Motivation Among Engineering Students: A Qualitative Analysis

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Abstract
In recent years, it has emerged that the UK Engineering sector continuously experienced a low turnout of engineering graduates. Elucidations on this issue vary; yet most have been ambiguous. A matter that has the potential to shed light on this issue would be to understand the motivations that drive students into becoming engineers and in particular, their cultural and ethnic identities that affect them. Four undergraduate students were selected from each year of undergraduate study and participated in semi-structured interviews. The data was transcribed and analysed using NVivo. The interviews were analysed through open coding. The categories that emerged were used to build a number of models that built up towards four major themes: Degree, External Factors, Internal factors, and Motivation. Analysis of the models showed that students often identified parents and lecturers as figures of significant influence and motivation. In particular, they stated the needs for achievement, affiliation and autonomy as well as expectations about their future career as a factor that influences their motivation. These factors were also present in their choice of degree as well as how they felt about the support from their University.

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Introduction

The word motivation is derived from the Latin verb *'movere'*, meaning 'to move' (Beck, 2004). A broad concept as a whole, motivation is generally used to understand why, as human beings, we perform certain actions at certain times. These actions can be influenced by personal goals in life or activities that have a desirable outcome. The idea of striving to reach desirable goals in life and staying away from detrimental outcomes is known as "psychological hedonism." This ideology provides a basic understanding to why certain actions are performed with relation to motivation (Beck, 2004). As Schunk, Pintrich and Meece (2008, p.4) state, motivation is *"the process whereby goal-directed activity is instigated and sustained"*.

Motivation could be viewed as an important factor in student life (Turner & Patrick, 2004; Rebolledo-Mendez, du Boulay & Luckin, 2006). It is an issue that has been viewed as an important construct within both education and psychology and has been the focus of academic research for more than 30 years. Linking the concept of motivation with the current engineering issue, promotes an interesting research topic. Motivational influences can change over time, and this could particularly occur during the academic life of a student. Most studies on motivation have focused on a socio-cognitive model of motivation and this is particularly salient within an academic environment where social as well as inner (cognitive) influences are contributing factors. According to current research, motivation has a strong influence on performance, energy levels and cognitive processes (Zusho, Pintrich & Coppola, 2003). Thus, it is vital that Higher Education institutions help to maintain the motivation of students throughout the course and understand if and why student motivation decreases over time.

Current Engineering Issue

In 2008 and 2009, United Kingdom experienced a prolonged and deep recession. Employment rates decreased dramatically and many industries were affected. Engineering was one of the major sectors to be affected by the recession, thus organisations within the sector, adopted certain measures to counteract the economic situation. One major measure taken by firms was reducing employment. This strategy was approved by many industries, but may have tarnished the attractiveness to become an engineer (Connolly, 2012).

Recent studies carried out by the Higher Education Careers Service Unit (HECSU) have illustrated a revival in engineering. Many industries within the engineering sector have increased employment and also increased initial salary wages (Ferguson, 2012). However, according to studies carried out by the Royal Academy of Engineering, UK has a shortage of engineering graduates. Developing countries such as China and India are developing 8 times more engineering graduates than the UK. Furthermore, research carried out by Engineering UK identified that engineering graduates within the UK "need to double." At present the UK is producing 46,000 engineering graduates every year. However, these figures must reach the heights of 87,000 engineering graduates per year by 2020 (Gibney, 2012).

Consequently, Engineering firms are struggling with the shortage of engineers; as a result firms are forced to outsource work and retain ageing staff (Richardson, 2012).

This in turn, is damaging to the firms' productivity and growth within the market. It is clear that over the past few years, the engineering sector has struggled with a number of issues; one being the low engineering graduate rates. There are several factors which may have influenced the current low engineering graduation figures, a major influence being the recent recession. However, one key topic that may shine light on this problem is the issue of "motivation among engineering students".

While there have been some studies conducted on motivation within engineering students, most of the research with regard to motivation at university level has been conducted in the social sciences. Research within the topic of motivation will provide a better understanding to the current issue within engineering. Predominantly, the data would be extremely useful for Higher Education Institutions in the UK as they will be able to understand how different factors affect student motivation and what role the Universities could play in improving student motivation and performance.

