On- and off-campus student persistence and academic performance

by Stuart R. Palmer and Sharyn L. Bray

A study of more than 9000 unit enrolments in an Australian engineering programme found that: (a) the off-campus withdrawal rate was close to twice that for on-campus students; (b) whether a student withdrew or not was highly correlated to their mode of study; (c) the rate of withdrawal was significantly different between the two student groups; (d) the grade distribution for completing students was significantly different between the two groups; (e) the mean final grade was significantly higher for off-campus students; (f) the failure rate for off-campus students was significantly lower; and (g) the overall wastage rate (withdrawn rate plus fail rate) was significantly higher for off-campus students.

Flexible delivery of engineering and technology education is now an essential component of the engineering education scene, catering for significant numbers of students who cannot attend traditional, full-time, on-campus studies. A key driver in the development of engineering and technology programmes that incorporate flexible delivery is the culture of life-long learning that has arisen from the need to re-equip people with new skills resulting from organisational and technological change. It is unrealistic to expect organisations to release staff to attend full-time, on-campus study; engineering and technology programmes need to cater for mature-age students in the workplace who are upgrading their qualifications and skills.

In Australia, most engineering and technology undergraduates studying in the off-campus mode are mature-age students. The literature suggests that:

- engineering students have one of the highest withdrawal rates of all disciplines
- off-campus students have higher withdrawal rates than on-campus students; and
- mature-age students have higher withdrawal rates than conventional entry students.

This suggests that off-campus mature-age engineering students would have a relatively high rate of withdrawal from their studies prior to completion. The literature also suggests that of those students that persist (don't withdraw), off-campus students have a better academic performance than their on-campus counterparts. The engineering and technology programmes at Deakin University in Australia cater for both on-campus conventional entry students and mature-age off-campus students. Anecdotal reports from academic staff tended to support the general withdrawal and performance characteristics reported in the literature. However, no formal research had previously been conducted, and a cursory inspection of student academic records provided some counter examples to the accepted wisdom.

To gain an objective understanding of the withdrawal and performance characteristics of both on- and off-campus students in the engineering and technology programmes at Deakin University, a study was undertaken on more than 9000 unit enrolments over the period 1996 to 2000. This paper reports on the study and its results.

Student persistence and academic performance

A 1968 study in the United Kingdom found that engineering and technology students had one of the lowest rates of course completion in the normal course time (68%) and the highest rate on non-completion of studies (21.8%). Seymore and Hewitt, in an investigation of why United States science, mathematics and engineering (SME) students swap study majors, found that 38.1% of commencing engineering students swapped out of an SME study major. In a major United States study Astin reported that only 43% of first-year engineering students successfully completed their studies. Dobson, reporting on first-year progression rates in Australian universities in 1995, found that 22% of commencing engineering students where not successful in...
Educational studies, particularly in engineering, have shown varying outcomes. Shah and Burke, using Australian student data in 1996, concluded that "an engineering student has the lowest chance of completing a course while a law student commencing at the same age has the highest chance of doing so". In a 1997 review of Australian literature on the academic performance of mature-age students, Eaton and West report that mature-age students perform better than conventional entrants do (fewer failures and higher average grade), but have a higher dropout rate. Shah and Burke using Australian student data in 1996 concluded that the probability of course completion decreases with the age of the student and, in particular, that "A student who commences a course...in Engineering at an age of 24 years or more has a 50% or less chance of completing it."

From this, one can only conclude that a mature-age student studying engineering in off-campus mode must have close to the highest probability of 'dropping out' of all undergraduate students. Woodley and Parlett note that the terminology used in the literature relating to student persistence and academic performance varies widely and is not consistent. Based on their work, the following definitions relating to engineering studies at Deakin University are proposed:

- non-completion of final enrolment—new students who are offered a place on a course, but who do not confirm their enrolment by the enrolment cut-off date
- withdrawal—students formally enrolled in a unit of study but who officially withdraw prior to the end-of-semester exam
- failure—enrolled students who did not withdraw and did not attain a pass grade in the unit of study
- wastage—the proportion of enrolled students who did not attain a pass grade in the unit of study, that is, the proportion of enrolled students in the category of 'withdrawal' and 'failure'.

