

INTERNATIONAL STUDENT PERFORMANCE IN THE PROFESSIONAL DEVELOPMENT COMPONENT OF THE ENGINEERING DEGREE

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Abstract

Prior studies conducted, based on the student progress unit, appear to indicate that international students outperform their Australian counterparts in the engineering field. It has been proposed that international students are highly motivated to pass units due to the higher penalty of failure in light of the additional burdens they face (e.g. upfront fees, relocation, economic pressures etc), resulting in better relative international student pass rates. The higher international student progression rate is therefore not overly surprising in the technical component of the engineering degree, as this does not rely heavily on English language ability. It is the professional development component of the engineering degree, which requires the student to possess the ability to effectively communicate both verbally and in written English, which raises some cause for concern.

The question of the relative performance of international students in the professional development component of the engineering degree was studied by examination of the students enrolled in the Introduction to Professional Engineering unit at the University of Western Australia over the past five years. The study methodology consisted of the analysis of student results, comparing international and Australian student performance. In addition, a comparison of international student success and university English competency level through which the student was granted university entrance was also conducted. Further explanatory information was collected through the administration of surveys and interviews of international students enrolled over the past two years.

The present study showed that over the last five years, international students have scored significantly lower in the professional development component of the engineering degree, relative to the Australian students. They also display significantly lower progression rates. The primary reason identified for this difference is the level of English language competency at commencement of the degree. A large number of the international students consulted did not believe their English was at an adequate level to pass the introductory professional development unit nor did they believe sufficient assistance with language difficulties was available throughout their studies. The locally run entry avenue courses (preferred by many students over the internationally recognised tests such as the TOEFL and IELTS) were identified as very poor indicators of a student's English language and their ability to cope with the demands of the professional development component of the engineering degree. In this sense, the institution is not meeting the student expectation that being granted admission ensures that their English ability is sufficient.

To maintain or increase international student intake and continue to reap the accompanying benefits (i.e. educational, cultural, economic, etc) that this provides, it must be ensured that educational institutions meet the expectations of international students. In doing so, quality international student graduates, suitably skilled and prepared for a successful future are likely to be produced.

Introduction

To maintain and increase international student intake and continue to reap the accompanying benefits (i.e. educational, cultural, economic, etc) that this provides, it must be ensured that educational institutions meet the expectations of international students. Accompanying this, quality international student graduates, suitably skilled and prepared for a successful future are likely to be produced. A technique used to assess, in part, whether this is being accomplished are student progress unit studies. These are a convenient measure of the relative 'success' of international students as defined and discussed in Dobson, Sharma and Calderon (1998). In their paper, a number of prior student progress unit studies are examined. These studies conclude that international students outperform their Australian counterparts in the engineering field of study. The more recent study by the Department of Education, Science and Training (2004) resulted in the same conclusion. Dobson, Sharma and Calderon (1998) propose the higher penalty of failure for international students in light of the additional burdens (e.g. upfront fees, re-location, economic pressures etc) and the accompanying motivation to pass units that this provides as a reason for better relative international student performance. The higher international student progression rate is therefore not overly surprising in the technical component of the engineering degree, as this does not rely heavily on English language ability. It is the professional development component of the engineering degree, which requires the student to possess the ability to comprehend spoken and written English well and effectively communicate both verbally and in written English, which raises some cause for concern.

The Formation of a Professional Engineer

The engineering degree may be divided into two primary components; the technical component, comprising knowledge of mathematical and physical principles, modelling and analytic techniques and a set of generic skills forming part of the engineering graduate's professional development. These generic skills include team working ability, effective communication, problem solving approach and critical thinking ability and the awareness of social, cultural, ethical, and environmental and a plethora of other issues associated with the practise of engineering in a societal context.

In the University of Western Australia engineering courses, the aim is to develop two sets of attributes in engineering graduates, those mandated by Engineers Australia and those prescribed by the university. Compliance with the Engineers Australia set is an accreditation requirement. Adherence to the set prescribed by The University of Western Australia is important in that these characteristics distinguish a UWA degree from those of other universities. The Engineers Australia accreditation standard specifies that "All programs must ensure that their graduates develop to a substantial degree the following generic attributes or capabilities". The generic attribute of direct relevance to the professional development component of the engineering degree states that the student should develop the "ability to communicate effectively, not only with engineers but also with the community at large". UWA policy documents specify a set of characteristics of a UWA graduate in the following terms: "Students at The University of Western Australia are encouraged to develop the ability and desire ... to write and speak clearly, concisely and logically". Taken in conjunction with the general UWA guidelines on literacy which state "...a UWA degree will certify that a graduate has significant literacy skills contextually in the subjects in which they have majored and generally in terms of their ability to communicate in English" (UWA 2001), the emphasis on English language competency in producing quality engineering graduates is clear.

