ACTIVITY-BASED STUDENT INDUCTION, MOTIVATION, PERFORMANCE AND PROFESSIONAL SOCIALISATION: A CASE STUDY

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Concern about high early attrition rates from of our engineering courses led to an innovative team, contextual induction process. We sought to introduce the students to the skills needed to survive the first year and alleviate their concerns about the demands of their course. Those with higher perceptions of the process and with strong identification with engineering were expected to perform better subsequently. We correlated measures of this commitment and "grade point scores" of entrants as a measure of ability with performance. Induction was well received by students. Neither their perceptions of the programme, their estimates of their gain in technical knowledge nor other measures, however, was significantly related with subsequent performance. These negative results have led us to concentrate on the academic and pastoral support systems. During induction students had a facilitator and used experts but were forced immediately into autonomous learning. Despite our findings we remain convinced that commitment to the profession will be motivational and that our induction can encourage this commitment.

Introduction

One of the results of the twin pressures of increased class sizes and reduced funding both institutionally and personally has been students' dependence on their own resources. A survey of students withdrawing from engineering courses conducted at The Robert Gordon University [1] showed that disorientation, lack of support and poor study skills had been among their major concerns. Students in the School reported that these factors were compounded by their inability to anticipate what engineering courses entailed. They were unclear as to the structure of their course, found it differed from their preconceptions and had not found it stimulating. The result was poor performance and high attrition rates.

To address we introduced a one week induction programme for all undergraduate entrants. Previously in the course of a day the class was addressed by a series of speakers who disseminated concentrated information about the course, the School, support systems and facilities at the University. The new approach called "The Challenge", was in the context of an engineering activity. Students acquired, processed and evaluated technical information but this was just a vehicle for addressing the above concerns. Firstly the week provided an informal introduction to staff and peers. A staff member allocated to each group facilitated the students' activities in using communication systems and information sources. These facilitators continued after the week as the students' personal tutors. Other staff had roles as "experts" in the field. Each role had a different notional affiliation and so students were encouraged to assess information received in the light of the expert's brief. Students were frequently encouraged to use technology, access different information sources and above all to reflect on the effectiveness of their actions. The week was looked on as the beginning of a first year programme to provide student support and to develop study and information processing skills. Most importantly we sought to encourage the entrants to view themselves as embryo engineers and to develop an image of engineering as a challenging and rewarding occupation. This we hoped would sustain them through the earlier part of their course where they report difficulty in seeing the underlying structure.

The programme was evaluated by questionnaire and interview of all students and staff involved. The paper will report on the results of this evaluation and propose how the experience may be developed to maximise its effectiveness. The proof of its effectiveness must, however be sought in the withdrawal statistics.

The Challenge

Induction is a process in which a group of individuals consisting predominantly of male school leavers graduate to studentship. A well designed course will help all types of individual to adapt their study skills, learn the procedures and accept the norms needed to succeed in today's university environment. Our survey of the inductive process elsewhere suggests that it is a transition little assisted by most universities. Engineering students seem to be particularly vulnerable. We decided to try to improve our service to our freshers by planning a more comprehensive induction programme. The aims were to overcome the students' feelings of disorientation and of confronting a

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faceless organisation, to let them learn the systems and procedures by using them and to begin the socialisation process ie give them a realistic identification with the profession of their choice - engineering. To do this we provided them with an activity - "The Challenge". They were told that Scotland had been declared independent and that the new government had invited tenders from organisations proposing to generate 25% of its power requirements from a renewable source. To provide focus and group identity each group was arbitrarily allocated a particular energy source. They were not asked to carry out in-depth calculations but had to provide a sound analysis of the technical options while taking account of the social, environmental and economic constraints. A facilitator was attached to each group who encouraged action, reflection, use of available resources such as experts and library facilities and helped to lubricate group interaction. A team of experts was available for consultation. Each represented a different affiliation, eg power company, environmental campaigners etc and each could only be contacted by one medium eg electronic mail, telephone etc. This encouraged consideration of the "hidden agenda" of an expert and served to introduce the students naturally to the university systems. Speakers included former students and other relevant engineers and a visit to a conventional power station was included. Students presented their tenders on the last day of the programme.

