Internationalisation of Technology and Society Course at University of Southern Queensland

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Abstract

There is growing interest among engineering educators in the question of internationalisation of engineering courses. In this paper the authors first present an analysis of the factors that may cause course designers to internationalise their course material. It is then demonstrated how those factors have influenced the design and delivery of one of the courses offered by the faculty of Engineering and Surveying at the University of Southern Queensland (USQ). Details of the student profiles and general student feedback on the course are also included. The proportion of off-campus students from South East Asia is very significant.

Technology and Society is a one-semester course that deals with a range of topics in the management of the interface between engineers and the rest of society. It meets the requirement from Engineers Australia that engineering graduates, among other things, should have an understanding of social, cultural, economic and environmental responsibilities of the professional engineer in both a local and global context. All engineering students at USQ take it, normally in the second year of their program. As USQ offers this course both in Australia and overseas, it is important to make the course as international as possible.

The paper argues that that whilst some of the factors lead unquestionably to globalisation of the curriculum, there are others that would lead to localisation of the curriculum. It reviews the process of internationalisation of the course and concludes with a summary of the authors' experiences with internationalisation so far and some predictions on likely scenarios and outcomes.

Introduction

Throughout human history engineering skills and knowledge have crossed geopolitical borders and have been adapted to suit local conditions. This is, in essence, the process and result of the internationalisation of engineering. Internationalisation is now promoted at all organizational levels because of the substantial benefits that it promises to all those who are involved. For example the UNESCO supported International Centre for Engineering Education (USICEE) fosters co-operation among academic organizations worldwide. Their aim is to get those involved to share experiences and break down cross-cultural barriers thereby promoting international trade, goodwill, peace and development[1]. Another example of internationalisation at the highest level is the Washington Accord[2]. This deals with the specific issue of international recognition of academic degrees and diplomas. The internationalisation process is also facilitated by the work of international engineering societies through their publications and conferences.

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Increased globalisation over the last few decades has meant that engineers are more likely than ever to work in countries other than their own or work within international teams. As a result many engineering educators have recognised the need for some international experience to be included in engineering curricula[3]. Jones and Oberst provide a progress report on programs that have already been implemented to integrate international experience into undergraduate engineering education in the United States[4]. On the other hand globalisation has also led to very significant increases in the number of students who enrol in overseas programs in engineering. These students are normally full-fee paying and they study either on-campus or by distance learning. A number of authors have emphasised the importance of engineering faculty administrators and engineering educators informing themselves about the educational background, cultural background and learning styles of overseas students. In other words some amount of trans-national competency should be a prerequisite. Sharda[5] recommends that those negotiating with overseas partners for twinning arrangements must have a good understanding of the other country's educational system and equivalence of qualifications. Parsons and Dowling[6] suggest that staff should move beyond attributing failure rates among overseas students to the simple theory of students "deficiency" and should experiment with ways to improve their teaching.

It is evident that the concept of internationalisation of engineering education encompasses a number of inter-related issues including international recognition of qualifications, training of faculty administrative and teaching staff and curriculum development. The focus of this paper, however, is on how the process of internationalisation is influencing the content and delivery of the *Technology and Society* course. This course is part of all undergraduate programs offered by the Faculty of Engineering and Surveying (FOES) at the University of Southern Queensland (USQ). The next section of this paper elaborates on the reasons behind the internationalisation of engineering courses and programs. This is followed by a description of the content of the *Technology and Society* course and the strategies that have been adopted for its internationalisation.

Incentives behind Internationalisation

A reasonable hypothesis would be that the internationalisation of engineering academic programs is carried out because those who are promoting or are doing it feel that there are benefits to be gained for their students, their institution, or themselves.

Benefits to students would be the acquisition of trans-national competencies that would help boost their confidence and improve their career prospects both within local and international job markets. There is even a strong argument to support the idea that, with increased globalisation, engineering educators have the responsibility to ensure that programs are specifically designed to facilitate development of those competencies. Students graduating without a minimum level of trans-national competency could be disadvantaged, at least in the short term. Whilst globalisation can open up overseas job markets for local graduates, it may also allow overseas graduates to compete for local jobs or there may be an outflow of jobs to other countries.