Method

In this study, in-depth interviews were conducted. Four students were selected from different academic years and interviewed.

Setting, participants and data collection

The study was conducted in Birmingham, UK and included students from the University of Birmingham, Aston University and Birmingham City University. There was a student from the first, second, third and final years of study (see Table 1). Ethical approval for the study was reviewed and approved by Aston University. Consent forms were signed by each participant and were fully informed about the study and data analysis.

Table 1 *Interview participants and their details*

Participant	Year of Study	University
CS	First year	University of Birmingham
SD	Second year	Birmingham City University
AM	Placement year	Aston University
AK	Final year	Aston University

Data analysis

Data analysis was conducted in three steps according to thematic analysis (Boyatzis, 1998). In the first step, the transcribed interviews were analysed for raw data themes which were identified and coded. This step involved a deductive approach (the codes were influenced by established theory and findings from previous literature). In the second step, new codes were generated which did not fit pre-determined categories. In the third step, the reliability of the codes was checked by an external researcher. The transcription and data analysis was conducted using the NVivo 9 qualitative data analysis software.

Results

The codes built up towards four major themes: Degree, Motivation, Internal Factors and External Factors. Motivation was found to not be a single phenomenon; but consisted of different types such as achievement, affiliation, autonomy, order, and understanding. These were not preselected, but emerged out of the data. The overall model that emerged is shown in Figure 1 (without the relationships).
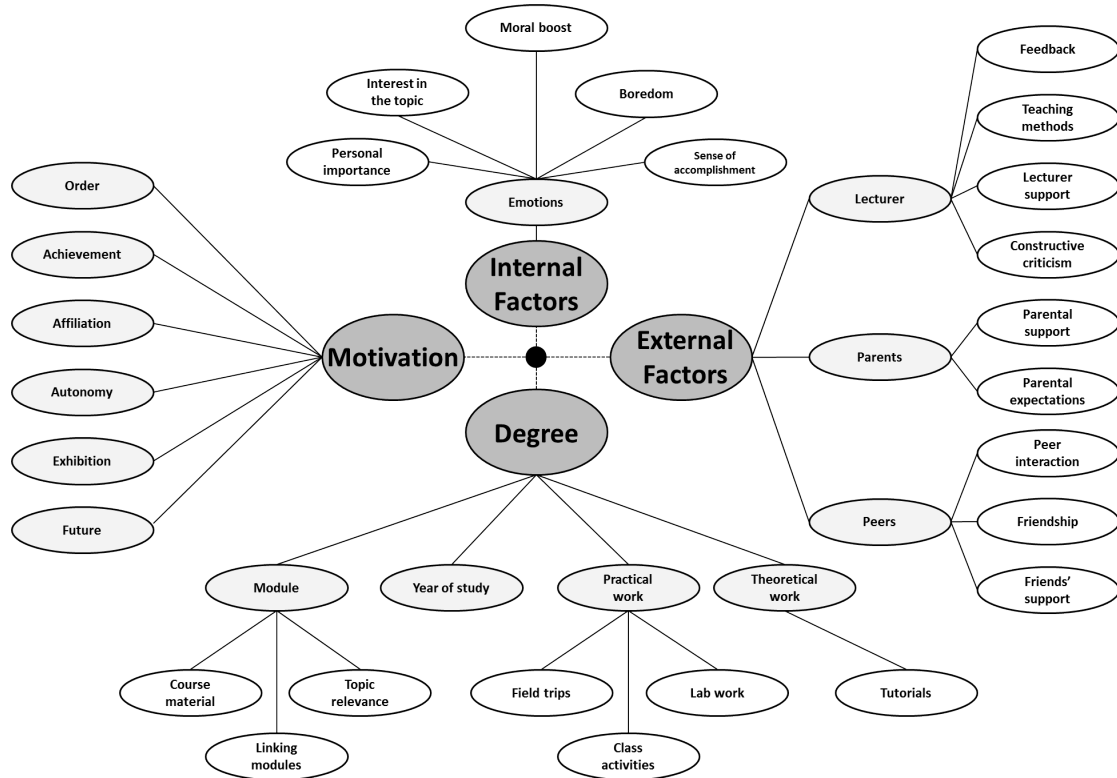

