

Using the formal curriculum to build connections and confidence between engineering students from different cultural backgrounds

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***Abstract:** Preparing engineering students to work confidently in an international and multicultural context is challenging and complex. The global professional requires both technical and socio-cultural knowledge and skills. Meaningful learning experiences that build confidence and connections between culturally diverse students are essential learning for the global professional. Some of the literature suggests that having a sense of connectedness within the university environment may impact on whether an individual responds well to the challenge of intercultural engagement. This paper describes a curriculum intervention carried out on a highly technical third year engineering unit. The effectiveness of the intervention to enhance intercultural engagement between students from different cultural backgrounds is explored via the use of surveys and focus groups. This study provides some encouragement for ways to internationalise curriculum, but also highlights other challenges that impact on students' effective engagement in these activities. This paper would be of relevant to anyone interested in using the formal curriculum to engage students from different cultural backgrounds to work together.*

Introduction

The Engineering Profession as with other professional areas is facing continual change as a result of local and global demands. Engineers Australia's (EA) stage 1 competencies: PE 3.5 (d) "*Recognise the value of diversity, develop effective interpersonal and intercultural skills, and build network relationships that value and sustain a team ethic*", as well as the EA Graduate Attribute: "*ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams...*". The well recognized definition of internationalization of the curriculum by the Organisation for Economic Co-operation & Development (OECD) states: "*Curricula with an international orientation in context, aimed at preparing students for performing professionally/socially in an international and multicultural context, and designed for domestic students as well as foreign students.*"

There are fundamentals that are universal such as stated by Rhamdhani *et al* (2009) "*the practice of engineering may vary in relation to the environment in which the engineer finds him/herself working, which may affect the approaches taken for planning, design and construction to get optimal solutions*" Higher Educational institutions expect that the curriculum they offer will enhance the learning experience of all students regardless of their backgrounds, so that their graduates will be prepared for a global and local workforce. Swinburne University of Technology's 2015 Statement of Direction (2009) states that: "*staff and students will be ... international in their outlook..*", and that Swinburne graduates will be "*aware of local and international environments in which they will be contributing*" (e.g. socio-cultural, economic, natural), (Swinburne Attributes and Skills, 2009).

How might an intervention within an individual unit be designed to encourage authentic intercultural engagement that builds connections and confidence between students from different cultural backgrounds? According to Otten (2003), much effort is made to orientate and assimilate international students into the university environment; however local students also need opportunities to develop skills to engage better with students from different cultural backgrounds. Learning opportunities need to be devised within the curriculum, to encourage greater inter-cultural engagement between international and local students to broaden their experience and to build their intercultural

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communication skills. According to the work of Volet and Ang (1998) there are cultural-emotional reasons as to why students from different cultural backgrounds do not readily engage with each other. They suggest that for many students to be able to work together comfortably, they need to feel that they understand each other, share communication styles, commitments, expectations, work styles, a sense of humour and generally feeling comfortable working with each other. Volet and Ang identified that students often held negative stereotypes and ethnocentric views about those who were different to themselves, views that were not backed with actual experience, however these views were serious barriers to these students choosing to engage inter-culturally. More recently, Montgomery (2009) suggests that students are now more comfortable with diversity and expect to work in culturally diverse groups than perhaps they were in 1998 at the time of Volet and Ang's research.

Intercultural engagement between students according to Leask (2009), requires intentional planning, facilitation, encouragement and rewards. As with Volet and Ang, Leask also believes that there needs to be attention paid to how to best take advantage of the formal and informal curriculum to provide opportunities for culturally diverse students to engage meaningfully. Formal curriculum for the purpose of this paper means those learning activities that are designed and aligned with the assessments within the unit, and the informal curriculum refers to those activities outside the formal study program (orientation, camps, buddy systems). Leask also suggests assessment tasks need to be designed so that there are rewards (e.g. marks associated with the *process* of learning to engage cross-culturally) clearly rewarding students for efforts made to engage in the challenge of working cross-culturally. Montgomery (2009) suggests that students who have had previous international experience, e.g. having been geographically mobile, or born into or lived amongst culturally mixed communities, may be more comfortable, adaptable and open to working with people from different backgrounds. According to the 2010 Australasian Survey of Student Engagement (AuSSE) Report, opportunities for students to have interaction with staff and other students are critically linked to long term retention but also to engagement and ultimately academic achievement. According to the 2010 Ausse Report "...peer learning and connectedness increase student engagement."

