AUSTRALASIAN JOURNAL OF ENGINEERING EDUCATION

Co-Editors:

Ms Gunilla Burrowes
School of Electrical Engineering
The University of Newcastle
University Drive
Callaghan 2308 NSW
gunilla@ieee.org

Ms Yvonne Toft
School of Health & Human Performance
Central Queensland University
Rockhampton, Qld 4702
y.toft@cqu.edu.au

Dr Euan Lindsay
Dept of Mechanical Engineering
Curtin University of Technology
GPO Box U1987
Perth, WA 6845
e.lindsay@curtin.edu.au

Published in Australia by:

The Australasian Association for Engineering Education Inc

ISSN 1324-5821

Papers published in the AJEE have undergone a formal process of peer review, with each paper being formally peer reviewed by at least two independent reviewers and the decision to publish is based on these reviews.

The correct bibliographic reference for this paper should include the web address where it was published:

Australasian J. of Engng. Educ., online publication 2006-01
http://www.aaee.com.au/journal/2006/palmer01.pdf

REASONS STATED BY COMMENCING STUDENTS FOR STUDYING ENGINEERING AND TECHNOLOGY

Stuart Palmer and Sharyn Bray
School of Engineering and Technology
Deakin University, Geelong, Victoria, Australia

Abstract

Responses were collected from commencing engineering students and an inventory of reasons stated for electing to study engineering was developed. Commencing engineering students were strongly career oriented; they believed that engineering would be an interesting and rewarding career that would offer enjoyment and career options. No difference was found in the principal reasons stated by respondents based on gender or course of study. On-campus students nominated principally career-related reasons for their choice of study (71 percent). While career-related reasons were still important for off-campus students, the most frequent type of responses were related to career upgrading (43.9 percent).

Introduction

In Australia, the occupational categories of the engineering workforce have evolved over time to meet the needs of the profession, industry and society. The modern Australian engineering workforce consists of:

- professional engineer – four-year university qualified;
- engineering technologist – three-year university qualified;
- engineering associate – two-year university and/or vocational sector qualified;
- engineering technician – one-year vocational sector qualified; and
- engineering tradesperson – trade qualified [1].

The Australian engineering technologist classification is analogous to the 'Incorporated Engineer' in the UK and the 'Engineering Technologist' in the USA. The three-year undergraduate bachelor of technology (BTech) course can now be found along side bachelor of engineering (BE) courses in a number of Australian universities, with students from both programs studying many common subjects. The BTech qualification not only produces graduates to populate an important occupational classification in the engineering workforce, it also fulfils a valuable role in providing an attainable articulation goal/stepping stone for those members of the engineering workforce upgrading their formal qualifications, as well as attracting a number of secondary school leavers undertaking their first higher education experience.

The School of Engineering and Technology at Deakin University offers a three-year Bachelor of Technology and four-year Bachelor of Engineering (together referred to hereafter as 'engineering courses') at the undergraduate level, in both on- and off-campus delivery modes. No previous comprehensive investigation as to why students choose engineering courses at Deakin University had been carried out. If there existed robust and reliable information about the reasons why students elect to study engineering courses at Deakin University, then the attraction(s) of these courses could be better understood, recruitment of potential student groups likely to be attracted to study at Deakin University could be more effective, and the courses could be developed to help ensure that student expectations for the courses can be met.

As part of undergraduate engineering studies at Deakin University students take a unit entitled SEB121 Fundamentals of Technology Management in the first semester of the first year of their studies. The enrolment in this unit includes both BE and BTech students, as well as a small number of students not studying engineering-related courses but who take this unit as either an elective or (more commonly) as a requirement in their course. This unit is common to all undergraduate engineering courses, and for the majority of commencing students it will be one of the first units they encounter in their courses. Surveying students enrolled in this unit should provide a comprehensive snapshot of the reasons why commencing students elect to study engineering courses at Deakin University.

