

Balancing Expectations in Engineering Education: Enhancing Student Experiences through Empirical Research - A Comparative Analysis

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ABSTRACT

This paper draws upon the findings of an empirical study comparing the expectations and concerns of engineering students with students enrolled on business and management programs. It argues that whilst the two groups of students have very similar expectations, motivations and concerns before their start their studies, once at university, engineering students are twice as likely to drop-out than are their compatriots in business studies. Drawing upon the study findings, recommendations are made as to what might be done to counteract this. The conclusion argues that there is a need for more in-depth research to be conducted in this area in order to identify the reasons behind the different attrition rates and to further enhance engineering undergraduate experience.

Keywords

Student attrition, student experience, motivation, engineering education.

1. BACKGROUND

The institutional setting in which students learn has long been acknowledged as being central to how university is experienced and perceived (Dewey, 1938; Moore, 2004; Lauder et al, 2006; Biggs & Tang, 2007). Whilst it may be argued that universities provide the wider social context in which students' cultural capital is developed (Bourdieu, 1986; Halsey, 2006), in many respects, the somewhat introspective nature of university culture may be conceptualised as being analogous to that of a Total Institution (Goffman, 1961; Mann, 2008). This may particularly be the case with Engineering Education where, beginning with the bureaucratic processes associated with enrolment and registration, students either quickly become embedded into the engineering culture, and in doing so find themselves forming a form a mutually beneficial relationship with their department, or conversely they fail to make any connection with either the subject or the department and so become isolated and disengaged.

High attrition rates in engineering programs across the country (DIUS, 2008) would suggest that the latter is the more commonplace experience for many engineering students. Business and Management studies tend to have similar rates of student attrition – with retention being an issue in some institutions (NAO, 2007) although, it should be noted, not in the institution where the research took place. In looking at what Engineering and Business Management students' expectations are of university, and critiquing where these expectations may originate, this paper provides a comparative analysis of the issues underpinning student retention and curriculum development in Engineering Education.

One important factor influencing students' expectations and experiences of university is public policy. Seemingly diametrically opposed policy drivers (Tight, 2003) reflect a social expectation that a university education should promote social justice by widening 'participation' and 'access'; whilst conversely institutions are increasingly forced to make economic cuts and focus on efficiency (Mann, 2008). This somewhat contemporary and politically contentious issue will undoubtedly see the financial burden placed upon individual students increasing – an increase that will inevitably be matched by higher expectations in terms of learning experiences and quality of teaching. It is against this rapidly changing environment that this study has been conducted with the overall aim of identifying and analyzing whether engineering programs are meeting students' expectations, and if not, considering what can be done to enhance engineering students' learning experiences and in doing so begin to address issues around retention and attrition.

2. THE BALANCING EXPECTATIONS PROJECT: METHODOLOGY

Starting with the research question; '*How do the expectations and concerns of Engineering and Business Management Programs differ prior to enrolment?*', the Balancing Expectations project set out compare and contrast the expectations and experiences of students on two very different Programs of study at a research-driven UK Higher Education Institution. In doing so it was anticipated that the study would provide empirical data upon which improvements to the undergraduate engineering student

experience could be built. Utilizing purposive sampling techniques, the first stage of the research involved the administration of a survey to all Engineering and Business Management 1st year students. The survey was completed by 216 students, of which 120 were enrolled on engineering programs and 96 on business and management programs.

The survey was divided into three main sections; demographic details; reasons for studying (engineering or business); and, concerns before studying. Utilizing a standard Likert (Agreement) Scale, the data was coded 1-5 (1-Strongly Agree: 2-Agree: 3-No Opinion / Neutral: 4-Disagree: 5-Strongly Disagree). The data was analyzed utilizing standard descriptive statistical techniques. The median and mean were calculated along with the variance and standard deviation. The data findings were initially put into a tabular format. For the purposes of this paper the mean for each question is displayed in graphical format. The questions and other statistical data are given in the findings section. A critique of the findings is given in the discussion section.