The foundation unit for the professional development of engineers in the UWA engineering curriculum is the core first year unit 'Introduction to Professional Engineering'. This unit lays the foundation for the professional development component of the engineering degree. Throughout this unit, students gain an appreciation of the engineering profession beyond the technical aspects and develop an understanding of issues such as those surrounding the

multi-disciplinary aspects of engineering and social and cultural influences on engineering practise.

More specifically, students are introduced to the multi-disciplinary nature of large engineering projects, allowing them to gain appreciation for aspects such as legal, contract, and project management issues. Students are exposed to the importance and role of sustainability in engineering design and the engineering life cycle and the various issues affecting an engineer's role in an organisational structure and in the broader community. Accompanying this is the development of awareness in students of the importance of intra- and extra-organisational communication and competent team working and communication skills including comprehension, technical report writing and oral presentation. Students are taught the essential elements of risk analysis techniques as applied in the engineering profession. Also covered in the unit are professional ethics, codes of conduct, values and social and cultural issues associated with the engineering profession and engineering projects. Students are taught to develop competent information accessing and source evaluation skills accompanied by an understanding of when it is necessary and how to reference and paraphrase material. Throughout the unit, the students are exposed to the variety of engineering and engineering related career paths available upon graduation.

The relative international and Australian (standard) student results in this unit (enrolment breakdown is provided in Table 1) are presented for the 2005 academic year (Figure 1 and Table 2), to illustrate quantitatively the motivation for the study undertaken.

Table 1 – IPE enrolment breakdown 2005.

Students	Number	%
International	42	11.60
Standard	318	87.85
Extension	2	0.55
Total	362	

Examination of this unit has indicated poor relative international student performance and accompanying dissatisfaction amongst this group of students. Observation of these students indicates that this trend continues throughout the remainder of the professional development component of the engineering degree. Since the technical component of most other units required for degree completion far outweighs the professional development component, the disparity in performance is not so apparent in these other units.

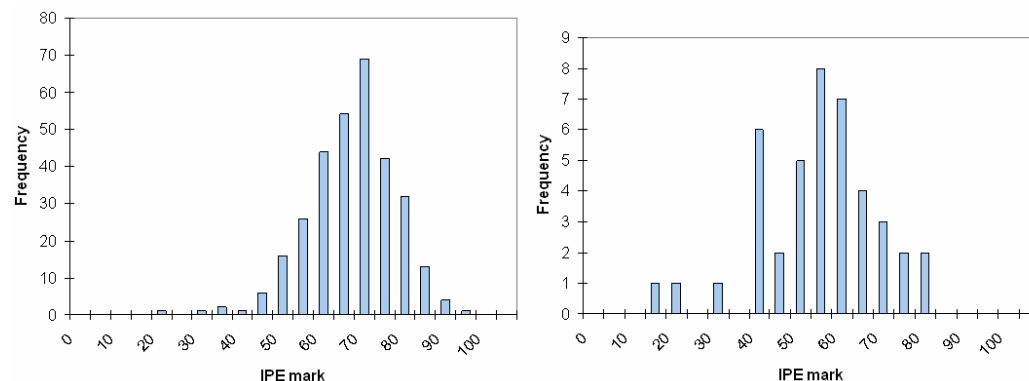


Figure 1 – Standard and International enrolment IPE marks 2005.

Table 2 – IPE marks by enrolment type 2005.

	INTERNATIONAL	STANDARD	TOTAL
mean	52.50	65.16	62.36
SD	14.48	10.74	14.78

As stated previously, the foundation unit for the professional development of engineers in the UWA engineering curriculum is the core first year unit 'Introduction to Professional Engineering'. There exists no other unit dedicated to the professional development of engineering students. This professional development continues throughout the engineering degree, but it is intertwined in the technical units and is thus difficult to separate for the purpose of studying the performance of various student groups. The question of the relative success of international students in the professional development component of the engineering degree was thus studied by looking at the students enrolled in the Introduction to Professional Engineering unit over the past five years.