Figure 1 The final model

The need for achievement

The need for achievement was a major influence on student motivation (see Figure 2). This was influences by aspects of the degree such as class activities. Practical work was highly recommended by students who found theoretical work to be boring with little relevance to their future careers. Student performance was influenced by the year of study, the Lecturer and the amount of work load. Moreover, Lecturer recognition favourably influenced a sense of accomplishment. This phenomenon is underlined by AM, *"At times during the academic year there were a lot of deadlines close together and I feel though sometimes with certain assignments I could not give my full commitment to each module, so I never really achieved the grades I should have".*
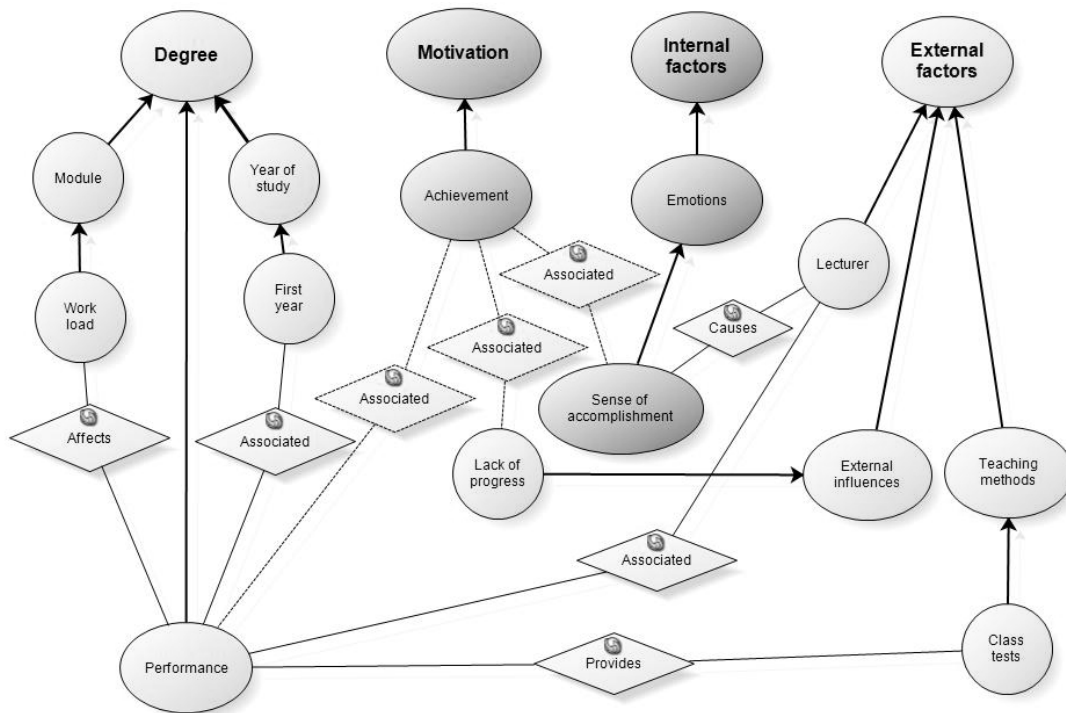
Figure 2 *The need for achievement*

The need for affiliation

Another important factor was the need for affiliation. It emerged that the need to develop social bonds was influenced significantly by external factors; most specifically by the support of parents, friends and lecturers.

Group work during the revision period provided the opportunity for students to learn information from each other and also utilise each other's strengths. For that reason, students maintained that pooling talent during revision was influenced by the affiliation motive. This relationship was emphasised by SD: *"during group work, sharing knowledge and providing support to each other"*.

Moreover, students suggested that the need to develop strong social bonds during group coursework and class activities. According to AM, *"Everyone will bring their strengths to the table. It is really motivating as you have to cover your aspect of the module and then someone else will do their aspect"*.

External influences

In analysing the interviews, three main external factors emerged: lecturers, parents and peers. It was found that these three factors had a great influence on both the students' performance and perception of the degree and their motives and emotions.