In the 2003/2004 financial year Australian education exports was valued at $5.63 billion[7]. Education is Australia's third largest service export and the eighth overall. Many Australian universities rely heavily on overseas full-fee paying students for their financial viability. In the last decade these institutions have put significant effort towards increasing their share of the education export market. Internationalisation strategies are very often specifically developed to improve competitiveness. Initiatives to facilitate internationalisation at USQ include:

- setting up appropriate hardware and software platforms to enhance flexibility in delivery of courses. This allows, for example, on-line discussion and prompt access to electronic versions of course materials by distance mode students.

- training of staff so that prior learning is recognised and exemption claims from prospective students with overseas qualifications are carefully, but effectively processed.

- allowing flexibility in course calendars. For example assignment deadlines for overseas distance mode students are automatically adjusted to account for their local public holidays.

- setting up of a trans-national pedagogy task force. This is a group of about ten academics drawn from all faculties, looking into the question of generic learning and teaching processes that would be appropriate to trans-national education.

It appears that there are three possible reasons that could lead to the internationalising of engineering programs and the way they are delivered or administered. The first one is academic in nature and it is a reflection of the engineering educator's responsibility to facilitate the development of graduate competencies that are trans-national while not ignoring requirements that are specific to the needs of the student's local community. This first reason affects academic content and not necessarily the way it is delivered. The second reason is commercial and stems from the institution's objective of maintaining or improving its overseas student market share. While it does not affect academic objectives, it provides incentives for flexibility in course delivery and student administration. The third reason is pedagogical and its basis is the engineering educator's recognition that teaching processes may need adaptation to suit the diversity of social and educational backgrounds of the student population.

The 'Technology and Society' Course

In 2000 the Faculty of Engineering and Surveying at USQ went through a major revision of its programs. The new programs that were to be offered from 2002 onwards were designed to be in accordance with the graduate attributes specified by Engineers Australia[8]. All programs were to incorporate the *Technology and Society* course whose objectives, to a large extent, relate to the following graduate attribute:

> *"Graduates have to demonstrate that they have, to a substantial degree, an understanding of the social, cultural, economic and environmental responsibilities of a professional engineer in both a local and global context".*

The content of the course is summarised in table 1 which also gives the nominal allocated study time for each topic. The course is run by a multidisciplinary team with members drawn from the Faculty of Arts (FoA), the Faculty of Business (FoB) and the Faculty of Engineering and Surveying (FoES). The two FoA team members are responsible for topics 6 and 7 in table 1. The four FoB members are responsible for topics 4, 5 and 8. The four FoES members are responsible for the remaining topics. The team leader is from FoES. Individual team members put together the teaching material for their allocated topic and give the associated scheduled lectures to on-campus students. The course runs over one semester and two hours of lecture are scheduled per week. Distance-mode students supplement the printed study material they receive with additional teaching material they can access through the course website. This includes lecture slides and tutorial discussion papers. All teaching team members have access to and can participate in on-line discussion involving both on-campus and distance mode students.

Table 1: 'Technology and Society' course content

Topic (approx study time, hours)	**Content**
1. History of Technology(15)	Drivers of technological development during different periods and within different communities; Benefits and risks of technological development
2. Sustainability (15)	Ecosystem models; Definitions of Sustainability.
3. Environmental Impact (15)	Environmental Impact Assessment.
4. Politics (15)	Definition of politics; Models of government; Relevance of politics to engineers and surveyors.
5. The Economy (30)	Demand and supply; Microeconomic and macroeconomic models; Cost-benefit analysis; Globalisation;
6. Models of Society (15)	Reductionist and systems models of society; Concepts of rules and roles to explain social interactions and behaviour; Positioning theory as an interactionist model of social behaviour; Position of engineer in society; Social consequences of large scale technologies.
7. Cultural Impacts on Engineering and Surveying Practice (15)	Traditional and wider definition of culture; Importance of cultural literacy to engineers and surveyors; Strategies for successful trans-cultural engagement.
8.The Legal Framework (15)	Origin of the law; Precedent; Statutory interpretation; International law; Relevance of the law to engineers and surveyors; The rule of law.
9. Management Concepts (15)	Models of management; Project planning; Management systems and standards; Marketing; Production systems.