The Deakin University engineering programmes

In Australia the standard entry into professional engineering practice is via the completion of a four year Bachelor of Engineering (BE) undergraduate course. The Deakin School of Engineering and Technology offers three year Bachelor of Technology (BTech), four year BE, Masters and Doctoral engineering programmes in flexible delivery mode. The undergraduate programmes are delivered in both on-campus and off-campus modes. A student studying full time would normally be enrolled in four units of study per semester. Conventional-entry students would normally undertake these programmes on-campus and full-time, with some of these students taking part or all of their studies part-time and/or off-campus in later years to better suit their employment or other personal circumstances. Mature-age students may study the programmes on-campus, full-time, but many elect to study off-campus and/or part-time because of...
Fig. 1 Deakin University engineering student testing a line-following robot constructed as part of a mechatronic design unit.

employment or other commitments. The programmes are designed to articulate tightly with a range of national and international vocational, technical and diploma level engineering study programmes. A formalised system of granting advanced standing into the course based on recognition of prior learning (RPL) and workplace experience has been developed that permits block credit of up to one-third of a Bachelor of Technology degree and up to half of a Bachelor of Engineering degree.

The flexible delivery and articulated entry characteristics of these engineering programmes mean that students studying in off-campus mode form a significant proportion of the total student population at the Deakin School of Engineering and Technology. Hence it is important for the School to understand the characteristics and performance of this student group, along with those of the conventional-entry student group studying on-campus. Previous research in the School identified that off-campus students are predominantly mature aged at the commencement of their studies, with a significantly different age distribution to their on-campus counterparts (on-campus mean = 18.5 years, standard deviation = 2.1; off-campus mean = 34.4 years, standard deviation = 7.2). In the School there was anecdotal evidence that off-campus students had higher drop-out rates, but those that persisted performed better academically than on-campus students. However, preliminary investigations yielded some counter examples to these commonly held beliefs. It was considered important to determine objectively the rates of persistence and academic performance of the two principal classes of students in the School. This was not intended to fuel any debate about which was the 'better' student group or the 'better' mode of study. Rather, it was intended to assist the academic staff of the School to understand the different characteristics of these two student groups so that teaching and learning strategies could be best adapted to their differing circumstances.

Methodology

This research study aimed to discover quantitative relationships between academic performance and mode of study via a longitudinal statistical analysis of student academic results in a representative cross-section of study units from the undergraduate engineering programmes at Deakin University. Ten units of study were selected from the first two years of the Deakin engineering programmes. The units were chosen because they were common to all or most of the engineering disciplines on offer, hence capturing the full diversity of the major study areas selected by students, as well as having relatively large enrolments to enhance the validity of statistical comparisons. The range of subject areas covered by these units included physics, mathematics, computing, engineering science and engineering management. Various units included significant laboratory work, computer programming, mathematical problem formulation and solution, case study investigation, essay/report writing, spatial visualisation and CAD drafting.

The list of units included in the study and their nominal year level are included in Table 1.

<table>
<thead>
<tr>
<th>Unit code</th>
<th>Unit name</th>
<th>Year Level</th>
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</thead>
<tbody>
<tr>
<td>SCC172</td>
<td>Basic programming concepts</td>
<td>1</td>
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<tr>
<td>SCM113</td>
<td>Discrete mathematics</td>
<td>1</td>
</tr>
<tr>
<td>SCM124</td>
<td>Introduction to mathematical modelling</td>
<td>1</td>
</tr>
<tr>
<td>SCM228</td>
<td>Engineering mathematics</td>
<td>2</td>
</tr>
<tr>
<td>SEB121</td>
<td>Fundamentals of technology management</td>
<td>1</td>
</tr>
<tr>
<td>SEB221</td>
<td>Managing industrial organisations</td>
<td>2</td>
</tr>
<tr>
<td>SED102</td>
<td>Engineering graphics and CAD</td>
<td>1</td>
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<tr>
<td>SEM111</td>
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<td>1</td>
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<td>SEM212</td>
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Table 2: Summary results for individual units and all units combined

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<th>Enrolment, no.</th>
<th>Enrolment, %</th>
<th>Withdrewn</th>
<th>Mean score</th>
<th>Failed</th>
<th>Wastage</th>
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<td>62.9%</td>
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<td>23.3%</td>
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<td>59.4%</td>
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<tr>
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<tr>
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<td>48.0%</td>
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</tbody>
</table>

From the university student information database, enrolment and results data were downloaded for each of the units identified in Table 1 for the years 1996 to 2000 inclusive. After manual editing to remove duplicate student records, non-engineering students and other extraneous data, the following statistics were compiled for each unit in each year:

- number of students enrolled—on-campus/off-campus
- percentage of enrolled students withdrawn—on-campus/off-campus
- chi-square test of independence of study mode and withdrawn status
- large-sample inference test of the proportions of withdrawn students in the on- and off-campus groups
- excluding withdrawns, chi-square test of homogeneity for the distribution of final grades (fail/pass/credit/distinction/high distinction) between on- and off-campus students
- excluding withdrawns, mean final score—all/on-campus/off-campus
- excluding withdrawns, one-way analysis of variance (ANOVA) test of mean final score for on- and off-campus groups
- excluding withdrawns, percentage of students who failed to pass—all/on-campus/off-campus
- excluding withdrawns, large-sample inference test of the proportions of failed students in the on- and off-campus groups
- percentage of enrolled students 'wasted', that is, the percentage of withdrawn and failed students combined
- large-sample inference test of the proportions of wastage in the on- and off-campus groups.

For each unit the data for the five years 1996–2000 was combined and the above statistics were recompiled to provide an overview of each unit. Finally, all data collected was combined and the above statistics were recompiled to provide an overview of student performance in the engineering programmes at Deakin University. For this research project, a statistical significance level of 0.01 was used.

Results

The data collected represents 9245 student enrolments in individual units of study (subjects). 5922 (64.1%) of these enrolments were on-campus students and 3323 (35.9%) where off-campus students. Table 2 presents the results compiled for each unit from the combined summary unit data over the period 1996 to 2000. Any significant deviation in the data for particular years compared to the combined summary results is noted in the Discussion section below. Table 2 also presents the overall results compiled from all of the collected data.
combined. Where there is a statistical difference between on- and off-campus results (p = 0.01) the data pair is shaded. Fig. 2 presents the distribution of final grades for on- and off-campus students based on all data combined.

**Discussion**

**Overall**

Combining all collected data, the following observations were made. Overall, the off-campus withdrawal rate was close to twice that for on-campus students; whether a student withdrew or not was highly correlated to mode of study ($\chi^2 = 541.528, p < 1 \times 10^{-19}$) and the rate of withdrawal was significantly different between the two student groups ($Z = -19.062, p = 0.000$). The grade distribution for completing students was significantly different between the two groups ($\chi^2 = 199.109, p < 1 \times 10^{-19}$) (see Fig. 1) and the mean final grade was significantly higher for off-campus students ($F = 66.684, p < 1 \times 10^{-19}$). The failure rate for off-campus students was significantly lower ($Z = -3.008, p < 0.003$), and the overall wastage rate was significantly higher for off-campus students ($Z = -12.570, p = 0.000$).

**Persistence**

In all except one (SEM212 in 1996) of the 50 cases investigated the off-campus withdrawal rate was found to be greater than the corresponding on-campus rate, and in a majority of cases the difference was statistically significant. After combining the five sets of data for each unit, only one unit (SEM212) out of ten had a withdrawal rate that wasn't significantly different between the two student groups—the enrolment in SEM212 was significantly less than other units, leading to less robust statistical inferences.

When withdrawal and failure rates were combined to yield wastage, there were only two units (SCM228 and SEM212) out of ten where the wastage rate wasn't significantly greater for off-campus students. It is interesting to note that SCM228 is a second year mathematics unit that follows on from SCM113 and SCM124, and SEM212 is a second year materials unit that follows on from SEM111. It could be suggested that students experiencing difficulty in these subject areas may have already withdrawn or failed at the first year level, leading to lower wastage rates at the second year level. The high wastage rate at the commencement of studies for off-campus students is noted in the literature. It is further noted that the only other second year level unit included in the study is SEB221, a second year engineering management unit that follows on from SEB121. Unlike SCM228 and SEM212, SEB221 did have a significantly higher wastage rate for off-campus students. But, many off-campus students are routinely exempted from SEB121 because of RPL. So, for many off-campus students SEB221 will be the first unit in the engineering management studies stream that they encounter, and hence it may also have a higher wastage rate similar to many first year level units.

