Assessing the Likely Impact of Mandatory Residential Sessions for Engineering and Technology Students

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Abstract
Off-campus students are important to the Deakin School of Engineering and Technology – in 2003, 47.5 % of all enrolments in the main engineering and technology Bachelor courses were off-campus students. In 2005, the School will be compelled, for professional accreditation, to introduce annual two-week mandatory residential sessions into its engineering and technology courses. In 2004, prior to its implementation, the impacts of the introduction of a mandatory on-campus residential element into engineering and technology courses were unknown. This research project sought to understand these impacts, so that strategies could be developed to minimise the likely impact of these changes. In engineering, off-campus study is an essential element of access to education for those in remote locations and/or seeking to upgrade their qualifications whilst employed. There was very little support from any students (on- or off-campus) for the introduction of residential sessions. The School should expect that the introduction of mandatory residential sessions will reduce the number of off-campus students enrolling to study engineering and technology.

Introduction

The School of Engineering and Technology at Deakin University has, for a number of years, provided access to off-campus students seeking to 'upgrade' their trade, vocational, technical and other qualifications, to enter the professional sphere of the engineering workforce[1,2]. Off-campus students are important to the School – in 2003, 47.5 % of all enrolments in the main engineering and technology Bachelor courses were off-campus students.

At the last professional course re-accreditation Engineers Australia challenged the validity of engineering courses without a mandatory on-campus component, on the grounds that all undergraduates need to experience the 'on-campus environment' to gain and demonstrate "…specified attributes and capabilities."[3] They recommended that there be an 'appropriate' balance between on-campus and off-campus learning activities, in particular for hands-on laboratory and practical learning, professional practice exposure, project based learning, and face-to-face team work. Although off-campus students were already required to attend on-campus periodically for particular laboratory work, Engineers Australia also recommended (though, without any substantive rationale) that a minimum on-campus attendance requirement for off-campus students be set at one residential session of 2 weeks (10 working days) for each year of equivalent full-time study - to be implemented from 2005.

Australian-based off-campus students are typically mature aged, employed and often with significant experience in the engineering workforce. In 2004, prior to its implementation, it was unknown how the mandatory residential sessions would impact on off-campus students. The proposed project sought to understand these impacts, so that strategies could be developed to minimise the likely impact of these changes on engineering and technology students studying in off-campus mode.

Method

To quantify the likely impact of mandatory on-campus residential sessions, a survey of all current (in 2004) Deakin engineering and technology students (730 students) was undertaken seeking responses to how a mandatory residential session would have impacted on their ability to complete their course. Students were advised that:

- this requirement did not apply to existing students enrolled in studies prior to 2005;
- this requirement applied to both on- and off-campus students enrolling for the first time in 2005;
- the residential sessions would require full-time attendance for two-weeks for each equivalent full-time year of their course, i.e. three 2-week sessions for BTech students and four 2-week sessions for BE students;
- the residential sessions would be held in second semester, and incorporate the intra-semester break week, plus the following week of the normal academic semester;
- students would be responsible for their own transportation and accommodation costs to attend the residential sessions;
- while the residential sessions may incorporate some practical work from the course, there would also likely be some remaining course practical work that would require students to attend on-campus again at another time; and
- the residential sessions would also include presentations by industry speakers, opportunities to meet and work with other students, opportunities to meet with academic staff, and social activities.

The survey was undertaken by a postal questionnaire that sought the students responses to the following questions:

- would the introduction of mandatory residential attendance have had an impact on your decision to enrol in your course?;
- would you have been able to attend a residential session for each year of your study?;
- indicate the difficulty to you of the following aspects of attending a residential session - time off work; travel to Deakin University; time away from your family; giving up leave/holidays; cost; other;
- if all required on-campus attendance for your course were included in the residential sessions, would that make attendance any easier?;
- what do you think would be the benefit(s) of a number of residential sessions in your course?;
- if residential sessions were to be introduced into your course, what activities do you think should be included in such sessions?; and
- what other comments you would like to make about the proposed mandatory residential sessions to be introduced into engineering courses?

As required by the Deakin University Human Research Ethics Committee, the questionnaire was anonymous and voluntary.