Ocupational Identification and Professional Socialisation

Contextual Learning

Our approach was to be based on constructivist principles. Constructivism asserts that learning is a process of integrating experience into mental schema. These schema are extended, modified or rejected in the light of subsequently acquired information. Felder [7] found that most engineering students learn inductively, that is, they observe the world around them and from these observations induce the underlying concepts and principles. This is in tune with findings that learning is maximised when it is contextualised. Collins *et al*[3] (1991) reported that much of traditional learning is through decontextualised, simplified examples and leads to inadequate understanding and inability to apply the learning to novel situations. Grabinger *et al* [9] insist that the learning environment needs to involve them [students] in activities that allow them to plan, control, drive and assess their own learning activities and apply what they have learned to new challenges". It was this contextualisation and such metacognitive processes that we sought to encourage through "The Challenge".

The Role of the Expert

The majority of the experts were engineerss and through their example we aimed to provide an insight to how a professional engineer thinks and acts. One factor which [3] had highlighted as contributing to withdrawal was the students' failure to perceive a structure in the course and relevance in the subject matter. We sought by the use of experts to encourage critical thinking and evaluative judgement of information rather than its blind acceptance. This we hoped would assist the freshers to seek relevance and holism in the various subjects they studied. Perry [11] has suggested that as an individual progresses through the education system and into their chosen career their perception of expertise evolves. Initially an "expert", for example a teacher or lecturer, is viewed as an absolute authority. No shades of opinion are seen and the learner enjoys a great deal of certainty about the validity of knowledge gained. As they encounter increasingly complex issues, however, they begin to realise that they may not obtain the same information from different sources. This leads to confusion and uncertainty. They are able to recognise contradictions in the information from different sources but do not have sufficient understanding or confidence to evaluate it and form their own conclusions. Eventually they progress to a stage where they realise that there are few absolutes. They accept that each expert's view of a complex situation is necessarily coloured by his/her own background, and learn to form their own judgement of what represents the right interpretation of information in a particular situation.

It is worrying Perry suggests that students' confidence and certainty are at their nadir 3 years into their undergraduate course. As this is the typical length of a degree course, it suggests that they leave University in a state of confusion and uncertainty. We sought, by deliberately highlighting the vested interest of the experts in an environment of close tutor support, to help them to come to terms with this conflict early. The facilitators encouraged the students consider the experts' perspective and to try to distil from it a view of the facts in relation to providing energy commercially. Less use was made of the experts then we had hoped but facilitators reported that students did appear to come to terms with conflicting views expressed in answers. Induction, when students feel disorientated may not be the time to confront this issue but we considered that there was unlikely to be any other occasion with such a supportive environment and where there were no pressures of assessment.

Student Responses

We have presented elsewhere students' perceptions of the induction process. Here we concentrate on indications of commitment to engineering as a profession and motivation to succeed. One aspect investigated was motivation to adopt engineering as a career. There are some who suggest that engineering is a Cinderella profession and that entrants to degree courses are those disappointed by failure to be accepted onto their first choice of course. However, of the 75 respondents, 64 were on their first choice of course and only 2 would have preferred a subject other then engineering. Indeed of a wide variety of factors which might have influenced their application to join, "particular course of highest.

Students were asked to rate the importance of certain factors in their selection of engineering as a future career. Table 1 shows the mean rankings in each these factors. In the following discussion it is important to realise that the factors were chosen to be meaningful to the students and to help tutors in their pastoral role. We have subjectively divided the factors into 2 groups, extrinsic and extrinsic motivators. Security of employment, high starting salary and high future salary we classed as extrinsic motivation. Social status, career options and challenging work we identified as intrinsic. As an intention to work abroad could be for the employment based challenge of the work or for unrelated reasons we omitted it. We differenced the student's ratings on the two groups of factors to provide an assessement of orientation towards extrinsic rewards or rewards emanating from the work itself. We hypothesised that the more intrinsically motivated the individual the higher would be his/her commitment and consequently performance on the course. The resulting 25 point scale has been condensed into a five point scale showing the strength of orientation towards extrinsic or intrinsic motivation. Figure 1 shows the distribution of the students' orientation. The majority of the students showed no strong orientation to either extreme. This could be interpreted to mean that they had a reasonably balanced and realistic outlook on their career.

We argued that those who were more intrinsically motivated would find the Challenge more stimulating and would subseqently perform better in their studies. The resulting orientation were correlated with the students' responses to a question in which they rated their technical and personal skills after induction and with their subsequent performance in the first year of their course. These correlations are based on a reduced data set because 13 respondents did not fill in their names and so their questionnaire responses could not be matched with their assessment results.