The overall wastage rate obtained by combining data from all units, for all years and both modes of study was 48.0%; this implies a persistence rate of 52.0%. This result is likely to be influenced both by the significant proportion of off-campus/mature-age students in the survey group (who have high wastage rates) and the fact that the data is drawn from first and second year level units (which have high wastage rates). However, it is not markedly lower than the value of 55.8% reported in 1997 for all Australian engineering and surveying students who commenced their studies in 1992.
Academic performance

After combining the five sets of data for each unit, the grade distributions of the two student groups were equally split—five were significantly different and five were not—while for the mean final grade four units were significantly different and six were not. As noted previously, when all data were combined, the overall grade distribution and mean final grade were significantly different, with off-campus students showing a mean final grade approximately 4.7% higher than on-campus students. In only two of the 50 cases investigated was the off-campus failure rate significantly different to the on-campus rate. Additionally, in both cases the off-campus failure rates were not markedly different from other years; the difference was that the corresponding on-campus failure rates were dramatically lower than other years.

General

The literature notes that for off-campus/mature-age students, there are often competing demands for their time from home, work and study, and reconciling all of these may not always be possible1,2. Traditionally, it has been held that factors external to, and beyond the control of, the university, such as changes in family or employment circumstances, prior academic preparation of the student, and health problems, are the major causes of why off-campus/mature-age students withdraw from study3. A study of off-campus programmes at Deakin University in 1980 and 1981 by Edge appeared to support this position4. However, a later investigation at Deakin in 1995 by Brown found that internal factors, such as insufficient support from tutors, were given as the major reasons for student discontinuance5. In 1996 the School of Engineering and Technology undertook a telephone survey in which 179 off-campus students were contacted to identify any factors contributing to difficulties in their studies. For those students who had already withdrawn, the principal reasons given for discontinuance were workload and health problems. However, across all off-campus students surveyed a wide range of factors, some under the control of the university, were identified as causing study difficulties, these included the following:

- late delivery of study materials from the university
- delivery of incomplete and/or damaged and/or incorrect study materials from the university
- academic difficulties—struggling with study, particularly mathematics requirements
- computer problems—unable to access the university network and/or install software required for a unit
- unable to attend on-campus practical/laboratory work sessions
- competing demands of work, family and study
- complaints with assessment of work and/or assignment feedback
- complaints with assessment of advanced standing into the course
- financial problems—unable to afford a computer/in transit employment

Fig. 3 Engineering students operating equipment in a flexible manufacturing cell at Deakin University. Does interaction among students influence withdrawal rate and academic performance?

- change of address—university lost contact with students
- examination arrangements—unsure how to arrange for examination in a remote location
- lack of information/guidelines on assignment requirements
- would prefer to study at own pace rather than conform to the university’s semester timetable.

Off-campus student success is affected by both internal and external factors. While some of these external factors are beyond the control of the university, there is much that the university can do to address internal factors within its control and reduce student wastage. University educational and administration systems are often designed around an idealised model of student preparation and circumstances. While a vision of an ‘average’ student may be a workable approximation for conventional-entry on-campus students, the diversity of off-campus/mature-age students requires more flexible university systems6; there is a need to recognise the ‘complex personal equations operating with individuals’7 and to design systems to accommodate them.

In Australia, there is competition between universities for engineering students. For the School of Engineering and Technology off-campus/mature-age students are an important element of the portfolio of undergraduate student enrolments. In all universities the desire to achieve enrolment targets should be balanced with ensuring that accepted students have a genuine likelihood of course completion. With reference to the OUUK, the literature suggests:

‘...the university...should aim to provide such adequate diagnostic, support and remedial material that the student’s decision to register finally is a constructive and realistic one.’8
'Drop-out could be reduced if greater efforts are put into encouraging people to consider fully their situation before registering for a course. Better course descriptions and sample course materials would ensure students know exactly what they are registering for.'

Conclusions

Based on a longitudinal study of 9245 unit enrolments in first and second year level units in the undergraduate engineering programmes at the Deakin University School of Engineering and Technology, the conventional wisdom regarding the persistence and academic performance of off-campus students was confirmed. It was found that overall:

- the off-campus withdrawal rate was close to twice that for on-campus students
- whether a student withdrew or not was highly correlated to mode of study
- the rate of withdrawal was significantly different between the two student groups
- the grade distribution for completing students was significantly different between the two groups
- the mean final grade was significantly higher for off-campus students
- the failure rate for off-campus students was significantly lower
- the overall wastage rate (withdrawn rate plus fail rate) was significantly higher for off-campus students.

Additionally, it was found that the year level of the unit influenced the off-campus wastage rate. Where the unit was the first in a study stream sequence to be influenced the off-campus wastage rate. Where the unit was enrolled in the same unit. Where the unit was the situation before registering for a course. Better registering course descriptions and sample course materials whether a student withdrew or not was highly significant different between the two student groups

References

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