Methodology

During the period 2000-2002, the assessment for the unit SEB121 incorporated the use of an on-line conferencing system into which students submitted their assignments. In all three years, the students were required to introduce themselves in a public on-line conference area by posting a resume of themselves, including their name, course being studied and their reason(s) for electing to study engineering or technology. The archives of these on-line conferences yield a comprehensive picture of the reasons why commencing Deakin University students elect to study engineering courses.

Data was collected from the conference archives using the following procedure. The archives of student responses to the assignment question identified above for the years 2000-2002 were examined and an inventory of the reasons stated for electing to study engineering and technology was developed. For each respondent in each of the three identified years, the student's stated reason(s) for electing to study engineering or technology was classified according to the previously developed inventory and recorded, along with their reported course of study. Using archived unit enrolment information, demographic information about gender and mode of study (on- or off-campus) was attached to each identified student response. All information permitting identification of individual respondents was then deleted. Descriptive statistics on the reasons stated for electing to study engineering courses were compiled. The results were statistically analysed to determine if there were any significant differences in the stated reasons of the demographic groups in the sample (year of cohort, course of study, gender and study mode). An explanation of each statistical methodology is given with the results below. For this research project a significance level (p) of 0.05 was used.

Results

Response rate

In 2000, 128 students were enrolled at the time the on-line assignment question was completed, 116 assignment submissions were received; hence the computed response rate was 90.6 percent. In 2001 141 students were enrolled, 134 submissions were received and the response rate was 95.0 percent. In 2002 134 students were enrolled, 127 submissions were

received and the response rate was 94.8 percent. Combining data from all years, 377 responses were received out of 403 enrolments, giving an overall response rate of 93.5 percent.

Inventory of reasons

Following examination of all student responses to the assignment question for the years 2000-2002, the following inventory of the reasons stated for electing to study engineering courses was developed.

1. To work 'in the field', not in an office all day
2. Parent, family member or friend works/worked as an engineer
3. A career that I will enjoy and allow me to pursue my interests
4. A rewarding career with a wide range of options for employment
5. The course that I had the tertiary entrance score to get into (not course of first choice)
6. As an engineer I will be able to help build a better world
7. No response stated
8. Changed into engineering from a course I didn't like
9. Upgrading my qualifications / change of career
10. My current employment requires me to obtain a bachelor's degree in technology
11. I'm not sure why I chose engineering
12. To be involved in shaping the future
13. SEB121 is a required unit in a non-engineering course
14. The course description in the handbook sounded interesting
15. I enjoy creating/designing things and solving problems
16. To advance my quality of life
17. To study a course that has definitive answers to questions

In the following sections, the number and an abbreviation of the reason is used for brevity.

Demographic information

In 2000, the gender proportions of respondents were 10.2 percent female and 89.8 percent male. In 2001, the gender proportions were 14.2 percent female and 85.8 percent male. In 2002, the gender proportions were 9.0 percent female and 91.0 percent male. Combining data from all years, the overall gender proportions were 11.2 percent female and 88.8 percent male. The three year groups were large and random, so the Chi-square test of homogeneity was applicable. The gender proportions were not significantly different between the three years ($\chi^2_2 = 2.09$, $p > 0.35$). Each year pair (2000/2001, 2000/2002 and 2001/2002) of gender proportions were compared using the large sample inference about two proportions test, and no significant differences were found. These gender proportions compare to the reported overall commencing female participation rate in Australian engineering undergraduate studies of approximately 14.4 percent [2].

In 2000 the course of study proportions of respondents were 71.1 percent BE, 25.0 percent BTech and 3.9 percent Other. In 2001 the course proportions were 64.6 percent BE, 33.3 percent BTech and 2.1 percent Other. In 2002 the course proportions were 66.4 percent BE, 25.4 percent BTech and 8.2 percent Other. Combining data from all years, the overall course proportions were 67.2 percent BE, 28.1 percent BTech and 4.7 percent Other. Based on a Chi-square test of homogeneity, the course proportions were not significantly different between the three years ($\chi^2_4 = 8.27$, $p > 0.08$).

