The debate in drama-in-education has shifted significantly since the 1980s. In the here-and-now, notions of self and others and the enactment of self-knowledge in the drama classroom, as I have observed when working with young people, are inextricably linked to gendered identities. Boumelha (1994) states, “It is impossible to stand outside the systems of gender difference…none of us can say ‘That doesn’t affect me’” (p. *ix*). As the teacher and researcher I continue to learn from my students about my own practices as well as their perceptions of themselves as gendered individuals. In the words of Angela McRobbie (1991) “For me… I am continually learning from my students in the same way as I hope they are learning from me” (p. 73). Lifelong learning embodies gender. Gender, as an agent for knowing self and others, is a discourse that gives form and shape to identity.

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COMPARATIVE ACADEMIC PERFORMANCE OF LIFELONG LEARNERS IN ENGINEERING AND TECHNOLOGY

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ABSTRACT

The engineering-technologist degree is an important element of continuing engineering education for many members of the engineering workforce. This paper reports on the study of close to 9000 unit enrolments to gain an objective understanding of the withdrawal, persistence, and academic-performance characteristics of both engineering-technologist and professional-engineering students.

INTRODUCTION

In many countries, including Australia, the engineering workforce incorporates the occupational classifications of professional engineer and engineering-technologist. Entry to these professional occupations normally requires the completion of a four-year and three-year, respectively, undergraduate university bachelor’s degree. The engineering-technologist degree is an important element of lifelong learning and continuing education for many members of the engineering workforce returning to study in order to upgrade their formal academic qualifications. In Australia, professional-engineering and engineering-technologist programs can be found together in the same institution, with students from both programs studying some common units.

Anecdotal reports from Deakin University academic staff indicated a perception that engineering-technologist students were not as academically strong as their professional-engineering counterparts, and were more likely to withdraw from or fail to pass units in which both student groups were enrolled. However, no formal research had previously been conducted. So, to gain an objective understanding of the withdrawal and performance characteristics of both engineering-technologist and professional-engineering students in the engineering and technology programs at Deakin University, a study was undertaken of close to 9000 unit enrolments over the period 1996 to 2000.

THE AUSTRALIAN ENGINEERING WORKFORCE

Prior to 1980, a four-year bachelor of engineering and a three-year diploma of engineering were available in Australia as undergraduate university programs. Both these credentials led to professional-engineering status and full membership of the Institution of Engineers, Australia (IEAust). After 1980, in an effort to standardise entry qualifications and clarify educational pathways, the IEAust removed the diploma route to professional-engineering status. This change created an occupational gap between professional engineers and two-year qualified engineering associates. A 1989 report on lifelong learning, which articulated education for the engineering workforce, recommended the recognition of a new, three-year professional qualification for the distinct occupational category of "engineering-technologist" (Lloyd, Stokes, Rice, & Roebuck, 1989). The IEAust supported this move and incorporated this occupational category into its National Generic Competency Standards that provides the framework linking occupational classification, educational preparation, and professional recognition in Australia. 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;
- engineering tradesperson – trade qualified (Institution of Engineers Australia, 1999).

THE DEAKIN UNIVERSITY ENGINEERING AND TECHNOLOGY PROGRAMS

The Deakin University School of Engineering and Technology offers a three-year bachelor of technology (BTech) program, a four-year bachelor of engineering (BE) program, and Masters and Doctoral engineering programs in flexible delivery mode. The BTech program provides an exit point with a nationally-recognised, professional qualification for those students aspiring to the occupation of engineering-technologist, as well as for those intending BE students who, for academic, employment, or other reason(s), are not able to complete the four-year course. The BTech program also provides a staging post for students who are unsure of their capacity to complete the BE course to "test the water" and to swap courses if their preliminary studies provide confidence boosts.

The BTech degree at Deakin is an important avenue for continuing engineering education; a previous survey of graduates of the School of Engineering and Technology's undergraduate programs (Palmer, 2002) revealed that BTech students are older (more likely to be mature-age students) and are more likely to study off-campus (because of work and other commitments) than their BE counterparts. Survey respondents had been graduates for four years or less, and the average age of BTech respondents was 33.5 years, compared to 28.0 years for BE respondents – this was significantly different ($F_{41} = 6.031$, $p < 0.019$). The proportion of BTech respondents studying in the off-campus mode was 52.9 percent, compared to 12.0 percent for BE respondents – this was also significantly different ($X^2_1 = 8.311$, $p < 0.004$). 40.5 percent of respondents were BTech graduates, hence BTech students comprise a significant group amongst all undergraduates in the Deakin School of Engineering and Technology.