Lecturer feedback was associated with high degrees of motivation. Students expressed the need to obtain critical feedback indicating that it provided a guideline for identifying weaknesses. This correlation was raised by CS: *"In both cases the feedback is important. When given positive feedback more motivated. The feedback is not very negative for bad grades as they do not want to upset you"*

However, students claimed that feedback was difficult to obtain and was not provided often enough. AM stated, *"It feels [as] though some lecturers are not really bothered with the students and they are more in their own world. They just come to lectures, read out the slides and they gone straight back to the office. It is really hard to catch them around and if you ask them problems with the course they are not really helpful"*.

Students stated that understanding course material was highly important. It materialised that several aspects associated with lecturers were related to achieving a better understanding of course material. Students held that a lecturer's presentation, characteristics and personal practical experience favourably affected understanding. A lecturer's characteristic was also associated with student involvement and had an influence on a student's interest within a topic. Interest within a topic was also influenced by the presentation style of a lecturer. This relationship was underlined by HM: *"If the lecturer is interested in the material and the module, then you feel more engaged. Otherwise, it's less clear as the lecturer may rush through the lessons"*. Students acknowledged similar characteristics of an ideal lecturer as AM evinced, *"I really love lecturers, who are very enthusiastic about their work, very bubbly, vibrant characters. They really bring out the best in students; really engage them in their classes. Some lecturers can be very dull and boring. Students tend to be snoozing off"*.

It became evident that a lecturer's apathy and personal research adversely affected the final year studies. Moreover, it became clear that a lecturer's apathy displayed a negative correlation with understanding. This analysis found that the influence a lecturer has on internal influences of a student was very important. A better understanding of course material would be possible if a lecturer was enthusiastic, empathetic, implemented a practical learning style and regularly available. The next important influence on student motivation was the parents.

Students held that the support provided by parents were always positive regardless of good or bad grades. This point was highlighted by SD: *"When get bad grades try to motivate me to achieve better grades and provide me with feedback on how to improve which is very helpful"*.

Furthermore, it emerged that in certain cases parents do influence career choice. CS stated, *"My father's job was related to mechanical and electrical engineering. I was interested with the job and it influenced my career"*.

Notably, it appeared that parental expectations influenced performance and future career. Students stressed the pressures of meeting parental expectations even more so if a family relative used as a comparison against their own performance. Parents expected their children to obtain good grades and a successful career. This point was emphasized by AM: *"I would say that de-motivated me in terms of academic results. My parents have unintentionally put a lot of pressure on me to achieve good grades. Sometimes in the past, when I have not achieved good grades, I fell I have let them down and this has really de motivated me"*.

As might be expects, parental happiness was influenced by good performance. For this reason, students felt motivated to maintain parental happiness by achieving good

grades. Moreover, they were demotivated when parental expectations were not met. This was voiced by HM: *"I think most people feel the need to please their parents, and I'm the same I guess. I want to get their approvals so doing well in my degree is important, and good grades are something to show them"*.

The model strongly indicates that students feel motivated to meet parental expectations and ensure parental happiness. However, support appears to be provided by parents regardless of performance. Yet, students are highly demotivated by bad grades as they feel that they have not met parental expectations.

It transpired that peer interaction played a significant role in performance, revision and motivation. Students held that practical work improved peer relations, however bad grades negatively affected peer interactions. Furthermore, peer interaction had a positive impact on student motivation. This relationship was underlined by SD: *"For instance in a class where one by one go out to the white board and teaching the group in subject they understand. Also motivating the group by transferring the knowledge and advising each other in every topic. This is especially happening during exam times"*.

Students maintained that peer encouragement remained continuous regardless of the grade obtained. Yet, encouragement from peers had a positive impact on their motivation. This view was voiced by HM: *"Talking to your friends about problems in modules and assignments helps you overcome any problems you might have, like maybe you feel like you're the only one in class who didn't get a particular explanation, and then talking with friends and seeing you're not the only one makes you feel good about yourself and motivates you to learn and do better"*.

Support from friends can provide a morale boost and consequently increase motivation. This is particularly important after obtaining bad grades. In addition, students asserted that peers boasting about good grades can have negative influence on their motivation. This was stressed by AM, *"I think there has been a few isolated incidences, maybe in second year where I did not do well in a few modules and it was quite de motivating when a few of the peers were quite boastful of their results. They were saying this exam was too easy, which was really demotivating"*.