In 2000, the study mode proportions of respondents were 81.3 percent on-campus and 18.7 percent off-campus. In 2001, the study mode proportions were 85.1 percent on-campus and 14.9 percent off-campus. In 2002, the study mode proportions were 76.1 percent on-campus and 23.9 percent off-campus. Combining data from all years, the overall study mode proportions were 80.9 percent on-campus and 19.1 percent off-campus. Based on a Chi-square test of homogeneity, the study mode proportions were not significantly different between the three years ($\chi^2_2 = 3.61$, $p > 0.16$). Each year pair of study mode proportions was compared using the large sample inference about two proportions test, and no significant differences were found.

No significant differences were found in any of the demographic characteristics measured between the three year groups of students. This suggested that the results obtained for individual years could also be validly pooled and considered as a single larger group.

Reasons stated for electing to study engineering and technology

Table 1 gives the indicated proportions for each of the reasons stated for electing to study engineering and technology by respondents for each year 2000-2002 and all years combined. The stated reasons are ordered using the rank order of all years combined. Based on a Chi-square test of homogeneity, the indicated proportions of reasons stated were not significantly different between the three years ($\chi^2_{32} = 27.24$, $p > 0.7$). Each year pair of indicated proportions of reasons stated was compared using the large sample inference about two proportions test, and no significant differences were found.

Table 1: Reasons stated for electing to study engineering and technology.

Reason Stated	Year 2000	Year 2001	Year 2002	All Years
3. An interesting career I will enjoy	41.9%	45.2%	41.7%	43.1%
4. A rewarding career with options	22.6%	21.4%	21.9%	21.9%
15. Enjoy creating/designing/problems	5.8%	8.6%	10.9%	8.6%
9. Upgrade qualifications/career change	7.1%	6.2%	7.8%	7.0%
6. Help to build a better world	5.2%	4.8%	1.6%	3.8%
2. Parent/family/friend was an engineer	3.2%	3.3%	3.6%	3.4%
5. The course I could gain entry to	1.3%	3.8%	2.6%	2.7%
10. Job requires me to get tech. degree	1.9%	1.4%	2.1%	1.8%
7. No response stated	3.2%	1.0%	1.0%	1.6%
1. To work 'in the field', not an office	1.3%	1.4%	1.6%	1.4%
12. To shape the future	1.3%	0.0%	2.1%	1.1%
8. Changed from a course I didn't like	1.9%	0.5%	1.0%	1.1%
13. Required unit for another course	0.6%	1.4%	1.0%	1.1%
14. Course description was interesting	1.3%	1.0%	0.5%	0.9%
11. Unsure why I chose engineering	0.6%	0.0%	0.0%	0.2%
16. Advance the quality of my life	0.6%	0.0%	0.0%	0.2%
17. A course that has definitive answers	0.0%	0.0%	0.5%	0.2%

Reasons stated for studying engineering and technology by gender

When considering the indicated proportions for each of the reasons stated for electing to study engineering and technology by gender, it was found that there was a significant difference between genders in 2000, a borderline significant difference in 2001 and no significant difference in 2002. When the results for all years were pooled, based on a Chi-square test of homogeneity, the indicated proportions of reasons stated by gender were significantly different ($\chi^2_{16} = 31.55$, $p < 0.012$). Table 2 gives the indicated proportions for each of the reasons stated for electing to study engineering courses by gender. The stated reasons are ordered using the rank order of all years combined.

Table 2: Reasons stated for electing to study engineering and technology by gender.