We were rather disappointed that little correlation was found between this measure and either perceptions of induction or subsequent performance. This may of course reflect the adequacy of the measure. We are considering alternative measures for future intakes. Motivation has been shown to be a key factor in student performance e.g. [8], [6]. Previous research has focussed on motivation to succed academically. We remain convinced that if we can capitalise on the longer term motivation to succeed in one's subsequent career we can help students to achieve better performance.

Five-point scales were used to gauge students' perceptions of the induction programme. These covered factors such as enjoyment, challenge, usefulness of the experience etc. Internal correlations between the factors were very strong. This suggests that the measures could be aggregated into a single descriptor of the students' enthusiasm for the approach. Table 2 gives descriptives of this and an aggregated skills gain measure described. We had anticipated that those who had responded enthusiastically to the induction process might subsequently perform better on their course of study. We were frustrated to find no discernible correlation with performance measures.

A further set of scales gauged the student's self-assessment of skills gained during induction. An objective was to familiarise students with the use of systems such as computers, telecommunications, library etc. This was gauged by scores aggregated into a technical skills measure. Similar aggregate scores were computed for personal and interpersonal skills. High scores on these measures gave highly significant correlations with the perceptions of the experience, again suggesting that the approach had suited some students better than others. Many staff had averrred that poor technical and personal skills are a prime cause of student failure early in the course. Here again we sought an indication that those gaining the most from the induction would subsequently perform better.

Entrance Qualifications

A fourth measure we used was the so-called grade point scores of the entrants in their pre-University education. In most cases this was based on Scottish Highers although a minority had equivalent qualifications. We, of course, hypothesised that the higher the score the more likely would be an individual to succeed. We averaged the end of session assesment marks of each student and then divided these scores into six bands. withdrawals were classed as 0 on the scale. Although those with low scores were found to be slightly more likely to fail or withdraw the relationship did not reach statistical significance.

Self Description

As a fifth measure we attempted to gauge the entrant's identification with the description "engineer"

We had hoped that strength of identity with the profession would be discernible and would prove to be a predictor of performance. Seventy-two respondents answered a question asking them to describe themselves at entry to their course. Both investigators, one of whom is an engineer, attempted to rate the responses which were transcribed anonymously. They concluded that only subjective influence would allow one statement to be rated higher or lower than another. Students did show a strong identification with their occupational title, 25 used the term "engineer" and a further 23 the term "engineering". Of the remainder several used phrases such as "my chosen career" which surely implied this identification. Most saw the attainment of the title as a future event and although only 10 described themselves as students it is surely implied in "I have begun the initial stages of my lead up to the future. I hope this will in turn make me the best engineer I can be". They see themselves as being trained to work as team members in practical, technical, problem-solving situations. Several mentioned the need "to gain enough knowledge in engineering so as to be able to solve problems off my own back without feeling apprehensive." They clearly see the engineer as both practical, often to the extent of being hands-on, and confident in his abilities to solve technical problems.

[1] investigated the occupational identity of engineers some 40 years ago in the American context. Unfortunately although much anecdotal evidence exists there are no more recent studies in the UK context. The categories proposed by Becker and Carper to gauge professional socialisation seem relevant today and so have been adopted. These are identification with the occupational title, commitment to a particular sector, commitment to a particular institution and perception of the social standing of the profession. In common with Becker and Carper's findings in a very different context and era we found that the engineers had little commitment to a specific task. Instead many talked of the diverse career paths and opportunities which would be open to them when they qualified. Where a specific sector was identified perhaps unsurprisingly it was the offshore oil and gas industry. Even here, however, only one narrowed the context to the fabrication and welding sector.