An investigation of the attributes or competencies required by the engineering professional accrediting bodies in the UK (Engineering Council), USA (Accreditation Board for Engineering and Technology), and Australia (IEAust) for the occupational categories equivalent to professional engineer and engineering-technologist reveal,

- a high degree of consistency between the three countries,
- the differences between the two occupational categories are of degree or depth rather than kind (Lloyd, Ferguson, Palmer, & Rice, 2001).

This similarity and difference is reflected in the Deakin BE and BTech programs for the Manufacturing discipline. BE students complete 32 units of study over four years (or equivalent) while BTech students complete 24 units of study over three years (or equivalent). The BTech course contains four elective units, and of the remaining 20 units, all but four (hence 16) are identical to those taken by the BE students. The four units unique to the BTech course are two units of mathematics and a unit of physics that employ an algebraic foundation rather than calculus, and a single-semester, final-year project unit. The BE course contains four elective units, the 16 units common with the BTech course and an additional 12 units (equivalent to one and a half years) unique to the BE program. These 12 units include a calculus-based mathematics and physics foundation, a broader range of engineering technology units, additional engineering design units, an additional management unit, and a two-semester final year project.

With 16 common units between the two programs, there are a significant number of classes with both BTech and BE students. Perhaps because the BTech course has reduced secondary-school mathematics and science entry prerequisites compared to the BE course, there has been an anecdotal perception amongst some academic staff that BTech students are not as “academically strong” as their BE counterparts and hence, in BE/BTech common units, more prone to withdrawing from study prior to the exam and/or more likely not to pass the unit. Given that BTech students form a significant proportion of the school’s total undergraduate enrolment, it was considered important to objectively determine the 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; 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 appropriately adapted.

METHODOLOGY

This research study aimed to discover quantitative relationships between academic performance and course of study via a longitudinal statistical analysis of student academic results in a representative cross-section of study units from the undergraduate engineering programs at Deakin University. Ten units of study were selected from the first two years of the Deakin engineering programs. The list was chosen to include units common to both the BE and BTech programs, as well as some units prescribed only for the BE program but which include some BTech-enrolled students who elect to study at a higher level and/or hope to change courses. Another selection criterion was to use data from units having relatively large enrolments. This was done in order to enhance the validity of the statistical comparisons. The inclusion of level-one and level-two mathematics, management, and materials units allowed issues of first-year progression in these subject areas to be considered. The range of subject areas covered by these units included physics, mathematics, computing, engineering science, and engineering management. The list of units included in the study, and their nominal year level, is included in Table 1; those shaded are prescribed for the BE program only.

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. The following statistics were compiled for each unit in each year;

- number of students enrolled – (all, BE, and BTech);
- percentage of enrolled students withdrawn (student terminated unit enrolment) – (all, BE, and BTech);
- chi-square test of independence of course enrolment and withdrawn status;
- large sample inference test of the proportions of withdrawn students in the BE and BTech groups;

Unit code	Unit name	Year level
SCC172	Basic programming concepts	1
SCM113	Discrete mathematics	1
SCM124	Introduction to mathematical modelling	1
SCM228	Engineering mathematics	2
SEB121	Fundamentals of technology management	1
SEB221	Managing industrial organizations	2
SED102	Engineering graphics and CAD	1
SEM111	Materials 1	1
SEM212	Materials 2	2
SEP101	Physics 1A	1

Table 1. Units included in the research study.

- excluding withdrawns, chi-square goodness-of-fit test for the distribution of final grades (fail/pass/credit/distinction/high distinction) between BE and BTech;
- excluding withdrawns, mean final mark/score – (all, BE, and BTech);
- excluding withdrawns, one-way analysis of variance (ANOVA) test of mean final score for BE and BTech groups;
- excluding withdrawns, percentage of students who failed (to pass) – (all, BE, and BTech);
- excluding withdrawns, large sample inference test of the proportions of failed students in the BE and BTech 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 BE and BTech groups.

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

RESULTS

The data collected represents 8915 student enrolments in individual units of study (subjects). 6380 (71.6 percent) of these enrolments were BE students and 2535 (28.4 percent) were BTech 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 below. Table 2 also presents the overall results compiled from all of the collected data combined. Where there is a statistically significant difference between on- and off-campus results ($p \leq 0.01$) the data pair is shaded. Figure 1 gives the distribution of final grades for BE and BTech students based on all data combined.