Reason Stated	Male	Female	All Years
3. An interesting career I will enjoy	43.2%	42.3%	43.1%
4. A rewarding career with options	22.2%	19.7%	21.9%
15. Enjoy creating/designing/problems	8.4%	9.9%	8.6%
9. Upgrade qualifications/career change	7.4%	4.2%	7.0%
6. Help to build a better world	3.7%	4.2%	3.8%
2. Parent/family/friend was an engineer	3.7%	1.4%	3.4%
5. The course I could gain entry to	2.5%	4.2%	2.7%
10. Job requires me to get tech. degree	2.1%	0.0%	1.8%
7. No response stated	1.6%	1.4%	1.6%
1. To work 'in the field', not an office	1.4%	1.4%	1.4%
12. To shape the future	1.2%	0.0%	1.1%
8. Changed from a course I didn't like	1.0%	1.4%	1.1%
13. Required unit for another course	0.4%	5.6%	1.1%
14. Course description was interesting	0.4%	4.2%	0.9%
11. Unsure why I chose engineering	0.2%	0.0%	0.2%
16. Advance the quality of my life	0.2%	0.0%	0.2%
17. A course that has definitive answers	0.2%	0.0%	0.2%

Reasons stated for studying engineering and technology by course

When considering the indicated proportions for each of the reasons stated for electing to study engineering and technology by course of enrolment it was found that there was a significant difference between courses in all three years 2000-2003. When the results for all years were pooled, based on a Chi-square test of homogeneity, the indicated proportions of reasons stated by course were significantly different (χ^2_{32}

= 120.14, $p < 4 \times 10^{-12}$). Table 3 gives the indicated proportions for each of the reasons stated for electing to study engineering and technology by course of enrolment. The stated reasons are ordered using the rank order of all years combined. Given that students enrolled in 'other' courses may come from non-technology study areas, it was considered important to identify any differences in the reasons stated for electing to study engineering courses between BE and BTech students. When responses from students enrolled in 'other' courses were removed, it was found that there was no significant difference between BE and BTech students in individual years 2000-2003; however, when the results for all years were pooled, based on a Chi-square test of homogeneity, the indicated proportions of reasons stated by course (BE or BTech) were significantly different ($\chi^2_{16} = 27.47$, $p < 0.037$), though the results in Table 3 suggest that the significance was marginal.

Table 3: Reasons stated for electing to study engineering and technology by course.

Reason Stated	**BE**	**BTech**	**Other**	**All Years**
3. An interesting career I will enjoy	42.6%	43.6%	47.6%	43.1%
4. A rewarding career with options	23.3%	21.5%	0.0%	21.9%
15. Enjoy creating/designing/problems	10.6%	4.7%	0.0%	8.6%
9. Upgrade qualifications/career change	7.8%	4.0%	14.3%	7.0%
6. Help to build a better world	3.1%	5.4%	4.8%	3.8%
2. Parent/family/friend was an engineer	3.6%	3.4%	0.0%	3.4%
5. The course I could gain entry to	1.6%	6.0%	0.0%	2.7%
10. Job requires me to get tech. degree	1.6%	0.7%	14.3%	1.8%
7. No response stated	1.6%	2.0%	0.0%	1.6%
1. To work 'in the field', not an office	1.3%	2.0%	0.0%	1.4%
12. To shape the future	1.0%	1.3%	0.0%	1.1%
8. Changed from a course I didn't like	0.8%	2.0%	0.0%	1.1%
13. Required unit for another course	0.0%	1.3%	19.0%	1.1%
14. Course description was interesting	0.5%	2.0%	0.0%	0.9%
11. Unsure why I chose engineering	0.3%	0.0%	0.0%	0.2%
16. Advance the quality of my life	0.3%	0.0%	0.0%	0.2%
17. A course that has definitive answers	0.3%	0.0%	0.0%	0.2%

Reasons stated for studying engineering and technology by study mode

When considering the indicated proportions for each of the reasons stated for electing to study engineering and technology by mode of study it was found that there was a significant difference between study modes in all three years 2000-2003. When the results for all years were pooled, based on a Chi-square test of homogeneity, the indicated proportions of reasons stated by study mode were significantly different ($\chi^2_{16} = 203.63$, $p < 2 \times 10^{-34}$). Table 4 gives the indicated proportions for each of the reasons stated for electing to study engineering courses by mode of study. The stated reasons are ordered using the rank order of all years combined.