Results and Discussion

From a total identified current engineering and technology enrolment at the time of the survey of 730 students, 145 valid questionnaire responses were obtained, giving a response rate of 19.9 percent. The following respondent age statistics were collected from the questionnaire: mean age 30.4 years; standard deviation 8.5 years; age range 18 to 48 years; and median age

30 years. The following respondent gender statistics were collected: female 7.6 percent; and male 92.4 percent. The following respondent course of study statistics were collected: Bachelor of Engineering (BE) 69.7 percent; and Bachelor of Technology (BTech) 30.3 percent. The following respondent study location statistics were collected: on-campus 24.3 percent; and off-campus 75.7 percent. 22.4 precent of respondents self-reported their location status as rural and isolated.

The gender, course of study, study location and rural and remote status characteristics of the entire enrolled student group where known, permitting a comparison of the population and respondent sample groups. A significance level of 0.01 was used for all parametric statistical tests. The proportion of females in the population was 9.2 percent, which was not significantly different from the respondent group ($X^2_1 = 0.38$, $p > 0.53$). The proportion of BE students in the population was 74.0 percent and the proportion of BTech students in the population was 26.0 percent, which was not significantly different from the respondent group ($X^2_1 = 1.04$, $p > 0.3$). The proportion of rural and remote student in the population was 30.1 percent, which was not significantly different from the respondent group ($X^2_1 = 3.48$, $p > 0.06$). The proportion of on-campus students in the population was 51.1 percent and the proportion of off-campus students in the population was 48.9 percent, which was significantly different from the respondent group ($X^2_1 = 34.68$, $p < 4 \times 10^{-9}$).

The good match between the gender, course of study and rural and remote status demographic characteristics of the respondent sample and population groups suggests that valid conclusions about the population group can be inferred from the respondent group. It is noted that the study mode proportions of the population and respondent groups were significantly different - while the population group contained approximately equal numbers of on- and off-campus students, off-campus students apparently felt the need to respond at more than three times the rate of on-campus students - this result itself suggests something about the importance of the topic of the survey to off-campus students. The influence of study mode, and/or any other demographic characteristic, on student responses will be noted in the following statistical analysis.

A statistically significant correlation was observed between age of respondent and mode of study ($F_1 = 102.47$, $p < 3 \times 10^{-18}$); the mean age of on-campus students was 20.7 years; the mean age of off-campus students was 33.6 years. This result was expected, and consistent with previous surveys of Deakin University engineering and technology students[4,5], as many off-campus students are also mature-age students; electing to study in the off-campus mode so as to be able to combine their work, study, family and/or other commitments. From this result, it is expected that where a statistically significant correlation between a particular student response and mode of study is observed, it is likely that a similar correlation will also be observed between that student response and age of respondent.

Respondents were asked to rate on a scale of 1 to 5 (1 = no impact; 5 = extreme impact) what impact would the introduction of mandatory 2-week residential attendance for each year of full time study have had on their decision to enrol in their course. The mean respondent rating was 3.9. A statistically significant correlation was observed between reported rating and mode of study ($F_1 = 23.25$, $p < 4 \times 10^{-6}$); the mean rating for on-campus students was 3.0; the mean rating for off-campus students was 4.1. The median rating for off-campus students was 5, indicating that a majority of off-campus students felt the residential sessions would have an extreme impact on their decision to enrol in their course.

Respondents were asked to indicate (Yes or No) whether they would have been able to attend full-time, on-campus for a 2-week residential session for each year (eight credit points out of a total of 32) of their study. 44.0 percent of respondents indicated 'Yes', 56.0 precent of respondents indicated 'No'. A statistically significant correlation was observed between reported ability to attend residential sessions and respondent age ($F_1 = 24.7$, $p < 3 \times 10^{-6}$); the mean age for students reporting they could attend residential sessions was 26.7 years; the mean age for students reporting they couldn't attend residential sessions was 33.7 years. A statistically significant correlation was observed between reported ability to attend residential sessions and mode of study ($X^2_1 = 23.81$, $p < 2 \times 10^{-6}$); 79.4 percent of on-campus students reported that they would be able to attend residential sessions; 31.3 percent of off-campus students reported that they would be able to attend residential sessions. While a low response rate might be expected for off-campus students[6], interestingly, a significant number of on-campus students also indicated that they would not be able to attend residential sessions.