DISCUSSION

Overall

Combining all collected data, the following observations were made. Overall, the BTech withdrawal rate was about 20 percent higher than for BE students, whether a student withdrew or not was highly correlated to course enrolment ($X^2_5 = 40.107$, $p < 1.5 \times 10^{-7}$) and the rate of withdrawal was significantly different between the two student groups ($Z = -6.027$, $p < 1.7 \times 10^{-9}$). There was no significant difference between grade distribution, mean final mark or failure rate between the student groups. Because of the higher rate of withdrawal for BTech students, the corresponding overall wastage rate was also found to be significantly higher ($Z = -5.155$, $p < 2.6 \times 10^{-7}$).

Unit	Course	Enrolment (no.s)	Enrolment (%)	With-drawn	Mean score	Failed	Wastage
SCC172	BE	676	68.0 %	32.7 %	58.8 %	19.6 %	45.9 %
	BTech	318	32.0 %	34.9 %	55.3 %	29.0 %	53.8 %
	All	994	100.0 %	33.4 %	57.7 %	22.5 %	48.4 %
SCM113	BE	746	87.8 %	23.7 %	59.8 %	22.5 %	40.9 %
	BTech	104	12.2 %	35.6 %	62.5 %	14.9 %	45.2 %
	All	850	100.0 %	25.2 %	60.1 %	21.7 %	41.4 %
SCM124	BE	889	89.3 %	41.1 %	52.0 %	31.7 %	59.7 %
	BTech	106	10.7 %	50.0 %	49.6 %	39.6 %	69.8 %
	All	995	100.0 %	42.0 %	51.8 %	32.4 %	60.8 %
SCM228	BE	537	82.1 %	27.8 %	59.7 %	16.2 %	39.5 %
	BTech	117	17.9 %	19.7 %	63.4 %	11.7 %	29.1 %
	All	654	100.0 %	26.3 %	60.4 %	15.4 %	37.6 %
SEB121	BE	585	64.3 %	31.5 %	62.0 %	17.7 %	43.6 %
	BTech	325	35.7 %	35.1 %	59.5 %	15.6 %	45.2 %
	All	910	100.0 %	32.8 %	61.2 %	17.0 %	44.2 %
SEB221	BE	588	58.8 %	31.6 %	63.1 %	14.7 %	41.7 %
	BTech	412	41.2 %	35.9 %	64.9 %	9.1 %	41.8 %
	All	1000	100.0 %	33.4 %	63.8 %	12.5 %	41.7 %
SED102	BE	727	66.0 %	39.5 %	58.0 %	23.0 %	53.4 %
	BTech	374	34.0 %	52.1 %	53.1 %	27.4 %	65.2 %
	All	1101	100.0 %	43.8 %	56.6 %	24.2 %	57.4 %
SEM111	BE	643	66.8 %	42.2 %	63.6 %	17.2 %	52.1 %
	BTech	319	33.2 %	53.0 %	60.7 %	18.7 %	61.8 %
	All	962	100.0 %	45.7 %	62.8 %	17.6 %	55.3 %
SEM212	BE	211	65.3 %	19.9 %	62.1 %	13.6 %	30.8 %
	BTech	112	34.7 %	25.9 %	63.0 %	14.5 %	36.6 %
	All	323	100.0 %	22.0 %	62.4 %	13.9 %	32.8 %
SEP101	BE	778	69.1 %	25.5 %	60.9 %	19.8 %	40.2 %
	BTech	348	30.9 %	33.9 %	55.1 %	36.5 %	58.1 %
	All	1126	100.0 %	28.1 %	59.3 %	24.6 %	45.7 %
All units combined	BE	6380	71.6 %	32.6 %	59.6 %	20.4 %	46.4 %
	BTech	2535	28.4 %	39.3 %	58.8 %	21.6 %	52.4 %
	All	8915	100.0 %	34.5 %	59.4 %	20.7 %	48.1 %

Table 2. Summary results for individual units and all data combined.