This project confirms some of the findings from the more recent work of Montgomery (2009). Bennett (1998) provided a useful framework for the development of some of the survey questions with his Development Model for Intercultural Sensitivity (DMIS). According to the Bennett (1998) when dealing with cultural adaptation, the way individuals respond to working with people from different backgrounds is very much related to prior experience. This model (see Fig. 1) demonstrates the development from a very parochial ethno-centric view of the world that through experience can evolve to a more cosmopolitan or ethno-relative view of the world. Finally the work of Leask (2009) has provided a helpful framework for understanding some of the results of this study.

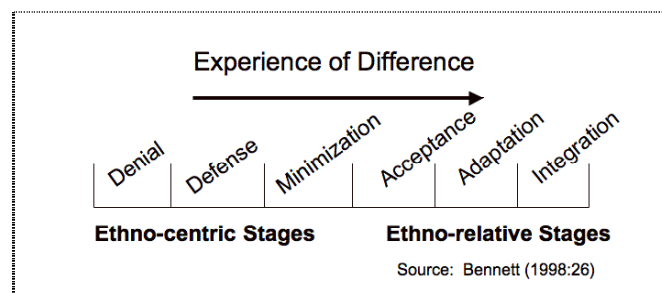


Fig. 1: Development Model of Intercultural Sensitivity (Bennett 1998)

Leask (2009) suggests four critical lessons learnt from introducing international perspectives summarised in Fig 2.

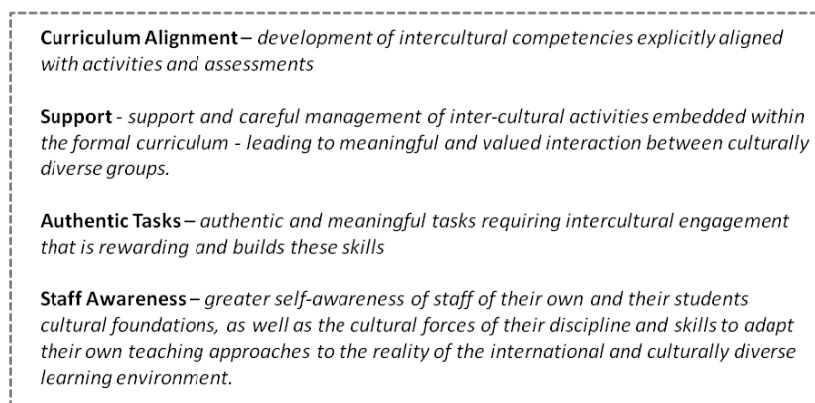


Fig. 2 Framework adapted from the work of Leask used for evaluating the project

The authors found the work of Leask (2009) and Bennett (1998) very helpful in considering the research question: *How might an intervention within an individual unit be designed to encourage authentic intercultural engagement that builds connections and confidence between students from different cultural backgrounds?*

This paper reports on an intervention that involved two iterations Phase 1 (2008) and Phase 2 (2009) and focuses on the formal curriculum, (part of the study program) rather than the informal curriculum, (outside the formal study program). The paper draws on data collected from two surveys (pre- and post intervention) and a follow-up focus group. The DMIS model based on the work of Bennett (1998) provided a basis for the survey and focus group questions. This paper will present results from the surveys and focus groups, to evaluate the effectiveness of the intervention to encourage students from different cultural backgrounds to build connections and confidence through working together on an engineering group project.