Respondents were asked to rate on a scale of 1 to 5 (1 = not difficult; 3 = difficult; 5 = impossible) the difficulty to them in getting time off work to attend a 2-week residential session. The mean respondent rating was 3.3. A statistically significant correlation was observed between reported rating and mode of study ($F_1 = 34.48$, $p < 4 \times 10^{-8}$); the mean rating for on-campus students was 2.3; the mean rating for off-campus students was 3.7. The median rating for off-campus students was 4 (and the maximum value was 6 out 5!).

Respondents were asked to rate on a scale of 1 to 5 (1 = not difficult; 3 = difficult; 5 = impossible) the difficulty in travelling to Deakin to attend a 2-week residential session. The mean respondent rating was 2.4.

Respondents were asked to rate on a scale of 1 to 5 (1 = not difficult; 3 = difficult; 5 = impossible) the difficulty in taking time away from their family to attend a 2-week residential session. The mean respondent rating was 2.9. A statistically significant correlation was observed between reported rating and mode of study ($F_1 = 20.74$, $p < 2 \times 10^{-5}$); the mean rating for on-campus students was 1.8; the mean rating for off-campus students was 3.2. Off-campus students are more likely to be older and have direct family responsibilities than on-campus students.

Respondents were asked to rate on a scale of 1 to 5 (1 = not difficult; 3 = difficult; 5 = impossible) the difficulty in giving up leave/holidays to attend a 2-week residential session. The mean respondent rating was 3.4. There was no significant difference in rating between on- and off-campus students. The median rating was 4.

Respondents were asked to rate on a scale of 1 to 5 (1 = not difficult; 3 = difficult; 5 = impossible) the difficulty of meeting the costs involved to attend a 2-week residential session. The mean respondent rating was 3.0.

Of the reported factors likely to cause difficulty for students in attending a 2-week residential session, giving up leave/holidays had the highest overall mean rating, indicating that this would be a problem for both on- and off-campus students. It is understandable that attending a 2-week residential might representing giving up half of that year's annual leave for an off-campus student in full-time work, however, it would seem that on-campus students are also reluctant to give up their intra-semester break to residential sessions as well. For off-campus

students, the factor given the highest difficulty rating was getting time off work. This may be due to the fact that, just because a person has leave from work owing, it is not always possible to take leave from employment when it is desired (or when it is required to fit in with a mandatory study residential session). Other reasons given as likely to cause difficulty for students in attending a 2-week residential session include:

- student currently being in prison;
- loss of income;
- partner would also have to take leave to look after children;
- loss of two weeks of 'normal' study time;
- contract workers are not entitled to annual leave;
- military personnel do not have a say where they will be posted at a particular date;
- oil and gas workers already spend a lot of time away from home;
- having a breastfeeding infant; and
- student works in a rostered block cycle, not weekly.

Respondents were asked to indicate (Yes or No) whether attendance at the residential sessions would be easier if all required on-campus attendance for their course were included in the residential sessions. 59.8 percent of respondents indicated 'Yes', 40.2 precent of respondents indicated 'No'. There was no significant difference in response by mode of study. Rolling all laboratory and other on-campus attendance requirements into the residential sessions would assist a majority of students. Respondents were asked, "What do you think would be the benefit(s) of a number of 2-week residential sessions in your course?" The most frequent responses (and the proportion of respondents giving that response) were:

- contact with academic staff (26.9%);
- contact with other students (26.2%);
- see no benefit (19.3%);
- networking opportunity (9.7%);
- some practical experience (6.9%);
- familiarisation with campus (4.8%);
- industry information sessions (4.1%);
- intensive learning (4.1%);
- help understand the course better (3.4%); and
- residentials not practical while working (3.4%).

Apart from nearly twenty percent of respondents indicating they saw no benefit in the residential sessions, the remaining three of the top four responses relate to contact, communication and collaboration. While many people enjoy in-person contact, there exist many opportunities for virtual communication, collaboration and networking that do not require proximal contact. Respondents were asked, "If 2-week residential sessions were to be introduced in your course, what activities do you think should be included in such sessions?" The most frequent responses (and the proportion of respondents giving that response) were:

- laboratory/practical work (30.3%);
- lectures and tutorials (14.5%);
- industry speakers (10.3%);
- group work (7.6%);
- site visits (6.2%);
- exam study techniques (3.4%);
- career guidance (2.8%);

- tour of campus (2.8%); and
- course assistance (2.8%).