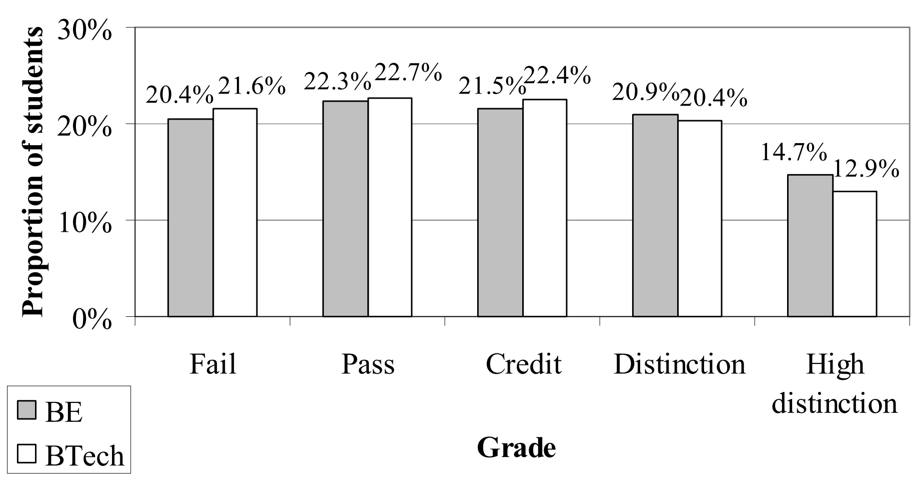

Figure 1. Distribution of final grades based on all data combined.

Persistence

Considering the combined summary results for each of the ten units, in only one unit, SCM228, was the BTech withdrawal rate lower than the corresponding BE rate. However, this is a second-level engineering mathematics unit, and BTech students enrolled in this unit must have already completed the level-one BE mathematics. So, presumably, any BTech students struggling with BE mathematics will have already left the BE mathematics stream.

This is suggested by the significant BTech withdrawal rates observed in the level-one BE maths units SCM113 (35.6 percent) and SCM124 (50.0 percent). In four of the ten units considered, the higher observed BTech withdrawal rate was statistically significant and, when all data were combined, the overall BTech withdrawal rate was significantly higher.

When withdrawal and failure rates were combined to yield wastage, again SCM228 is the only unit where the BTech rate is lower than the corresponding BE rate, presumably for the same reason(s). In three of the ten units the higher observed BTech wastage rate was statistically significant and, when all data were combined, the overall BTech wastage rate was significantly higher.

Academic performance

After combining the five sets of data for each unit, only one of the ten grade distributions was significantly different, that was for the physics unit SEP101. As noted previously, when all data were combined, the overall grade distribution was not significantly different – see Figure 1. Two units out of ten had a mean final mark that was significantly different, SED102 and, again, SEP101 – in both cases the mean BE mark was about 5 marks higher than the BTech result. As noted previously, when all data were combined, the overall mean final mark was not significantly different. Two units out of ten had a BTech failure rate that was significantly greater than the BE rate, SCC172 and, again, SEP101, where the BTech failure rate was approximately twice that of BE students. As noted previously, when all data were combined, the overall failure rate was not significantly different.

While overall there was no significant difference in academic performance between the two groups, the unit SEP101 Physics 1A, stands out as the exception, with significantly poorer academic performance by BTech students. This unit requires strong mathematics and science preparation, which BTech students may not have completed at secondary school. BTech students would not normally be enrolled in SEP101, but those considering transferring to the BE stream would take this unit instead of the unit SEP115 Physics for Technologists. SEP115 is an alternate version of the BE physics unit that covers principally the same topics, but employs an algebraic approach to the underpinning mathematics, rather than the calculus-based mathematics used on SEP101. Originally, all students were required to take SEP101, but poor results from BTech students resulted in the development of SEP115. The results obtained here suggest that the calculus mathematics continues to be a problem for BTech students, and supports the decision to introduce the alternate unit SEP115 for BTech students.

General

As noted previously, BTech students are more likely to be studying in off-campus mode and/or to be mature-age students. The literature suggests that students studying off-campus are less likely to complete their studies than their on-campus counterparts, but that those that do persist achieve comparable academic results on average. Glatter and Wedell, in 1971, suggested, "The purely quantitative data on wastage in correspondence courses indicates two things: that it is much higher than would be expected in full time oral courses; and that it is particularly heavy in the early stages of a course...At examinations, correspondence students seem to do as well or better than their counterparts taught the same subject orally."(p. 49) McIntosh and Morrison report on two Australian studies in 1965 and 1967 that show an average 33 percent withdrawal rate for first-year correspondence students, with only 34 percent eventually graduating (McIntosh & Morrison, 1974). Woodley and Parlett reporting on Open University of the United Kingdom (OUUK) students in 1982 found that 28 percent of provisionally enrolled new students did not complete their final registration; for all students finally enrolled, 24 percent withdrew prior to their course examination. Furthermore, the failure rate for those that sat their final examination was 6 percent; giving a overall "wastage" figure of 29 percent of all enrolled students (Woodley & Parlett, 1983). Urban et al., in a 1997 review of Australian students who commenced their studies in 1992, found that full-time students had the highest completion rate (73 percent) while external students had the lowest completion rate (37 percent); the mode of study was significantly correlated to academic outcome (Urban et al., 1999).