Context

The intervention involved a third year Thermodynamic/Heat Transfer unit which was part of the Bachelor of Engineering (Mechanical Engineering). Volet and Ang (1998) demonstrated that students prefer to work with people from a similar cultural background, often holding untested stereotypical assumptions about others from different backgrounds. They proved in their research that by placing students in culturally mixed groups, the experience has a potential to broaden experience and break down cultural stereotypes. In this highly technical unit, with a very diverse class of students, it was felt to be a good opportunity to place the students from a range of backgrounds into project groups, but also add an authentic real life engineering project that would require a range of knowledge from within the group, as experienced in the real world. The purpose of this project was to see if the experience would break down barriers, build connections and broadened perspectives by engage them in a common goal.

The students in the study were mostly male (98%) approximately 80% were local HECS students with a minority of international students (non-residents, full fee paying or exchange students). The project ran over two semesters: Phase 1 (2008) involved 112 students 87 of them were locals and 24 were internationals. Phase 2 (2009) involved 130 students, 104 locals and 26 international students. It should be noted at the outset that the local students in both phases were culturally and linguistically diverse. Students undertaking this unit were drawn from 2nd, 3rd and 4th year of the engineering program, so there was a range of technical knowledge, work experience, commitment, expectations and maturity levels combined with a range of cultural and linguistic backgrounds.

Method

The intervention was a 7 week group project, classes were randomly divided up into groups 4 to 5 students with at least one international student in each group. Project involved designing a sustainable system for delivering electricity to a small village (population of about 200) in two remote areas; one in Australia and another in an overseas location. Groups were required to research and compare the feasibility of a particular sustainable energy approach for each region. Groups were provided with a

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list of overseas locations to choose from e.g. China, India, Indonesia, Nepal, Hong Kong, USA, Thailand, Germany and Malaysia etc. These locations were based on the place of origin represented in the class and they were encouraged to consider the potential international knowledge that may be available within their group when making their choice. In the first phase (2008) the students were explicitly encouraged to consider the international student as a potential “international expert” this suggestion was removed in the second phase (2009). The Group Project Report included an Oral Report was expected to deliver an analysis of the applications and practices chosen for both locations, and needed to evidence consideration of socio-cultural, geographical and economic impacts in their research and recommendations. The rationale for the project was to encourage inter-cultural engagement between students, particularly valuing the diversity of the knowledge of the international students within the groups. Resources and supports (online and face to face) were put in place to assist with facilitating the challenge of group work.

There were important project design considerations that were needed when requiring students to work in culturally mixed groups as part of their assessment. Volet and Ang (1998) suggested that students prefer and choose to work with those they perceive as similar to themselves, therefore it was essential to have students randomly allocated into culturally mixed groups. The Convenor became quickly aware of the need to provide greater group work support than may otherwise have been required. The project task was designed to highlight the benefits of having a range of cultural knowledge and skills within a group, to encourage greater contribution and cooperation of all members of the group. Finally the assessment design of the project needed to reflect and reward the efforts required to work in the mixed group work.

In both phases, students were informed of the mixed group project worth 15%, and that it would run for 7 weeks. An important design change between Phase 1 (2008) to Phase 2 (2009) was to reduce the Group Report from 10 to 5 pages. The rationale for the shorter Group Report was to require greater synthesis and engagement between the group members to complete the final report.

Data Collection

For both phases, two surveys were distributed to students, Survey 1 (pre-intervention) in week two, and Survey 2 (and post-intervention) in week 10.

The initial survey invited students to reflect on their sense of being part of the university community, their perceptions of prior experience working with others from different cultural backgrounds, and how they saw how their profession fits with the global environment. The rationale for the initial survey was to ascertain individual perspectives on any prior experience working in culturally mixed groups and potentially how open they might be to work in culturally diverse groups. Using the experience of Volet and Ang (1998) questions were designed to identify how “welcome” and “valued” students reported they felt on campus, and whether they felt “connected” to the university. We also drew on the Bennett (1998) DMIS Model to design questions around a sense of self-awareness as to their openness and readiness to engage with people from different backgrounds.