The obvious difficulties with a course like *Technology and Society* are that:

- Its relevance to engineering (or surveying) may not be obvious to students.
- It can be perceived as being fragmented.
- Students may feel uncomfortable with its analytical dimension because it is not based on the kind clear-cut assumptions and mathematics that they come across in their normal specialist courses.
- They may even fail to see any analytical dimension in the course and therefore also fail in the development of critical thinking skills, which is an important objective of the course.

The following steps were taken to overcome those difficulties:

- The course is supported by a number of case studies that put emphasis on the social dimensions of engineering and surveying.
- Before any study materials were written, the course leader organised several meetings attended by all team members. This ensured that, before they started writing, all writers had adequate understanding of all the course objectives and were aware of what other writers were going to cover. Team members continue to meet regularly.
- It is emphasised that models form part of most if not all the topics covered. In other words modelling can be seen as one of the common threads that run throughout the course.
- Students are made aware of the fact that, unlike what they are used to in their specialist courses, there are no clear-cut answers to important questions that arise in a course like *Technology and Society.* Although models can be used to address those questions, the models are based on assumptions that cannot go unquestioned. Throughout the course, students are reminded that they have the responsibility to support their opinion on a particular question by arguments that are convincing to their audience.
- While course material is written and lectures are delivered by discipline experts from three faculties, tutorials are run mostly by non-experts from the Faculty of Engineering and Surveying. The tutors are very familiar with the whole course; they attend all lectures, and relate very well to the students because they are themselves engineers or surveyors.
- Only the course leader is responsible for course assessment, which consists of a three-hour examination and two assignments. The marking criteria for all the assignment exercises and at least for some of the examination questions are such that students are unlikely to pass if their work is mostly narrative. Students are encouraged to think critically and to demonstrate that by writing reflectively.

International Aspects of the Course

As the *Technology and Society* course is aimed at engineers both in Australia and overseas, it incorporates a number of international features, which give it global application and at the same time make it relevant at the local level for all students.

As outlined above, the course is underpinned by an extensive discussion of models – a concept familiar to the engineer. Models are introduced through a discussion of physical science and engineering models (such as electric circuit models), which are partial representations of physical systems. This is a concept familiar to engineers. The principle of using simplified models to

represent the key aspects of complex systems is then extended to models of society and the role of the individual engineer in that society. Models are subsequently used in the course to illustrate and explain topics as diverse as the global ecosystem, political systems, economic concepts, society and management systems.

While the models used may not always be universally applicable to all nations or cultures, the physical science model analogy makes it easier for engineers of all backgrounds, nationality and cultures to understand the interaction between technology and their own society.

There are also a number of features of the course that are applicable to both global and local aspects of engineering. These include:

- A global history of technology. Although this has some Australian examples, it is global in its extent and can be applied to many local contexts.
- The modules on sustainability and environmental impact assessment are written from a global perspective, with local implications.
- The module on politics and power is written from a global perspective, but has many examples which can be applied in local situations.
- Globalisation (including its impacts on local economies) is discussed in the economics module, which also discusses generally accepted theories of microeconomics and macroeconomics. Some Australian examples are used, but in a global context.
- The module on cultural impacts on engineering practice is written to assist engineers manage their role in both multicultural communities and teams consisting of diverse groups of professionals.
- There are a number of global considerations in the module on models of society.
- The material on management concepts considers universally accepted models of management as well as international concepts, like quality management systems (ISO 9000 series), with which students can quickly relate in their local environment.