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. Eaton reported that mature-age students have comparable failure and withdrawal rates to conventional entrants, but achieve higher academic results than their younger counterparts (Eaton, 1980). In a 1980 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 (Eaton & West, 1980). Shah and Burke using Australian student data in 1996 concluded that the probability of course completion decreases with the age of the student (Shah & Burke, 1996).

CONCLUSION

Based on a longitudinal study of 8915 unit enrolments in first- and second-year level units in the undergraduate engineering and technology programs at the Deakin University School of Engineering and Technology, it was found, overall, that

- the BTech withdrawal rate was about 20 percent higher than for BE students,
- whether a student withdrew or not was highly correlated to course enrolment,
- the rate of withdrawal was significantly different between the two student groups,
- the grade distribution was not significantly different between the student groups,
- the mean final mark was not significantly different between the two student groups,
- the failure rate was not significantly different between the two student groups,
- the overall wastage rate (withdrawn rate plus fail rate) was significantly higher for BTech students (principally due to the high rate of withdrawal for BTech students).

The higher BTech withdrawal rate may be due to the fact that BTech students are more likely to be studying in off-campus mode and/or be mature-age students. While this result is compatible with the suggestion from the literature that these classes of student have a higher rate of withdrawal from studies, further research exploring the individual reasons for student withdrawal is required for a definitive answer. For those students that persisted in their studies, generally, there was no overall significant difference in academic performance in terms of grade distribution, mean final mark, and failure rate. The anecdotal perception that BTech students are not as academically strong as their BE counterparts is not supported by these findings, and this result has been conveyed to staff at the school in an effort to counter this perception. The findings do not suggest that changes in current teaching approaches are required, but do provide support for the dual-stream mathematics approach – algebraic maths for BTech students and calculus maths for BE students, with bridging options for those transferring between the courses.

This research suggests that when lifelong learners study alongside conventional entry students, educators should take into account the likely higher withdrawal rate of off-campus and mature-age students, and provide appropriate alternative learning paths that consider the likely difference in educational preparation of those enrolled.

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A WHOLE NEW BALL-GAME: GENERIC SKILLS IN AN ENGINEERING SCHOOL – ARE THEY TAUGHT, OR MERELY CAUGHT?

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ABSTRACT

This paper explores the self-reported changes in the perceptions of 13 engineering students over a semester-long course, *Communication, Technology and Science*, (CTS) in their degree program. The CTS curriculum builds awareness of students needs for a broad range of lifelong learning abilities through generic skill development in a professional engineering context, and includes opportunities for students to develop such skills.

INTRODUCTION

Griffith University, in common with all Australian universities, recognises the importance of lifelong learning for its students and graduates, and indeed, builds its mission statement on the centrality of lifelong learning to personal and professional development throughout life. Similarly, it is committed to the development of students' generic skills while at university and after graduation, with its sponsorship over a number of years of the Griffith Graduate Project[1] and the primacy given to its statement of graduate skills and attributes in its Strategic Plan (2003-2007):

> Griffith graduates will be known for their expertise and ability to apply their multi-disciplinary knowledge and skills in innovative ways to novel problems. They will possess high levels of skills in: oral and written communication; problem solving; analysis and critical evaluation; information literacy - and the ability to: undertake independent life-long learning; initiate and lead enterprises; work effectively as a member of a team; assume responsibility and make decisions; undertake employment or further study, nationally and internationally - combined with high ethical standards.

This paper will outline one of the ways in which the university's commitment to lifelong learning and generic skills development has taken hold in an engineering school which traditionally, and not unusually for the discipline, has eschewed such notions as "soft" and "irrelevant." It represents a case study of a teaching and learning innovation designed to demonstrate to students the importance of self-awareness, self-knowledge, and self-development by providing structured opportunities for self-monitoring and reflection.

[1] The Griffith Graduate Project is sponsored through the Vice-Chancellor's Strategic Development Fund and has run since 1999 at Griffith University.