There is much anecdotal evidence that engineering is held in low regard and that engineers enjoy low social esteem in the United Kingdom. A major Australian report [4] reveals similar concerns on that continent. Russia appears to experience the extreme if Zlobin [16] is to be believed. He wrote that "it doesn't matter if you earned money by racketeeriong or selling drugs.....your status will be higher than that of an engineer". This is contrary to the high regard and social esteem found in continental Europe [10]. While it is generally held that the engineer in the united States enjoys a fairly high status Haddad [10] concludes that "engineering is an enigma to the lay public". It is suggested in the UK that school children also hold engineering in low esteem and this causes recruitment difficulties experienced by many Faculties of Engineering. The view is not substantiated by a sizeable study of school children and industrialists in the Birmingham area [14]. This showed that overall the pupils' "perceptions of engineering and manufacturing seems to be quite positive". Indeed it was considered by them to be more interesting, creative and glamorous than the industrialists' predictions of their views. The researchers suggest therefore that industry needs to look to its image to ensure that it is the childrens' more positive view which is reinforced. Engineering students and practising engineers are also frequently reported to hold their own skills in high regard. [13] for example conclude that both applicant and professional engineers hold a set of positive attitudes toward their discipline". The same positive attitudes were evinced strongly by our own entrants. The interesting nature comes across in "an [engineering] degree ... will give me access to a very interesting, challenging and diverse career", the creativity in the statement "I want to work with new technologies and improve systems". Many clearly believed that they would after qualification be highly regarded and respected in society at large.

A breakdown of the students' comments into performance-related groups revealed little to suggest that in their own perceptions those who failed or withdrew differed greatly from those who did well. It is not surprising that one who described himself as "excited by the possibilities an engineering degree will give me" did well. But so did one who simply described himself as "scared". If we are to reduce the loss of students, however, we must find out why those typified by statements like - "I have wanted to be a mechanical engineering since I started secondary school and will work hard to become one" - subsequently dropped out.

What destroyed that motivation? Did the course presentation destroy this image of mechanical engineering as a challenging profession? Clearly a much more searching enquiry would be needed to answer these vital questions. Motivation was, however, by far the strongest theme to emerge from the students' descriptors of themselves. Almost without exception they talked of their eagerness to apply themselves, success in their studies and enter what they clearly saw as an interesting and rewarding profession. The induction programme was intended to reinforce these positive attitudes towards engineering and the entrants' chosen profession, thereby sustaining their strong motiovation to succeed in becoming qualified. There are a considerable number of possible reasons for the poor progression rates. Subsequent debriefing suggests that the majority of those failing to make the grade remain committed to engineering as a career. These include unstimulating course presentation, the nature of the assessment system and extra-mural diversions. Another cause popularly

ascribed by academics is the entrants' poor numeracy and understanding of basic concepts. This we are addressing by remedial classes and personal tuition. Whatever the cause it is surely of paramount importance that we capitalise on the initial motivation and enthusiasm towards engineering and the positive estimation of the induction programme and retain a much higher percentage of students. To do so we cannot rely on anecdotal evidence and subjective perceptions. A serious study of the influence of the factors involved followed by a radical change in our approach is clearly indicated.

As noted above we were seeking a measure(s) which would prove to be an indicator of subsequent performance. This we hoped would in future years help us to identify vulnerable students very early on and to provide them with additional support. It is very disappointing, therefore, to have to report that none of the measures provided any significant correlationn with academic performance in the first year. As previously reported there were strong internal correlations on the scores for the induction programme. Neither the general enthusiasm for the approach nor the skills attainment, however, helped to identify students at risk. It is perhaps most surprising that no link was found between academic performance and entrance qualifications and performance. A separate internal study,[2], did find, however, a strong correlation between entrance qualifications and final degree correlation. It appears therefore that academic ability becomes the dominant factor among those who survive the early part of the course. This serves perhaps to confirm the findings of the internal report, [3], that the causes must be sought in structural issues and the support provided to the students. We are therefore looking critically at our personal and academic tutoring systems and aim to make both of them more effective.

Conclusions

Most students were enthisusiastic about induction which has served its purpose of quickly breaking down the front of impersonality which many students previously had reported. Whether the small overall improvement in first year performance is attributable to this or others of the several initiatives is a matter of conjecture. The surveys reported above have allowed us to gain valuable insights into the characters of our entrants.

They have not, however, directly, assisted in identifying causes of subsequent withdrawal or poor performance. Again they represent but one of a number of investigations with this end. Our search for significant predictors is continuing and we hope that a later paper may reveal more positive findings.

References

[1] Becker H.S. and Carper J. (1956) The Elements of Identification with a Profession, *American Sociological*, 21,3, pp 341-347

[2] Bryden Prof I. G., (1998), A correlation of entrance qualification and degree classification of students of the BEng (Hons) course in Mechanical Engineering and Mechanical & Offshore Engineering, *Unpublished internal report*, The Robert Gordon University, Aberdeen.