2.1 Sample

The demographic characteristics of the sample are given below in Figure 1. When comparing the two sample groups, notable gender differences are evident in that 32% of the engineering students were female, whereas in the business student group, 57% were female. There were also differences in the age group of the two samples; percentage wise, the engineering group had more 18-20 years and more mature students than the business group. When considering domiciliary origins (and hence fee levels, as well as ethnicity / nationality) the engineering group had significantly less ‘overseas’ students than did the business group

Table 1: Demographic Background of the Sample (Percentage)

		Engineering Students	Business Students	All
Gender	Female	32	57	43
	Male	68	43	57
Age	18-20	64	58	62
	21-24	27	39	32
	25	9	3	6
Domicile	Home/ EU	77	67	73

3. FINDINGS

3.1 Students’ reasons for studying engineering or business

Based upon the literature, six questions were articulated utilizing an Agreement (Likert) Scale. Students were asked to indicate their level of agreement to the following:

1. I want to make a difference to global society

2. I want to positively influence the lives of people around me
3. I want to work on exciting and innovative projects
4. I want to enter a profession where I will earn a good wage.
5. I want to study for a degree in a worthwhile subject
6. I was advised to by my family

The graph below displays the mean scores for both engineering and business students. The data reveals that both engineering and business students had similar reasons for studying their particular discipline.

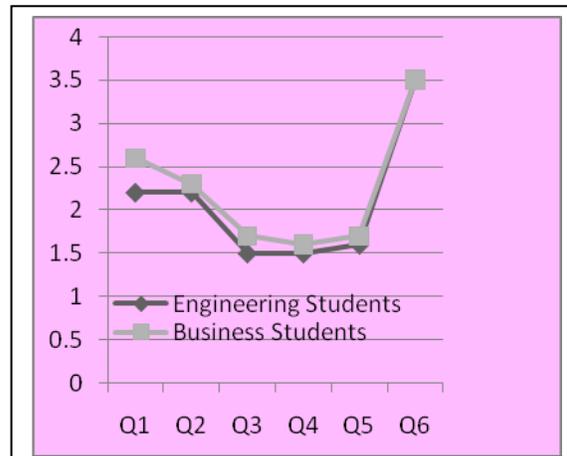


Figure 1: Students Reasons for Studying Engineering or Business (Mean Scores)

Table 2 below gives the Standard Deviation for each of the questions. It reveals that on the whole the spread of the data was relatively small.

Table 2: Standard Deviation

Q	Engineering Students	Business Students
1	0.9	1.2
2	0.9	1.0
3	0.7	0.7
4	0.7	0.8
5	0.9	0.8
6	1.1	1.1

When considering the first question, 63% of the engineering students agreed or strongly agreed that they wanted to make a positive difference to society. For business students the percentage was lower at 51%. Whilst global issues appeared more important to engineering students than to business students, this was not the case when considering local issues. In response to the statement ‘I want to positively influence the lives of those people around me’ 62% of both engineering and business students agreed or strongly agreed. For the third question, more engineering

students (93%) than business students (89%) indicated they wanted to work on exciting and innovative projects. Whereas, when considering monetary benefits of the respective occupations, 90% of engineering students and 93% of business students agreed or strongly agreed that they wanted to earn a *good wage*. The fifth issue, relating to students' perception of the value of the subject they were studying, revealed that 87% of engineering students were motivated by the desire to study for a *worthwhile subject*. For business students the percentage was 92%. The influence of families on student choices was covered in the final question with 21% of both groups indicating that the decision to study their particular degree was influenced by their family.

3.2 Students Concerns About Studying

Following a similar format to the questions about students' reasons for selecting to study either engineering or business (using Agreement / Likert Scales), students were asked to indicate their level of agreement with the following six questions:

Before starting my course I was concerned that...

1. The subject would be difficult to grasp as a whole
2. I would struggle with the Maths part of the curriculum
3. I might experience some discrimination on the grounds of gender
4. I might experience some discrimination on the grounds of ethnicity
5. I would struggle to fit into University life
6. I would have difficulties finding a job when I finish

The mean scores are displayed below.

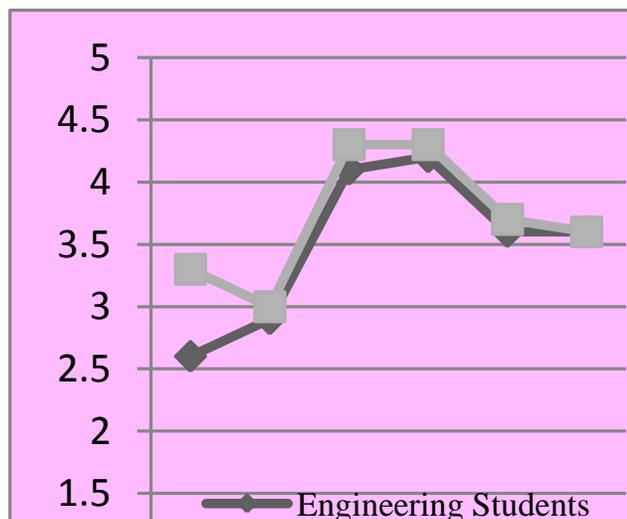


Figure 2: Students Concerns About Studying Before Starting University (Mean Scores).