Table 4: Reasons stated for electing to study engineering and technology by mode.

Reason Stated	On-Campus	Off-Campus	All Years
3. An interesting career I will enjoy	46.8%	25.5%	43.1%
4. A rewarding career with options	24.2%	11.2%	21.9%
15. Enjoy creating/designing/problems	9.2%	6.1%	8.6%
9. Upgrade qualifications/career change	1.3%	33.7%	7.0%
6. Help to build a better world	3.1%	7.1%	3.8%
2. Parent/family/friend was an engineer	3.9%	1.0%	3.4%
5. The course I could gain entry to	3.3%	0.0%	2.7%
10. Job requires me to get tech. degree	0.0%	10.2%	1.8%
7. No response stated	1.5%	2.0%	1.6%
1. To work 'in the field', not an office	1.7%	0.0%	1.4%
12. To shape the future	0.9%	2.0%	1.1%
8. Changed from a course I didn't like	1.3%	0.0%	1.1%
13. Required unit for another course	1.3%	0.0%	1.1%
14. Course description was interesting	1.1%	0.0%	0.9%
11. Unsure why I chose engineering	0.2%	0.0%	0.2%
16. Advance the quality of my life	0.0%	1.0%	0.2%
17. A course that has definitive answers	0.2%	0.0%	0.2%

DISCUSSION

It can be seen from Table 1 that the first four ranked reasons for all three year groups were identical, and in all cases these four items account for more than 75 percent of responses obtained, suggesting a high degree of agreement between year groups as to the most important influences on the students' choice of reasons for electing to study engineering courses.

Additionally, for all three year groups the first two ranked reasons account for the majority (more than 63 percent) of student responses. Interestingly, these two reasons relate to engineering as an interesting/rewarding career, suggesting that engineering students are particularly career-orientated. A 1994 report by Woolnough on a survey of 1180 18-year-old UK students intending to study at university (including 92 students intending to study engineering) that investigated the factors affecting students' choice of higher education study found that, of all university courses, engineering students reported the highest affirmative response (70 percent) to the question, 'Have you decided on a career yet?' [3] – this was nearly three times as high as the lowest rate reported by any student group. One possible contributing factor to this strong career orientation at a relatively early age is the need for the educational preparation for a career in engineering to begin early with a foundation in math and science that is progressively built upon throughout the student's schooling [4].

While these two surveys suggest that intending engineering students are strongly motivated by career choice/aspiration, there is also evidence in the international literature that commencing engineering students do not have an accurate understanding of the nature of professional practice in their chosen career. "Few IE [industrial engineering] students understand what industrial engineering is at the beginning of their education program and, more sadly, few improve their understanding by graduation" [5, p. 18]. Williams (2001) reports on interviews with environmental engineering graduates to examine their professional socialization, "…there was generally a poor understanding of what environmental engineering would cover at university, and many interviewees could not envisage (at entry) what the career would involve" [6, p. 177]. Pullin (1999) reporting on the UK Institute of Employment Studies' annual graduate review in 1999 describes a, "…none to happy portrait of a mismatch of expectations and aspirations between graduates and their potential employers, in which recruiters are too often disappointed with what they are getting and the recruited too do not get what they want" [7, p. 30]. "Some engineering students, even juniors and seniors, still do not know what an engineer does in the workforce" [8, p. 53].