This review revealed that students value the role peers play on their motivation. Students confirmed that the interaction and encouragement of peers increased motivation and performance. Moreover, the support of peers support was vital when bad grades were a factor.

Discussion

This study found that student motivation cannot be measured as a homogeneous entity. Students exhibit a variety of motivations that together influence their performance and overall motivation to complete their engineering degrees.

Students appeared to favour practical work over theoretical work. Practical application increased student involvement and provided a sense of purpose and improved understanding. A study conducted by Grolnick and Ryan (1987, cited in Deci, Vallerand, Pelletier & Ryan, 1991, p.332) found the importance of achieving a

sense of purpose to learn. It was found that students experienced low motivation and theoretical understanding, when asked to learn a topic just for exam purposes. Yet, students who learned a topic for understanding, without the aspect of an exam, experienced high levels of intrinsic motivation. This maintains the phenomena that course material that delivers a sense of purpose positively influences student motivation.

In addition, practical work honed competencies, augmented interest within a topic and enhanced student motivation. In contrast, it emerged that theoretical work influenced boredom and had no influence on student motivation. Savage, Birch and Noussi (2011) reached a similar conclusion, whilst examining motivational factors that affected higher educational engineering students. It was found that students were highly motivated by modules that involved practical work. Moreover, engineering students felt that the use of PowerPoint slides as a dull educational tool. Baillie and Fitzgerald (2000, cited in Savage *et al.* 2011, p.40) also acknowledged that some engineering topics were monotonous.

Mitchell (1993, cited in Linnenbrink & Pintrich 2002, p.319) specified that practical work is related to a catch feature, an aspect of situational interest. Situational interest can be increased, by including fun learning activities and highlighting the importance of the course material, teaching approaches emphasised by participants from the five semi-structured interviews.

On the other hand, it became evident that autonomy was of importance in certain situations. The need for independence remained constant over time, and was influenced by solving problems, making personal decisions and during class tests. Personal decisions were associated with learning approaches. Interestingly, it emerged that learning difficult course material that aroused curiosity was not considered important over time and the degree grade was considered to take more priority than learning of vital course material over time.

A study carried out by Kusurkar, Ten Cate, Vos, Westers, and Croiset (2012) found similar influencing factors. It was found that autonomy was positively linked with a good learning approach and high study effort. It became evident that self-dependence influences learning approaches, module priority and the improvement of weaknesses.

Another significant find was that the need to look to the future decreased in the third and fourth year. The majority of individuals from each year group were highly motivated to look to the future, a noticeable case for first year students. In addition, over time students felt the course material was not very useful for future aims. However, the qualitative data found an interesting phenomenon. It appears that final year students were strongly motivated by future goals, more specifically, getting into a graduate scheme. Remarkably, students valued the securing of a graduate scheme more than the degree grade. Moreover, students alleged that companies focus more on competencies than the degree grade. Consequently, students favoured modules that honed competencies and improved weaknesses.

This need to hone certain competencies is associated with mastering goals, which is a feature of goal orientation. The literature, suggests that students motivated by mastering goals stand a better chance of academic achievement. There is a positive

correlation between mastering goals and learning approaches (Linnenbrink & Pintrich 2002, p.320-323).

Ryan, Stiller, and Lynch (1994) identified that students who had a positive relationship with their lecturer were more intrinsically motivated than students who had a negative representation of their lecturer, a relationship sustained by data gathered from the research study. Students felt the need for a lecturer who is constantly available to deal with issues, employs a practical teaching approach, is enthusiastic in class and is concerned for a student's welfare. These characteristics of a lecturer positively influenced student motivation.

Moreover, the literature highlighted that feedback provided by a lecturer underlining the causable factor would push a student to work harder (Linnenbrink & Pintrich, 2002, p.318). This correlation emerged during the analysis of the qualitative data. It emerged that the lecturer feedback was related to personal importance. Students expressed the need to obtain critical feedback, as it would provide a guideline for improving weaknesses. However, students claimed that feedback was difficult to obtain and was not provided often enough.