At the conclusion of the group project, a second survey asked students to reflect on their experience of the group project, and whether they felt valued as a group member, how confident they were in working with people from different backgrounds. They were also asked to share whether they found the experience: interesting, useful, challenging and worthwhile for learning new skills. They were asked to reflect on any issues the mixed group project raised for them about the way they worked and communicated. There were open ended questions for them to share any issues and any opportunities they were aware of as a result of the project work.

Questions they were asked at the focus group expanded on what it meant to be valued in a formal class situation, how prepared they were to working with people from different backgrounds, and what had they learnt while working and studying relating to engaging with people who are different?

The focus groups for both phases were conducted by the non-teaching academic after completion of the final exam and prior to results. In Phase 1 (2008) there were 6 participants (one female) 3 local students and 3 international students. In the Phase 2 (2009) there were 5 participants (one female), 2 local students and 3 international students.

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Survey data was rudimentarily analysed using Excel, mainly looking for trends (percentages of agreement). Conclusions are based on reasonably small samples and the researchers intend to continue to collect further data in subsequent semesters.

Using the framework devised from the work of Leask (2009), the authors reviewed the qualitative data from the surveys and the focus group transcripts in terms of: curriculum alignment; support; authentic tasks; and staff awareness. The next section will provide details of the results from the two phases.

Results

The purpose of the first survey was to identify students' perspectives on how much they felt part of the Swinburne community (welcome, connected, valued etc.) and general awareness of global nature of the Engineering profession and also their prior or working in culturally mixed groups.

Table 1: Results from Survey 1, Preintervention Perceptions

I feel ...	2008 N=112 (87 Local, 25 International) (66 completed survey)		2009 N=130 (104 Local, 26 International) (57 completed survey)	
	International n = 12	Local n = 54	International n = 8	Local n = 49
welcome on the Swinburne campus	92%	76%	88%	90%
connected on the Swinburne campus	83%	57%	63%	61%
valued in class	67%	48%	25% *	54%
respected in class	58%	71%	63%	78%
part of the class	75%	62%	100%	78%
part of the community	46%	41%	25%**	48%
I am aware of how my profession fits within the global environment	66%	57%	62%	57%
Working in culturally mixed groups was...				
useful	75%	60%	63%	60%
interesting	75%	65%	63%	68%
challenging	67%	78%	75%	85%
worthwhile	58%	55%	57%	55%

* unsure 63%, ** unsure 50% (conducted in week 2)

Open ended comments collected suggested overall students were appreciative of past experiences of working in culturally mixed groups, however the usual difficulties experienced involved a lack of equity, dominating members and language issues.

The second survey conducted in week 10 post intervention was to identify how valued, confident students' felt working in the actual mixed group project, and whether the group project raised their awareness about their inter-cultural communication skills.

Table 2: Results from Survey 2 Post-intervention Perceptions

As a result of the group project:	2008 N=112 (87 Local, 25 International) (40 completed survey)		2009 N=130 (104 Local, 26 International) (32 completed survey)	
	International n = 11	Local n = 29	International n = 6	Local n = 28
I feel my knowledge is valued by the group.	64%	68%	66.7%	92.3%
I feel confident working/studying with people from different backgrounds.	36%*	36%**	100%	61.5%
I feel encouraged to work/study with people from different backgrounds	36%	11%***	60%	34.6%
I need to learn more about inter-cultural communication	55%	59%	66.7%	73.1%

* unsure 27%, ** unsure 21% ***31% unsure (conducted in week 10)

Open ended comments on group work issues related to unreliability, lack of shared commitment, inequitable workloads and lack of structure, while what worked well related to the way the groups co-

Salehi *et al.*, Using the formal curriculum to build connections and confidence between engineering students from different cultural backgrounds operated, the “international expert” (2008) was appreciated by some and problematic for others (and as a result of feedback in Phase 1, this discarded in the Phase 2). Other comments related to the design of the actual project and the level of support provided