Study Methodology

Examination of international student comparative success and progression rates in the professional development component of the engineering degree was approached with two complementary methods. Firstly, student marks for the academic years 2001 to 2005 were analysed to reveal any statistically significant differences between international and standard enrolments and to determine any relationship between international student success in the unit and the English competency entry avenue through which they had qualified to study Engineering at the University of Western Australia. This component of the study involved sample numbers of 194 international students and 1862 standard enrolments.

Secondly, surveys were administered and interviews conducted of the international students who had been enrolled in the unit over the past two years (a total of 88 international students were contacted). The questions covered in the survey and interviews were identical. The interviews however allowed further discussion and explanation of the responses received. A total of 23 complete survey and/or interview response sets were received, equating to a response rate of 26% for this part of the study.

The questions asked included:

- What method of entry did you follow to satisfy the university's English language requirements (e.g. TOEFL, IELTS, UWAFY, etc)?
- Why did you choose this entry method?
- Do you believe your English ability was good enough before starting the Introduction to Professional Engineering (IPE) unit?
- Was there enough help available within the IPE unit for any English language difficulties you had?

Integral to the issues under discussion are the entry avenues available to international students to satisfy the university English language requirements. At UWA there are 33 listed entry avenues identified for international enrolments, comprising of 55 English language testing mechanisms (UWA 2005). These entry avenues consist of a mix of internationally recognised tests and locally run courses. For example:

- TEE English & English Literature (50% pass mark)
- TER ESL (64.35% pass mark)
- TOEFL (Test of English as a Foreign Language)
- CELT (Centre for English Language Teaching UWA) (B grade pass level)
- IELTS (International English Language Testing System)
- UWAFY (UWA Foundation Year)
- WAUFP (WA Universities Foundation Program)

University policy states that "Literacy entry standards should be set at levels which prevent the admission of students who will not be able to cope with the demands of the particular course for which they enrol" (UWA 2001). Part of the present study was aimed at identifying entry avenues which were poor indicators of the minimum level of English language competency required to pass the unit. The study by Cotton & Conrow (1998) on the predictive validity of the IELTS entry test showed no statistically significant correlation

between any the test or subtests and any difficulties encountered with course work and academic performance. Examination of the correlation between IPE marks and English language related tertiary entrance subject scores (Figure 2) is in general agreement with this finding for several other English university entry requirement tests. Only around 13% of the variance in performance in IPE related to the student's English TEE mark obtained. The remaining 87% of the variance is attributable to other influences. The correlation between Physics 101 and TEE Physics, where a reasonable correlation might be expected, illustrates the notion that there are many other factors involved in the ability of these scores to predict success of students (see Table 3). The entry tests do not appear to be accurate indicators of relative academic performance. Correlations between English entry test scores and academic performance, in order to determine improved pass levels for these, were therefore not attempted in the present study.

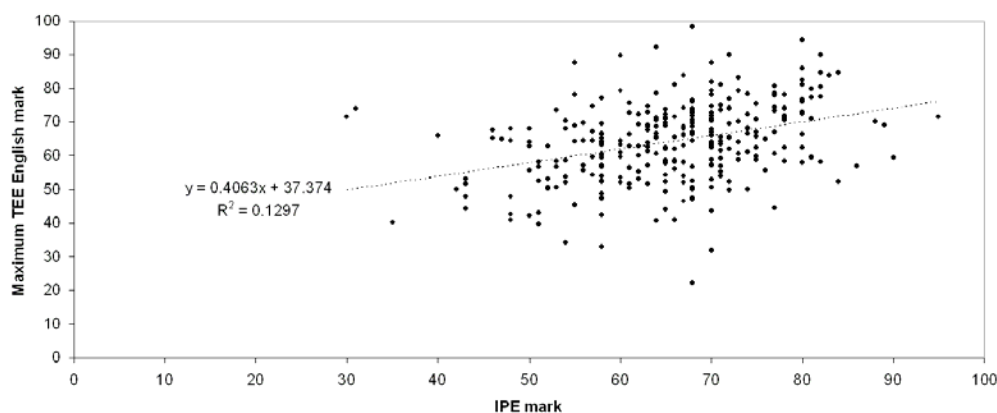


Figure 2 – Student IPE and TEE English marks, academic year 2005.

Table 3 – TEE mark correlation, academic year 2005.