However, not all aspects of the course meet the needs of all societies. One particular module in which this does not occur is that on the legal framework, which because of the vast range of legal systems has of necessity used the Australian legal system as examples of key legal concepts like the rule of precedent and statutory interpretation.

Experiences with Offering 'Technology and Society'

The *Technology and Society* course is typically offered twice each year, in the first semester (March to June) and the third or summer semester (November to February). The course has been offered in Semester 1 since inception. The first Semester 3 offer was in 2003.

Table 2 shows some key statistics for this course over the four most recent semesters of offer. The enrolment figures in Table 2 show that since the offer of a Semester 3 course enrolments previously concentrated in Semester 1 are now spread over two semesters in each year, and are levelling to between about 200 and 250 per semester. The first semester offering is divided in approximately equal proportions between on-campus students and distance students. All students in the third semester study by distance education.

Table 2: Sample Statistics for 'Technology and Society' Course

Offer	Semester 3 2003	Semester 1 2004	Semester 3 2004	Semester 1 2005
Total enrolments (external)	276	215	256	117
Total enrolments (on-campus)	0	139	0	101
International external students	206	53	119	25
International on-campus students	0	33	0	26
Proportion of International Students	74.6%	24.3%	46.5%	23.4%
Attrition rate	17.0%	17.2%	20.7%	16.5%
No. of all students passing	148 (53.6%)	245 (69.2%) [a]	146 (57.0%) [a]	Not yet available
No. of international students passing	105 (51.0%)	55 (63.9%) [a]	65 (54.6%) [a]	Not yet available
No. of all students with high grades[b]	35 (12.7%)	44 (12.4%)	54 (21.5%)	Not yet available
No. of international students with high grades[b]	23 (11.2%)	8 (9.3%)	14 (11.8%)	Not yet available

Notes to Table 2:

a. Number of students passing in Semesters 1 and 3 2004 includes allowance for students awarded supplementary examinations/make-up work (assessed at 56% chance of passing when they complete the work set), who have not yet completed these tasks.
b. "High grades" are the equivalent of Distinction and High Distinction.

Key points from Table 2 are:

- Distance education students are divided into Australian domestic students and international students. A number of international students enrol through agencies. They are between about 25% and 50% of students.
- Over the semester, typically 15% to 20% of students drop out of the course.
- Pass rates vary between about 50% and 70%. This includes the students dropping out of the course. Of those who complete the course, there is a higher pass rate - typically 65% passing outright. A further 10% of students are offered supplementary or make-up examinations. The main reason for failure is non- participation in assessment activities.

- There is a very high proportion of international students (45% or higher) in Semester 3. The proportion of international students in Semester 1 tends to be less than 25%.
- Pass rates for international students are lower than for Australian domestic students (ranging between 2.4% and 5.3% lower).
- A lower proportion of international students achieved high grades (Distinction or High Distinction) than Australian students. This disparity appears to be increasing.

In summary, this table notes that international students are not achieving as highly as Australian students in key performance indicators. While this could be partly due to language difficulties, cultural differences are likely to play a key role. This is supported by recent course evaluation surveys by the current course leader. While the main thrust of these surveys is to assess the strengths and weaknesses of the course for course improvement purposes, there is also a space on the form for comments. Two comments received from international students relating to the teaching of the course during a recent course survey were:

- *I understand that this course is conducted in Australia, but can some of your lecturers try to give examples of some other countries?*
- *Lecturers should make explanations involving not only Australia but other countries in the world.*

Comments such as these reinforce the view that this course requires to be more international in its content if the passing rate of international students is going to improve. In addition, irrespective of the passing rates of international students, there is a need to internationalise this course. It is therefore highly desirable to improve the international appeal of the *Technology and Society* course. At the same time, it needs to maintain its appeal to Australian students.