Results from focus groups

Students’ perceptions of feeling connected and valued were explored in more depth in the focus groups at the end of the project for both 2008 and 2009. Students were asked to comment on the effectiveness of the design of the project to encourage deeper intercultural connections and engagement between students. In 2008 the cultural aspect was made more explicit in the project design, suggesting that each group would have a potential “cultural expert” that they could draw on. For some students this was regarded as a bonus, for others it was not very realistic and a negative factor. In both focus groups 2008 and 2009, students were expressed enthusiastic at the opportunities of having to work in the culturally mixed groups, students actually expressed that it broadened their friendship groups with people they would not have otherwise have mixed with. Interestingly when the design of the project was changed for 2009 by removing any reference to suggestions of having a “cultural expert” within the group, students seemed more positive about the project. In 2008, an international students suggested he felt under a lot of pressure to be the “cultural expert” however in 2009, it was not the case. International students enjoyed the opportunity of sharing information about their home country, and in one case an international student learnt more about his own country of origin as a result of the project.

Discussion

Looking at the results of Survey 1, being “valued in class” and “being part of a community” was low, but particularly low for the international students in 2009. During 2009 international students were in the spotlight particularly related to security issues, high numbers coming from particular countries, changes to permanent residency rules, and this was during the Global Financial Crises. Any of these may have contributed to international students feeling less valued and less connected. (67% in 2008 down to 25% in 2009) feeling “part of the community” was also showing a drop from 46% to 25%. Contrasted to this however, international student seemed to feel “respected in class”, feeling “part of the class” scored higher in 2009 100% compared with 2008 75%. The authors are well aware these are different cohorts and cannot be directly compared and the numbers are small for any definite conclusions.

Most students reported in Survey 1 that they found working in culturally mixed groups challenging. The benefits suggested it helped them to adapt to different ideas and perspectives, to bridge cultural gaps and to develop their communication skills. Difficulties identified were communication issues, language skills, and cultural differences including work styles and commitment levels. International students expressed particularly that they wanted opportunities to work with local students.

The second survey provided some encouragement to the researchers that this project was helpful in broadening student perspectives, a local student was quite positive suggesting “*like I remember first year for instance we didn’t really have this sort of thing... and in final years you look at the world quite differently where it changes you because you are exposed to so many different things...*” (2008-02). Another local student suggested “*gives you a better cross section of what you are going to be working with industry...working with people from anywhere, all different age groups, all different backgrounds so it is definitely useful.*” (2009-02) An international student appreciated the experience reflecting: “*more efficient ways than we do back home..(laughs)..even when we look at sports...so we have a chance to work with people ...see how they perform...make it easier when we move on to the industry.. easier to adjust..*” (2009-04) and another international student “*the group projects are good for making friends and stuff*” (2009-02).

A framework based on the work of Leask (2009), was devised to evaluate the effectiveness of the mixed group project to guide future development of the project.

Curriculum Alignment – *Did the structure of the intervention support the development of intercultural competencies as reflected in the student feedback:*

Students were asked if the experience had broadened their cultural and international perspectives and if there were any other benefits. As with the findings of Volet and Ang (1998) some students valued the opportunity it presented, while others were not so positive. In 2008, some students were not

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impressed that they were being required with international students, seeing the work as irrelevant and disadvantaging their academic outcomes as reflected by this student *"Forcing this particular student to be the 'expert' in their country assumes they are more competent in explaining cultural aspects from their own perspective and also assumes they possess some communication skills in the English language."* (2008-33) By making the "cultural" aspect less explicit in Phase 2, students' comments usually related to difficulties working in groups such as differences in commitments, time management etc. however this local student commented *"I would rather choose who I worked with in the group projects. However can see the benefits of this arrangement."* (2009-07) and another student commented that project was *"a very good learning experience. Also is relevant and novel topic"* (2009-02). This unexpected finding confirmed research provided by Montgomery (2009), that these days, students expect to work in culturally diverse groups, and that group work difficulties were less about cultural difficulties and more about work styles, different motivations and expectations. In summary, the benefits identified by students over the two phases as a result of the mixed group project were related to getting a range of experiences, and sharing the work, learning about other cultures and developing their communications skills. There also seemed to be a recognition that while it was difficult working cross-culturally, it was worthwhile as suggested by this local student *"made sense to bring people of different backgrounds (together) and get them talking about different ideas.."* (2008-041) and another local student responded that *"...I have found these experiences to be very challenging but rewarding"* (2009-030).

