate success of methods for achieving intercultural competency will depend both upon their integration across the whole subject at least, and in the longer term, across the full range of the engineering curriculum, from first to final year. It will also depend upon widespread acceptance among engineering educators of the importance of allocating assessment weighting and class time to intercultural awareness. At present certain factors may be limiting the chances of students integrating cultural issues in their report writing, predominantly in assessment as students will concentrate on what will earn them good marks. So developing acceptance among staff for the need for assessment to reflect the importance of intercultural competence will be a key factor in the successful integration of intercultural awareness in curricula. Despite the challenges, we believe that assessment that incorporates intercultural competence requirements is possible.

The findings presented here are preliminary, and merely provide a sketch of the innovations underway with first year engineering students and tutors in terms of intercultural competence. A better picture will be obtained by the end of the project in 2012, and disseminated to the engineering education community.

References

EWB (2010). *EWB Challenge*. Accessed at http://www.ewb.org.au/explore/initiatives/ewbchallenge on 15th April, 2011.

Freire, P. (2007). *Pedagogy of the Oppressed*. New York: Continuum.

Goldfinch, T., Layton, C., & McCarthy, T. (2010). Encouraging cultural awareness in engineering students. *Proceedings of the 2010 Australasian Association for Engineering Education (AAEE) Conference* (pp. 1-6), Sydney, NSW, Australia.
Holvikivi, J. (2007). Culture and cognition in information technology education. *European Journal of Engineering Education*, 32(1), 73-82.
Liu, L. A., Chua, C. H. & Stahl, G. K. (2010). Quality of Communication Experience: Definition, Measurement, and Implications for Intercultural Negotiations. *Journal of Applied Psychology*, 95(3), 469-487.
Matsumoto, D. (2004). Reflections on culture and competence. In R. J. Sterberg & E. L. Grigorenko (Eds.). *Culture and competence: contexts of life success.* Washington, DC: American Psychological Association, pp. 273-282.
McLaughlin, J. M., & Whatman, S. L. (2007). Embedding indigenous perspectives in university teaching and learning: lessons learnt and possibilities of reforming/decolonising curriculum. *In* 4th International Conference on Indigenous Education: Asia/Pacific, 19-22 July, Vancouver, Canada. 16 pp.
Thomas, D. C., & Inkson, K. (2004). *Cultural Intelligence: People Skills for Global Business*. San Francisco, CA: Berrett-Koehler.
McTaggart, R. (1996). Issues for participatory action researchers. In O. Zuber-Skerritt (Ed.). *New directions in action research*, pp. 243-255. London: Falmer Press.
Pratt, D. D. (1992). Conceptions of teaching. *Adult Education Quarterly* 42, 203-220.
Smyth, J., Angus, L., Down, B., & McInerney, P. (2008). *Critically engaged learning: connecting to young lives.* New York: Peter Lang.
Ward, C., Fischer, R., Lam, F. S. Z & Hall, L. (2009). The convergent, discriminant and incremental validity of scores on a self-report measure of cultural intelligence. *Educational and Psychological Measurement*, 69(1), 85-105.
Welsh, E. (2002). Dealing with data: Using NVivo in the qualitative data analysis process. *Qualitative Social Research*, 3(2), Art. 26. Accessed at http://www.qualitative-research.net/index.php/fqs/article/viewArticle/865/1880 on 15th April 2011.

Acknowledgements

Support for this work has been provided by the Australian Learning and Teaching Council Ltd, an initiative of the Australian Government Department of Education, Employment and Workplace Relations. The views expressed in this publication do not necessarily reflect the views of the Australian Learning and Teaching Council.

The Authors would also like to acknowledge the significant support contributions to this work by Jade Kennedy, Peter Wypych, Jayan S Vinod, the tutors of ENGG154, and the UoW Educational Strategic Development Fund (ESDF).