While a residential session might be the initially obvious mechanism for some of these suggestions, others, such as exam study techniques, career guidance and course assistance are not obviously best delivered in person. And, there exist 'virtual' options for the delivery of all of the identified activities:

- laboratory/practical work - including cost-effective, multi-discipline, remotely accessed laboratory equipment that can be used to increase laboratory work participation by on-campus students[7];
- lectures - including live streaming and/or subsequent asynchronous access to engineering lectures, including for on-campus students who miss a 'live' class[8];
- tutorials - including one-to-one remote synchronous student tutoring with the possibility of video interaction[9];
- industry speakers - including video (tape and on-line digital versions) of guest lectures presented by industry experts;[10];
- group work - including virtual teamwork that was evaluated highly by student participants[11];
- site visits - including a virtual construction site visit that can be attended at any, and as many, times as required, without risk to student or site[12];
- exam study techniques[13];
- career guidance[14];
- tour of campus - including a 360° virtual tour of key campus facilities[15]; and
- course assistance[16].

Respondents were asked, "What other comments you would like to make about the proposed mandatory 2-week residential sessions to be introduced into BTech and BE courses?" The most frequent responses (and the proportion of respondents giving that response) were:

- financial burden too high (12.4%);
- disincentive to study at Deakin (10.3%);
- lost annual leave (10.3%);
- difficulty because of family commitments (9.0%);
- strongly disagree with residentials (6.9%);
- disincentive to study (6.9%);
- difficult to get time to attend (6.9%);
- exemptions should be available for prior experience (4.8%);
- should be optional not mandatory (4.1%);
- on-campus accommodation should be provided free or low cost (3.4%); and
- residentials defeat the purpose of off-campus study (3.4%).

None of these comments could be considered positive in favour of residential sessions. Very few comments supportive of residential sessions were noted, the first one being equal 15th in frequency of occurrence.

The comparative literature relating to on- and off-campus education reveals no significant difference in measurable learning outcomes[17,18]. The Engineers Australia accreditation policy describes an approach to accreditation based on demonstrated outcomes[19], but, the introduction of a mandatory requirement that all undergraduates must attend on-campus for

two weeks for each full-time year of their program seems to belie this. An outcomes-based approach to assessment is based on the premise that the outcomes are tangible, justifiable, measurable and open to delivery by a range of means. If an outcome is not measurable, it is not an outcome, it is a prescription. The prescription that off-campus students must attend on-campus for minimum periods to soak up some, as yet, ill-defined 'on-campus experience', and that this experience cannot be developed by other means, suggests a nagging fear that off-campus study is inferior to on-campus study. In fact, there is evidence that we should be sending on-campus engineering undergraduate students off-campus into the engineering workforce to properly develop professional practice skills[20], rather than compelling mature age members of the engineering workforce to attend on-campus for arbitrary periods. Of course, if an educational institution would prefer an alternative accreditation criterion to apply, it is incumbent upon them to demonstrate that the alternative process is equivalent. This suggests a challenging research agenda for those with a stake in off-campus engineering education.

Conclusions

The median off-campus response to the impact that the introduction of mandatory 2-week residential attendance for each year of full time study would have on their decision to enrol in their course was 'extreme impact'. 68.7 percent of off-campus students reported that they would not be able to attend residential sessions. The principal factors identified by off-campus students as likely to cause difficulty for them in attending a 2-week residential session were getting time off work, followed by giving up leave/holidays. There was very little support from any students for the introduction of residential sessions. The School should expect that the introduction of mandatory residential sessions will reduce the number of off-campus students enrolling to study engineering and technology. 2005 off-campus enrolments bear out this prediction.

In engineering, off-campus study is an essential element of access to education for those in remote locations and/or seeking to upgrade their qualifications whilst employed. As one of the two providers of comprehensive off-campus engineering studies in Australia, as an engineering School that has a past history of pioneering innovation in flexible delivery, and as a School located within a university that espouses a rhetoric of equity and access to education, the School of Engineering and Technology should play an active role in setting the agenda, leading the debate and participating in the research related to off-campus engineering education in Australia and internationally.

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