Support – *Was the support provided to student groups adequate for the challenge of working in culturally mixed groups:*

Support to manage the language and cultural issues may be a factor that needs to be addressed as evidenced by the issues shared in the focus groups. Common barriers to deeper engagement and connections were related to language and cultural difficulties as suggested by this international student commenting on local students *"they haven't experienced those sorts of cultures and don't know how to approach them"*(2008-05) another international student commented *"I don't speak English fluently I see the problem, I could see what was going on...English is an isolator in the relationship"*(2008-05) and another international student commented on a similar difficulty *"English can bring relationship gaps too. Many times I saw people miss-communicate with each other, there is always a gap especially due to English"*(2008-04). In the 2009 focus group, language and cultural aspects were less of an issue but rather the issue of structuring and managing the group work. An international student reflected on a lack of feeling connected, *"one thing I was missing .. is that back in Malaysia we had a lot more interaction with our colleagues, over here it is a bit less"* (2009-04) and another statement by this international student *"... same authority no one can rule between the group.. like with the members we are all the same in the group .. even the group leader does not have any authority to do anything, so if you have a dysfunctional group member there is nothing you can do about it, it is just the way it is.."* (2009-03). This suggests that for such projects to be even more successful, intensive support may improve the student outcomes and experience. By assisting students to manage their group work more effectively combined with the added complexity of working cross-culturally will require greater cultural skills and attention by teaching staff.

Authentic Tasks – *Was the task combined with working cross-culturally engaging enough to be meaningful and rewarding learning experience?*

This needs further investigation; however there is early evidence that students did find the task engaging, and the group experience rewarding. Particularly this came out in the focus groups when this international student commented: *"I had to learn something totally something new, ... from my own country which is about Sri Lanka and Australia, I came to know a lot of things in Sri Lanka that before I did not know.."* (2009-04)

Staff Awareness – *Was there evidence that staff were aware of the needs of students working in the culturally mixed teams and able to have adapted their teaching approaches to the challenge of the mixed group project:*

Again this is an area that needs further research. The Convenor is aware of the need to further develop the skills of the tutors to assist them to be better prepared to work with the complexity of problems experienced by the groups. This is another area to be further developed in future.

Conclusion

International students are already immersed in an international experience by coming to Australia. It is only when faced with working with culturally and linguistically diverse others, do students have opportunities to broaden their perspectives and develop more sophisticated intercultural communication skills. Local students are already a culturally and linguistically diverse group; however they are not naturally taking up the valuable opportunities of making connections with international students. Often local and international students co-exist in the same space but are not connecting with each other. By embedding authentic tasks that involve local and global environments combined with ensuring a cultural mix of students within groups, the learning opportunities may be broadened within the formal curriculum. In order to move the rhetoric into a reality, that we are preparing all students for working confidently and capably in a multicultural and international environment, these kinds of activities need to be developed within the curriculum. It is clear from the feedback that many of our students have appreciated the benefits and challenges of working cross-culturally. What has been learnt is that it is well known that group work is difficult, however having the added layer of cultural and linguistic differences creates even greater challenges and complexity and needs to be well supported. The formal curriculum needs to create an environment that encourages the development of capabilities for a changing world. It appears that if this is in place, and teaching staff are adequately prepared to support the process, students can build positive connections and confidence for working in a culturally and linguistically diverse environment. Planning for the next iteration will involve greater emphasis on group work skills, and also enhanced professional development for local tutors supporting and managing the culturally mixed groups.

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