Strategies to Improve Internationalisation

During the development of *Technology and Society*, the authors have considered and in some cases implemented a range of strategies to better internationalise this course. Initiatives include redesign of the course and its contents to be better meet global and local requirements of both Australian domestic and international students, design of assignments and examination questions to for international application and use of on-line delivery techniques.

Design and content of this course has been continuously reviewed and improved since the course was first developed. One recent initiative was to change the names of two modules; which had previously been named 'Culture and Diversity' and 'Sociological Insights'; to 'Cultural Impacts on Engineering and Surveying Practice' and 'Models of Society' respectively. In addition, the order in which these modules is presented has been reversed, in recognition that cultural issues are a subset of sociology.

These changes will be implemented in the Semester 3 2005 offer of *Technology and Society.* As well, further changes are being planned for the Semester 1 2006 offer of this course. One of these is to change the to content of a number of modules (including the 'Models of Society' and 'Cultural Impacts' modules) to make them more relevant to the global student cohort. Another is an increased emphasis on cost benefit analysis in the module dealing with the economy (this is

expected to both improve the relevance of the course to engineers and increase the emphasis on a topic that has international application). The introduction of a case study with international application, which can be related to all of the modules in the course, is also expected to improve understanding by both Australian domestic and international students.

Similarly, assignment and examination questions now have a more international flavour than previously. This has been achieved by permitting students to optionally provide answers that relate to their own local cultural background. Thus, terms like 'or your country' have been inserted in assessment questions where there could be concern that asking a question directly related to Australia might have less meaning for an international student.

Another area in which the course has been made more appealing to international students has been the increasing use of online communication. There have been many studies of this in the literature. For example, Macdonald[10], reported on the use of online interactivity in assignment development and feedback in Britain's Open University. In engineering management education in Australia (with which the *Technology and Society* course is strongly aligned) Ferris[12] used web integrated teaching in engineering management; and Palmer[13] described a successful use of on-line support for students studying engineering management off-campus in the summer semester (a similar situation to that of the majority of students in the *Technology and Society* course, including all of its Semester 3 students).

In the *Technology and Society* course, extensive use has been made of the WebCT platform for student discussion, uploading study materials such as lectures and tutorials and answering student queries. In the 2004 Semester 3 offer, for example, there were 261 discussions, 58 email transactions and 3382 user sessions (average 25 per day). In the Semester 1 2005 offer (which has a similar number of students to the Semester 3 2004 offer), the number of discussions to 20 May 2005 was 107. This is lower activity than for the Semester 3 2004 offer, possibly reflecting the high proportion of on-campus students. Similarly, the number of email transactions in this period is 32. However, the number of user sessions (the times students accessed the system) is 2148, or an average of 26 per day, which is comparable with the Semester 3 2004 offer. This quite high use of on-line discussion to supplement written course material means that distance education students (including international students) are both interacting with the course leader and with each other, thus increasing their overall understanding of the course.

A further on-line initiative has been a course web site, from which students can quickly access lectures, tutorials, and assignment and examination resources. This has always been a feature of the course, and has been improved at each offer of the course. For the Semester 1 2006 offer, strong consideration is being given to making the amount of meaningful on-line interaction part of the course assessment process. The purpose of this is to further increase the interaction between all students, both international and Australian, and thereby increase their interest in the course and their understanding of course material.

Conclusion

This paper has described the *Technology and Society* course offered by the Faculty of Engineering and Surveying and in doing so has demonstrated that there are academic, marketing

and pedagogical reasons for ensuring that this course has international appeal while not ignoring requirements that are specific to the needs of the student's local community. While this course was always designed for international delivery, the relative poorer performance of international students compared with Australian domestic students, coupled with desires by international students to improve the relevance of the course to them, has shown the importance of continuously improving the international aspects of the course while not ignoring local issues. Current modifications to the course to address these issues, along with increased use of online teaching methods and proposed future changes to course content, are designed to achieve this improvement.

Undoubtedly, *Technology and Society* will continue to develop to meet both international and local needs of students. It will only do so as course leaders continue to attune themselves to the needs of both international and Australian domestic students.

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