Why might commencing engineering students have a poor understanding of their chosen career? Modern professional engineering encompasses a wide range of disciplines. In the US in 1880, there were only three recognized disciplines of engineering [9]; the current US

Accreditation Board for Engineering and Technology lists 33 different engineering disciplines for which accredited undergraduate courses exist [10]. In 1920 six engineering disciplines were offered in Australian universities, by 1979 this number has risen to 17 and in 2000, 54 disciplines could be found on offer [11]. The recognized engineering disciplines span a broad array including aerospace, electrical, geological, nuclear and systems, altogether encompassing a wide diversity of knowledge, skills and work environments. It is impossible to easily describe the possible practice experiences of all members of the engineering profession, so it is no wonder that students might have a limited conception of the breadth of engineering practice. Even when it comes to the core of engineering activity that is common to all disciplines, it is well documented that the broader community either doesn't know what engineers do or, worse, holds incorrect views about engineering. A 1998 poll by the American Association of Engineering Societies (AAES) found that, "61 percent of Americans reported that they were 'not very well informed' or 'not at all well informed' about engineering…" [12, p. 8]. 53 percent of college graduates who responded to the survey reported themselves in the same two categories. A 1998 Gallop poll found that, "…only 2 percent of respondents associated engineers with the word 'invents'…whereas 5 percent associated them with the phrase 'train operator'" [13, p. 23]. The situation in the UK is no better; the executive summary of a report by the Royal Academy of Engineering begins, "The central role of engineering in society and the economy is not evident to the public at large nor to the media in particular; the popular perception being generally confined to manufacturing and major building works" [14, p. 6].

Even though a majority of respondents to the AAES survey above did not understand engineering, the same survey reports that when asked how pleased they would be if a member of their family said they wanted to be an engineer, using a scale of one (extremely displeased) to ten (extremely pleased), the median response was nine. Lack of understanding of engineering doesn't equate to lack of respect, or to a weak career focus in intending engineering students.

In a 1997 investigation by Seymour and Hewitt of why US science, mathematics and engineering (SME) students swap study majors, it was found that 38.1 percent of commencing engineering students swapped out of an SME study major, and, the two principal factors reported by switching students were 'lack of/loss of interest in SME: "turned off

science"' (reported by 43 percent of switchers) and 'Non-SME major offers better education/more interest' (reported by 40 percent of switchers) [15]. This again, suggests that some commencing engineering students do not have a clear appreciation of what to expect in their chosen studies/career. One is left to wonder if more primary and secondary school students were exposed to the nature of engineering practice and had an opportunity to gain an understanding about what a career in engineering would entail, whether more students would develop an interest in engineering and the strong career focus apparent in intending engineering students? Or, given that many commencing engineering students do not appear to have an accurate picture of the nature of professional practice at the commencement of their studies, would exposure to an 'accurate' picture of engineering practice in fact dissuade some potential engineering students from entering studies in this field? An examination of US data in the National Educational Longitudinal Survey (NELS) found that, of eighth-grade students who indicated they aspired to science and engineering (SE) careers in 1988, less than 25 percent still held this career aspiration six years later – the author suggests that encountering the reality of their intended profession may have been the cause [4].

Returning to the reasons stated by students for electing to study engineering. Woolnough's 1994 investigation of 18-year-old UK students intending to study at university asked respondents to rate 26 influences on a five-point Likert scale as to whether they encouraged or discouraged them towards or away from engineering or one of the physical sciences. The highest mean response given by any group was 4.3 by engineering students for the influence 'The likely job satisfaction in science and engineering'. Other important influences reported included, 'The intellectual satisfaction of doing science', 'Scientific hobbies and fiddling with gadgets at home' and a school environment that provided a positive experience in science. Once again, supporting the proposition that intending engineering students are strongly career orientated. In the investigation by Seymour and Hewitt (1997) noted above, a group of SME students were asked to indicate the reasons for selection of their original study major. Interestingly, the most significant reason reported for selection of study major was the 'Active influence of others', reported by 18% of all respondents, although, this result was strongly influenced by students who eventually switched out of an SME study major, suggesting that many of these students may have been 'forced' into studying an SME course when they really didn't want to. When 'switching' students were excluded, the most frequently reported

reasons for choice of study major became 'Intrinsic interest' and 'Pragmatism / materialism', although the 'Active influence of others' still remained the third most frequent response. Here, once again, selection of a career that will be interesting and/or rewarding were highly ranked reasons for choice of study major.