[3] Casely V. and Robertson E. (1995) Critical Factors for Student Success and Student Withdrawal, unpublished report, The Robert Gordon University, Aberdeen

[4] Clyde D.H. (1995), Challenges for the Future Engineer, *Australasian J of Engineering education*, 6,2, http://elecpress. lib.monash.edu.au/ajee/vol6no2/6clyde.htm, 04/07/98 16:29:12 GMT

[5]Collins A., Brown J.S. and Holum A. (1991) Cognitive apprenticeship: making things visible, *American Educator*, Winter (6-11) pp 38-46

[6] Elton L, (1995), Motivating students: relation to the world of work, in *Improving student learning: Through Assessment and Evaluation* Gibbs G. ed., Oxford, The Oxford Centre for Staff Development

[7] Felder R. and Silverman L. (1988) Learning and Teaching Styles in Engineering Education, *Engineering Education*, Apr, pp674-681

[8] Garcia T. and Pintrich P.R., (1994) Regulating motivation and cognition in the classroom: The role of self-schemas and self-regulatory strategies, in D.H. Schunk & B.J. Zimmerman (eds) *Self-regulation of learning and performance: Issues in educational applications*, Hillsdale, NJ: Lawrence Associates.

[9] Grabinger S., Dunlap J.C. and Duffield J.A. (1997) Rich environments for active learning in action: problem solving *Association for Learning Technology Journal* 5(2) pp 5-17

[10] Haddad A.J., The Evolution of the Engineering Community: Pressures, Opportunities and Challenges, *Journal of Engineering Education* Jan pp 5-9

[10] Hartnagel H.L. (1995) Engineering at German Universities, *Engineering Science and Education Journal*,4(1), pp 43-47

[11] Perry W.G. (1970) *Forms of Intellectual and Ethical Development in the College years: A scheme* Rinehart and Winston, New York

[12] Scruggs T et al (1985) Maximising what gifted students can learn: recent findings of learning strategy research, *Gifted Child Quarterly*, 29(4). 181-185.EJ333 116.

[13] Sewell D.F. and Pulko S.H. Male and female electronics engineers and electronic engineering: atttitudes and influences, *Engineering Science and Education Journal*, 4(3) pp104-108

[14] Tonkinson J. and Gazey B. (1997) School childrens' and industrialist attitudes towards engineering and manufacturing, *Engineering Science and Education Journal*, 6(1) pp31-36

[15] Webster J.A. (1997) Review of Engineering Education - a Retrospective Overview, IPENZ Annual Conference, Wellington New Zealand, February 8 1997,http://202.139.240.47/ publicn/papers/Wester4.htm 7 April 1998 16:36:10 GMT

[16] Zlobin.(1996) Things fall apart, *World Affairs* 158, 148-153

Table 1 Importance of Factors in Selection of Engineering as a Career Means of 5 point scales, 5=very important

		Social status and prestige	High starting salary	High future salary	Security of employment	Engage in challenging work	Diverse career options	Intention to work abroad
N	Valid	70	73	74	73	74	73	75
	Missing	5	2	1	2	1	2	0
Mean		3.09	3.75	4.04	3.97	4.01	3.84	3.56
Median		3.00	4.00	4.00	4.00	4.00	4.00	4.00

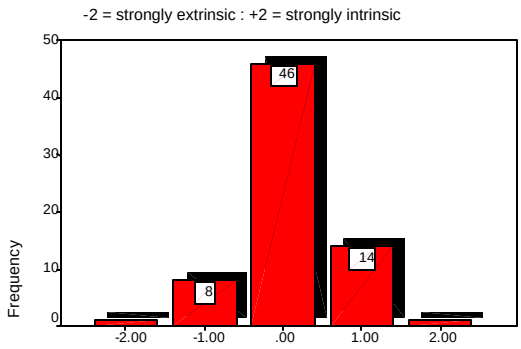

Figure 1 Distribution of students' motivational orientation

	N	Minimum	Maximum	Mean	Std. Deviation
Overall perception	72	1.7	4.3	3.4	.5365
Overall skills gained	71	1.4	4.1	3.0	.6237

Table 2 Means, maxima and minima aggregated students' perceptions of induction and their perceptions of skills gained