UWA Unit	TEE	R ²
Physics 101	Physics	0.37
IPE 103	English, English Literature or ESL	0.13

Results & Discussion

Examining international student performance by looking at the student progress units (ratio of units passed to attempted) as presented in the work by Mackintosh and Olsen (2005) would appear to indicate that international students do better than their Australian counterparts. This type of study however, provides no indication of relative performance in these units or any breakdown of the results for technical and communication based units. Two measures of the relative academic success of international students in the professional development component of the engineering degree examined were the mean marks obtained and the student pass rates in the foundation unit. The data for academic years 2001 to 2005 is presented in Tables 4, 5 and 6. Immediately evident from these tables, is the disparity between international and standard enrolment grades and pass rates. International students clearly do not perform as well as their Australian counterparts. A peak difference of almost 13% in the mean mark and 26.6% in the unit pass rate are observed in 2005. All differences in the means are statistically significant at an alpha-level of 0.01.

Table 4 – International IPE enrolments progression rates and marks 2001-2005.

Year	INTERNATIONAL				
	Students	% of enrolments	mean IPE mark (%)	SD	Pass rate (%)
2001	33	8.68	62.76	10.46	90.91
2002	32	8.44	60.72	6.71	96.88
2003	42	11.83	58.83	12.27	90.48
2004	46	11.92	58.59	7.93	89.13
2005	42	11.60	52.50	14.48	66.67

Table 5 – Standard IPE enrolments progression rates and marks 2001-2005.

Year	Students	% of enrolments	STANDARD		
			mean IPE mark (%)	SD	Pass rate (%)
2001	345	90.79	68.64	8.09	98.55
2002	347	91.56	65.27	5.29	99.71
2003	313	88.17	65.12	6.60	99.04
2004	340	88.08	63.25	8.21	98.53
2005	318	87.85	65.16	10.74	93.27

Table 6 – Overall IPE enrolments progression rates 2001-2005.

Year	Total No. students	Overall pass rate (%)
2001	380	97.89
2002	379	99.47
2003	355	98.03
2004	386	97.41
2005	362	89.61

The trend in student pass rates in the professional development component foundation unit is illustrated in the plot in Figure 3. The progression or pass rate is normalised in this plot by the overall progression rate.

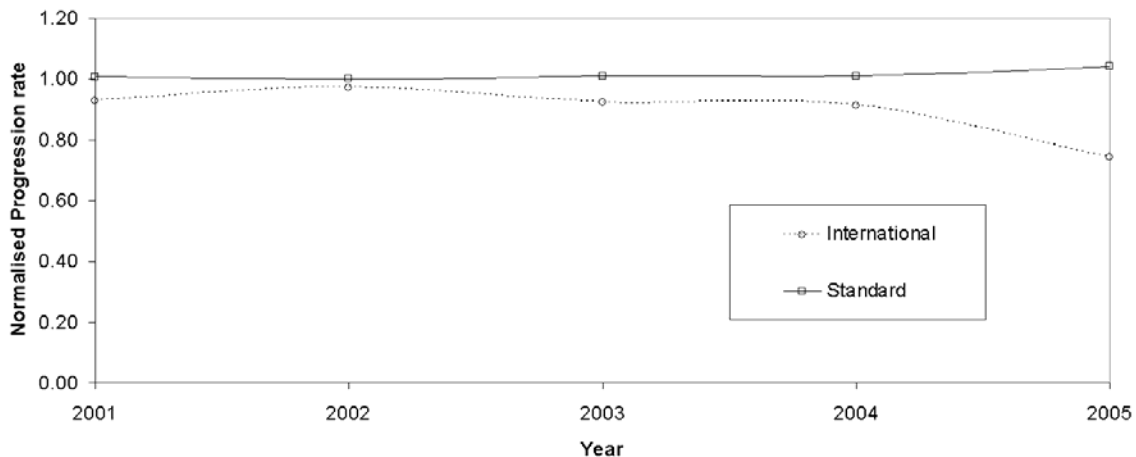


Figure 3 – Normalised student pass rates in the Introduction to Professional Engineering unit; 2000-2005.

Poor international student results in the unit drive the standard enrolment marks higher due to the faculty scaling policy (i.e. faculty policy dictates that a level 1 unit must have a mean between 60 and 65%). The final marks are therefore a false indicator of academic ability in the unit, since the greater the number of poorly performing international students, the better the standard enrolment student group appears to perform. This has the overall effect of decreasing the standard of the unit, the quality of the educational experience and the ability of its graduates. As international student enrolments increase, there appear to be no controls in place to ensure that the mean performance level of students is consistent. The scaling procedure effectively hides any change in performance level of students over the years. With scaled marks only being archived, any problems associated with decreased standards of education and poorer performance of particular student groups are difficult to discern.