When considering the impact of gender on the indicated reasons for studying engineering courses it is important to remember that female students made up only 11.2% of all respondents in this investigation, and a clearly significant difference in the indicated proportions for each of the stated reasons was observed in only one of the three year groups. However, when the results from all three year groups were pooled, some differences in responses by gender were observed. Male respondents were more likely to indicate that they were studying to upgrade their qualifications or that their job required them to obtain a technical degree qualification. Presumably, many of this group of respondents were already members of the engineering workforce, which in Australia is predominately male (females make up less than 7 percent of the Australian professional engineering workforce) [16], and hence males reporting these reasons at a higher rate was not unexpected.

Male respondents were more likely to indicate the influence of a role model (parent, family member or friend) who was/had been an engineer. Female respondents were more likely to indicate that engineering or technology was the course they could gain entry to at university, indicating that engineering or technology was not necessarily their first choice of study. Female respondents were more likely to indicate that they were taking the engineering and technology unit SEB121 as part of another course of study. It was known that the majority of students taking this unit as part of another course were education students taking a science studies major, and education undergraduate students in Australia are predominately female (79.1 percent of 2001 graduates from bachelor level education courses were female) [17]. Hence, females reporting this reason at a higher rate was not unexpected. Female respondents were more likely to indicate course selection on the basis that the course description sounded interesting.

In this sample group of commencing students (and indeed in Australian undergraduate engineering enrolments in general) males made up the bulk of the enrolment, 88.8 percent of all respondents when pooled, so it was not surprising that the rank ordering of stated reasons for electing to study engineering courses of male respondents mirrors the rank

ordering of all respondents pooled. Even though there were some observed differences in response rates between genders, the first three ranked reasons were identical, had similar indicated percentages and made up the majority of the reasons stated (73.8 percent for male and 71.9 percent for female) for both male and female respondents. This suggests that the previously observed strong career orientation of commencing engineering students applies to both male and female students.

When considering the impact of course of study on the indicated reasons for studying engineering and technology, the principal interest here was in the responses from BE and BTech students. The first two ranked reasons were identical, had similar indicated percentages and made up the majority of the reasons stated for both BE and BTech respondents (65.9 percent for BE and 65.1 percent for BTech); again, highlighting the previously observed strong career orientation of commencing engineering students generally. BE students were more than twice as likely to indicate reasons associated with design/creating/problem solving than BTech students, this is perhaps due to fundamental difference between these two occupational classifications in the engineering workforce: "The essential competencies of Professional Engineers include the ability to plan and design original and novel solutions using well developed powers of analysis and synthesis. They challenge current thinking and apply fundamental principles to situations which lie outside their prior experience…Engineering Technologists modify established engineering practices, and apply newly developed engineering practices on a regular basis. These skills are applied…with an understanding of the application and advancement of engineering technology…" [1, p. 7]. Broadly speaking, professional engineers would be expected to have a deeper theoretical understanding of technology upon which novel designs are based, while engineering technologists would be competent in the practical application of technology.

BTech students were nearly four times as likely to indicate that their course was the one that they could gain entry to. One of the principal differences between the BE and BTech courses at Deakin University is the underpinning mathematical approaches in key units of study; in the BE course a calculus foundation is employed, and in the BTech course an algebraic mathematical approach is used. This has ramifications for the prerequisite secondary school mathematics entry requirements for both courses. So, while a commencing student may have aspired to the

BE course, they may find that their background in secondary school mathematics studies only permits them entry into the BTech course. Students in this situation may undertake bridging studies in mathematics and transfer courses when they have achieved the appropriate prerequisite competency.