Perhaps not surprisingly, the most notable difference in the students' concerns related to their perceptions of the level of difficulty of their choice of course as a whole. Of the engineering group, 54% agreed or strongly agreed that, before they started university, they were concerned that *the subject would be difficult*

to grasp as a whole. For the business students this number was much lower at 28%. When considering the Mathematical content of the program, the students' concerns were less varied with 46% of the engineering students indicating that they were concerned about Maths and 45% of business students. When asked to indicate their concerns regarding potential discrimination, there were notable differences in the students' replies with 75% of engineering students indicating that they were not worried about discrimination on the grounds of gender. For the business group this number was higher at 86% suggesting that more engineering students were concerned about gender discrimination than business students. Similar figures were recorded with regards to students' perceptions of potential discrimination on the grounds of ethnicity, with 75% of engineering students and 85% of business students indicating that they were not concerned about this issue. With regards to concerns about future employment, 23% of engineering students and 22% of business students indicated that they agreed or strongly agreed that they were concerned that they would *have difficulty finding a job* when they graduated.

4. DISCUSSION & RECOMMENDATIONS

One of the most important issues addressed by the study is that of social responsibility. Notably, the findings indicate that engineering students are more likely to want to make a *difference* to global society than are business students. Research conducted by the Royal Academy of Engineering (2007) reveals that social responsibility is one of the key drivers encouraging young people to study engineering. Another important factor in motivating both engineering and business students related to the desire to work on innovative and exciting projects. When considering engineering students, this finding supports arguments made by the Royal Academy of Engineering (2007) who argued that the 'wow' factor associated with engineering acts as a major 'driver' in determining why young people enter the discipline. Similar work on the motivations of prospective business students has not been conducted. Another issue addressed by the survey related to the intrinsic motivational factors of employment and the perceived *value* of the degree. Whilst the Engineering literature argues that qualified engineering graduates are highly sought after – with industry keen to offer graduate level positions (RAEng, 2010), the statistics suggest that engineering students are more likely to be unemployed than business students (HESA, 2010). It seems that although the demand for engineering graduates is high, concerns persist regarding the numbers of suitably qualified graduates available to fill such (AGR, 2009).

With regards to student concerns, that more engineering than business students were concerned that their course would be *difficult* is not surprising. Previous research has found that young people do not choose to pursue a career in science or engineering because they perceive the subjects to be difficult to grasp (Science Council, 2008). It may be that young people perceive that business will be a 'less difficult' subject – although there is little or no research in this area to prove this. With regards to perceptions of potential discrimination previous evidence suggests that disparities reflective of gender issues are evident in both engineering, and engineering education. Such gender disparities are manifest in skills shortages as institutions experience

increasing difficulties in recruiting sufficient numbers of undergraduate. The resultant negative impact to the wider economy is analyzed and discussed at length in the UK policy literature (Langlands, 2005; NSF, 2009; RAEng, 2009).

In considering the study findings as a whole, the most striking finding is that prior to enrolling in the Institution where the study was conducted, engineering and business students had similar reasons for, and similar concerns about, studying at University level. Furthermore, the 'admissions criterion' for both disciplines is high, with students required to achieve a minimum of three good 'A' level passes in the prerequisite subjects. Yet, despite this, the retention rates for first year students at the Institution varies greatly, with less than 5% of business graduates dropping out as opposed to just over 10% of engineering students. It should be noted however, that of the engineering graduates, the majority of those not continuing to through to the second year do so because they *fail* the course – this is not the case for business studies where students are more likely to drop out for personal reasons.

4.1 Recommendations for Engineering Education

Utilizing the findings of this study the following three recommendations are proposed:

1. Engineering Education needs to capitalize on young peoples' interest in global issues and their natural leanings towards social responsibility. Curriculum could be designed around 'real-life' projects, using active learning to improve and enhance the student experience – providing students with the opportunity to 'make a difference'.
2. Concerns about employability and employment are high. Universities need to address employers' concerns about graduate skills and competencies across the whole curriculum. In engineering education in particular, universities need to work with employers to identify and analyze the 'skills gap' and to work towards providing 'work-ready' engineering graduates able to meet the needs of the market.
3. Stereotypical views that engineering is manifest by gender discrimination persist. Both the Engineering Profession and Engineering Education need to take steps to address this – encouraging more young woman to enter the profession and identifying more female role models willing to promote engineering to young people.