A large number of international students surveyed and/or interviewed (57%) reported that they believed their English language ability prior to commencement to be insufficient to pass the unit. Several students also reported that they had attempted more than one avenue of university entry in an attempt to satisfy the university's English language entry requirements.

Some students performed poorly on an internationally recognised English language competency test on their first attempt and then proceeded to satisfy the university entry requirements through an 'easier' test with little further effort to improve their English. In order to examine the relative success at predicting international student ability to cope with the English language requirements of the degree, the progression or pass rates in the foundation unit were determined for each entry avenue utilised by international students enrolling in engineering (see Table 7).

Table 7 – International IPE enrolments by entry avenue 2001-2005.

entry avenue	Intl enrolments	IPE fails	Progression rate (%)	% of total fails
WAUFP	58	13	77.59	50.00
TEE (WA)/TER	43	4	90.70	15.38
O levels	25	2	92.00	7.69
UWAFY	27	5	81.48	19.23
Other	16	2	87.50	7.69
IELTS	11	0	100.00	0.00
TEE (SA)/SAM	11	0	100.00	0.00
TOEFL	2	0	100.00	0.00
TEE (Vic)	1	0	100.00	0.00
Total	194	26	86.60	100.00

The locally run courses (i.e. WAUFP and UWAFY) account for a total of almost 70% of all failures. In 2005, the student group consisting of those who had gained university entry through the UWAFY had a pass rate below 34%. University policy dictates that international students should be at the same English competency level as the standard enrolments (Section 1.7 of the Policy Guidelines for the Marketing, Recruitment and Support of International Students states that "No student shall be admitted as a full cost fee student at an academic standard lower than that required of other students" (UWA 1995)). The variation in the pass rate with entry avenue raises some concern regarding the consistency of this standard. With such variance in the English competency entry level requirements, it is not surprising that student expectations of study in Australia do not align well with the reality (as discussed in the study by Dalglish & Chan (2005)). Some of the entry avenues provided appear to endow false confidence in international student English language ability with subsequent academic consequences.

In addition to the relatively poor pass rate of international students, most survey and interview respondents (65%) commented that they did not feel there was adequate English language support available throughout the semester. The author believes this is not reflective of the English language assistance services the university offers inline with the Policy Guidelines for the Marketing, Recruitment and Support of International Students (UWA 1995), but rather a reluctance by students to independently seek this help when required. The UWA guidelines on literacy state that "As literacy is critical to all students' learning, the teaching of it should not be considered merely a remedial activity" (UWA 2001). To address the aforementioned reluctance to seek literacy assistance independently, a communication focus stream was implemented in the Introduction to Professional Engineering unit in 2006. The implementation of this language assistance stream is currently underway. Initial indications of international student performance in this stream are positive. Different treatment of international students in English language intensive units has the potential to result in a more equitable outcome as far as student performance is concerned. In this way, student expectations are met and the quality of international student graduates is improved. International student progression and retention rates should also be positively affected.

Conclusions

It appears that the institution is not meeting the student expectation that being granted admission ensures that their English ability is sufficient. University policy and the university

and faculty of engineering computing and mathematics operational priorities plan are to increase the percentage of international students (up to a maximum of 15%). Therefore it is important to ensure English language entry levels are maintained at a suitable level. The risk of not ensuring this is either poor academic, industry and public opinion of the university and its graduates if students with poor literacy are permitted to pass or poor progression and retention rates of international students in the professional component of the engineering degree.

In order to achieve this suitable and consistent level of English level competency for admission, the author believes it is necessary to reduce the number of entry avenues, utilising only well recognised, thoroughly tested and respected examinations such as the IELTS and TOEFL. Such strategy would not necessarily mean the abolishment of the locally run courses. Instead, these could serve to prepare students for university study and improve their English language competency before attempting one of the recognised tests. In this way, the guideline on literacy stating that "Literacy entry standards should be set at levels which prevent the admission of students who will not be able to cope with the demands of the particular course for which they enrol" (UWA 2001) will be more likely to hold true, resulting in improved international student satisfaction with their university experience. "As a consequence a UWA degree will certify that a graduate has significant literacy skills contextually in the subjects in which they have majored and generally in terms of their ability to communicate in English" (UWA 2001).

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