Interestingly, nearly twice as many BE students as BTech students indicated that their reason for study was to upgrade their qualifications. This goes against the commonly held wisdom that the BTech course is seen as the logical, realistic and attainable stepping stone for students articulating from vocational to professional occupational classifications in the engineering workforce.

When considering the impact of mode of study on the indicated reasons for studying engineering courses the career-related reasons of interesting/rewarding career come through very strongly for on-campus students, together representing 71 percent of responses. This was perhaps not surprising given that commencing on-campus students at Deakin University are generally full-time students who have come directly from secondary school and have selected a particular course of study to obtain a degree after which they would intend to get a job and commence a career. Career interest is likely to factor strongly in the planning of these students. Contrast this result to off-campus students who give upgrading qualifications/changing career as the principal reason (33.7 percent) for study. Off-campus students at Deakin University are generally mature age students who are working at least part-time. This suggests that a significant number of off-campus students use this mode of study as a means of gaining access to tertiary education (and hence new qualifications) that they would otherwise by precluded from because of the need to work.

For off-campus students the next two highest ranked reasons were the career-oriented ones, collectively accounting for 36.7 percent of responses. The career focus was still a significant reason for choice of study for off-campus students, but was reported at about only half the rate compared to on-campus students. The next ranked reason given by off-campus was that a degree qualification was required by their job – reported by 10.2 percent of off-campus students, compared to nil responses from on-campus students. If the reasons ‘upgrading qualifications’ and ‘required by job’ are considered together as ‘career upgrading’, then 43.9 percent of off-campus responses related to this reason, which reinforces the proposition that off-campus study

facilitates career advancement for students who are currently employed. Interestingly, off-campus students were significantly more likely to report their reason for studying as 'building a better world', 'shaping the future' or advancing quality of life', which was perhaps an indication of the maturity that comes with the 'mature age' typical of off-campus students.

CONCLUSIONS

Commencing engineering students at Deakin University, as a whole, were strongly career oriented in their stated reasons for electing to study engineering courses. This result is in agreement with results observed in the UK and USA. They believe that engineering will be an interesting and rewarding career that will offer enjoyment and career options. While no particular observation can be made about the respondent groups in this investigation, the literature suggests that commencing engineering students may not have an accurate understanding of the nature of engineering practice. The apparent incongruity between commencing students being strongly motivated by their perception of the nature of a career in engineering, while at the same time possibly having a poor or inaccurate understanding of the nature of engineering practice presents a dilemma for those involved in the recruitment and delivery of university engineering programs. Are students entering these courses under false pretences? Would they still enrol if they had a more accurate understanding of engineering practice?

While some differences in the ranking of stated responses for electing to study engineering courses were noted between gender and course of study, the principal reasons given by respondents had the same rank ordering and approximately the same response rate, again, confirming the importance of career-related reasons for studying engineering. However, there was a distinct and significant difference in the stated responses for electing to study engineering courses between students studying in on- and off-campus modes. On-campus students nominated principally career-related reasons for their choice of study (71 percent of responses). While career-related reasons were still important for off-campus students (36.7 percent of responses), the most frequent type of response from off-campus students was related to career upgrading (43.9 percent of responses).

The differences between the two modes of study were not unexpected; on-campus students are principally directly from secondary school,

coming to study for their first degree and aspiring to commence a career in their chosen profession; while off-campus students are typically mature aged, working at least part time and are using study to advance or change their existing career path. Being aware of the differences in the reasons for studying between these two student groups could help focus and differentiate recruitment efforts to attract the respective student cohorts, as well as providing valuable information to course designers and content developers so that the study programs can cater appropriately for the needs and aspirations of both student sub-groups who would normally study the same material 'together', though not in the same time or place.

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