Parental expectations were associated with performance and future career prospects. Students emphasised the need to meet parental expectations and maintain parental happiness. Meeting parental expectations put pressure on students, even more so if a family relative was academically successful. Moreover, not meeting parental expectation would cause a decrease in motivation. Interestingly, this phenomenon challenges a correlation raised by Ryan *et al.* (1994), who alleged that challenging parents had a positive effect on student motivation.

The support and encouragement of peers throughout university provided a morale boost and at times increased student motivation. The need to develop social bonds was constant over an academic engineering course. Students maintained that revision, group work and class activities were associated with the need to develop social bonds. Moreover, students expressed that peer interaction improved understanding of modules as each member provided their own understanding of the module to the group. Ryan *et al.* (1994) held that competition between friends was found to have a negative impact on education variables and self-esteem, a correlation that also materialised via the qualitative analysis. Students expressed that peers boasting about good grades can have negative influence on their own motivation.

This need to exhibit performance is related to a performance goal which is a feature of goal orientation. An individual motivated by a performance goal tries to outshine competition and brag about their achievement (Linnenbrink & Pintrich 2002). The exhibition motive was constant over the course and was influenced by peer interaction and meeting parental expectations.

The need for exhibition is interrelated with the dominance motive. The need to influence others was constant across an undergraduate engineering course and is correlated to peers boasting. Additionally dominance is driven by competition with peers, other people's careers and gender expectation. A student suggested that male students did not work hard enough as female students, as job prospects were greater for males in the engineering field.

Students strongly emphasised the need to understand the material. Several factors positively influence the need to understand. A lecturer who clearly explains course material and implements a practical teaching approach positively influences understanding. In addition, the interaction of peers during the exam period also influences the need to understand. Overall it emerged that understanding positively affects an increase in student motivation. Research carried out by Benware and Deci (1984, cited in Deci et al. 1991, p.331) proposed a similar hypothesis. It was found that college students who learnt to gain an understanding of the subject were more intrinsically motivated than students who learnt just to pass the module.

Examining the learning approach of students found some significant relationships. Students asserted that their learning approach altered with respect to increased workload, personal interest of a module and the teaching method implemented by the lecturer. During periods of increased work load, priority was given to modules that were of high importance. Notably, recent research brought forth a relationship between personal interest and course modules, suggesting that an option of choosing a course module would be beneficial to a student. Furthermore, the literature maintains that students' motivation may vary depending on the module (Linnenbrink & Pintrich 2002).

Recommendations for future research

If this research study is to be continued further, the following variables would raise some interesting issues that would deliver an alternative perspective of student motivation. The aim of the research study was to understand how motivation changed across and undergraduate engineering academic life (3-4 years). The results gathered highlighted influential factors affecting performance. It would be interesting to correlate this data against other factors such as exam results, degree grade and future career choices.

A longitudinal quantitative study of change in motivation for individual students would provide a better perspective. To implement this study, a suitable sample of students would have to be targeted in their first year at university. At the end of every year, motivation levels would be recorded. Thus by the end of the final year a motivation level would be accessible for each individual across the academic engineering course. This would provide a clearer view of how motivation level changes across an engineering student academic life. The same study can also look at performance. Moreover, a sample that holds a variety of demographic groups, such as ethnic groups and sex may find some interesting relationships. Nevertheless such a research study would require an extensive amount of time and resources.

Conclusion

The results obtained from this study satisfied its aims and objectives. The data also found additional information that gave an alternative viewpoint on student motivation. Student motivation was found to be influenced by several factors (extrinsic and intrinsic). Students said that parental support was vital at difficult times. Peer interaction was also considered to be influential at times of revision and coursework. Most importantly, lecturers' attitudes and characteristics affected understanding and students' sense of purpose. Students were intrinsically motivated by practical work

more than theoretical work, as it honed competencies and provided a better understanding of the material. Furthermore, students maintained that the graduate scheme held more importance than the degree grade and felt that companies focus more on transferable skills than degree grades, an assertion that reinforces the need to develop competencies via practical work.

To conclude, engineering student motivation does appear to decrease over time. However, it can be increased if Higher Educational Institutions employ a more practical approach to teaching, continue to hone in on competencies such as presentation, teamwork and management skills. Moreover, Universities must ensure that a positive learning environment is created through lecturer support and peer interaction venues which will significantly affect the engineering graduation rates in the UK.

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