4.2 Concluding Remarks

The findings of this study have raised some interesting questions in relation to *why* the attrition rate in engineering is far higher than it is in business – particularly given that before enrolment, students' reasons for, and concerns about, studying were remarkably similar. The question is even more pertinent given the similar admissions criterion for both subjects in terms of *grades* (although not subjects). Indeed, that both disciplines demand equally high admissions grades makes the need to investigate the further of paramount importance.

At this stage, this research is not able to draw any definite conclusions as to the causal pedagogical and other factors influencing the student attrition rates. However, it should be noted that the School of Engineering has begun to take steps to address the issues of attrition identified in this paper. The first year curriculum has been changed to encapsulate a more 'Active Learning' approach – and additional support has been made available to assist students struggling with Maths, Science and Academic Writing. This success of this has yet to be established.

This exploratory study represents the first stage of a longitudinal study aimed at enhancing the experiences of engineering undergraduates. The next stage is to look closely at the pedagogical and other factors influencing the student experience within the School. There is clearly much further work to be done.

In conclusion this study suggests that student expectations of university are high – in both engineering and in business studies. With fees set to rise three-fold in the next twelve months, it is clear that Higher Education will need not only to meet such expectations – but to exceed them. The question yet to be addressed is... *How can engineering education meet students' needs and expectations whilst not compromising quality?*

REFERENCES

- AGR. (2009), *Graduate Recruitment Survey 2009*, <http://www.agr.org.uk/Content/Launch-of-the-AGR-Graduate-Recruitment-Survey-2009-Summer-Review>. Accessed 21st October 2009
- Biggs, J., & Tang, C. (2007). *Teaching for Quality Learning at University*. Maidenhead. Open University Press.
- Bourdieu, P. (1986). 'The Forms of Capital'. In Richardson, J.G. (ed). *Handbook of Theory and Research for the Sociology of Education*. Westport, Conn. Greenwood Publishing Group. pp 241-258
- Dewey, J. (1938). *Logic – The Theory of Inquiry*. New York. Holt.
- Goffman, I. (1961). *Asylums: Essays on the Social Situation of Mental Patients and Other Inmates*. New York. Double Day.
- Halsey, A.H. (2006). 'The European University'. In Lauder, H., Brown, P., Dillabough, J., Halsey, A.H. (2006). *Education, Globalization & Social Change*. Oxford. University Press. Chapter 58. pp 854-865/
- HESA (2010). Higher Education Statistics Agency. *Employment Statistics by University*. Available from <http://www.guardian.co.uk/news/datablog/2010/jul/15/employment-statistics-university-graduates#data>
- Downloaded 27th May 2011
- Kolb, D. (1984), *Experiential Learning as the Science of Learning and Development*, Prentice-Hall, Englewood Cliffs, NJ
- Lauder, H., Brown, P., Dillabough, J., Halsey, A.H. (2006). *Education, Globalization & Social Change*. Oxford. University Press.
- Langlands, A. (2005). *Gateways to the Professions Report*, London, Department for Education & Skills.

Mann, S.J. (2008). *Study, Power and the University*. Maidenhead. Open University Press.

Moore, R. (2004). *Education & Society: Issues and Explanations in the Sociology of Education*. Cambridge. Polity.

National Audit Office (NAO) (2007) *Staying the course: the retention of students in higher education. Report by the Comptroller and Auditor General*. London: The Stationary Office

NSF. (2009), *Closing the Gender Skills Gap: A National Skills Forum Report on Women, Skills and Productivity*, London, National Skills Forum.

RAEng. (2007), *Educating Engineers for the 21st Century*. London. Royal Academy of Engineering.

RAEng (2009), *Inspiring Women Engineers*. London. Royal Academy of Engineering

RAEng (2010). *Engineering Graduates for Industry*. London. Royal Academy of Engineering.
http://www.raeng.org.uk/news/publications/list/reports/Engineering_graduates_for_industry_report.pdf accessed 27th May 2011.

Science Council (2008), *Teens do not see science as route to good career*,

<http://www.guardian.co.uk/education/2008/nov/07/science-careers-hamilton> Downloaded 28th September 2009.

Tight, M. (2003). *Researching Higher Education*. Maidenhead. Society for Research into Higher Education. Open University Press.