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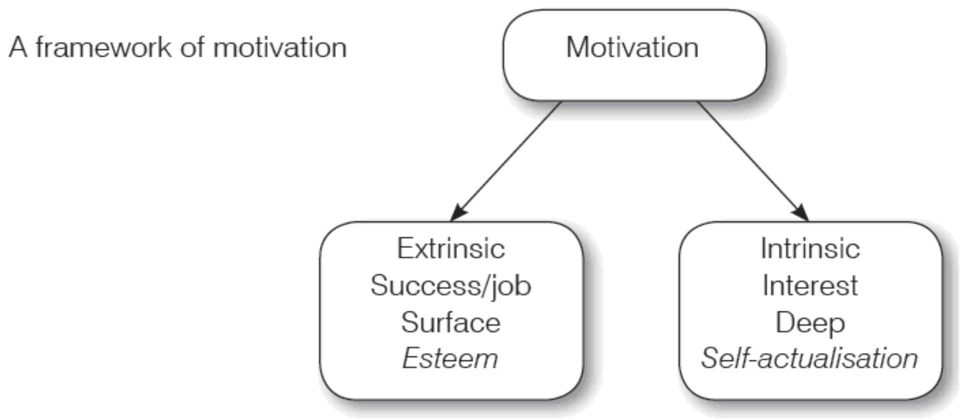
Motivating our Students for Student Engagement, Progression and Retention

Introduction

Apart from teaching students the necessary fundamental concepts and theories, the role of a teacher also involves motivating students' learning and facilitating students to develop their transferable skills to prepare for the real world. If teachers understand students' motivation, it can greatly enhance the classroom experience and students' performance as well as facilitate their teaching. Thus understanding students' motivation is a key factor in student's successful learning.

Student motivation is highly related to the student's desire to actively participate in the learning process. In understanding student motivation, concerns about the reasons or goals that underlie their involvement or non-involvement in academic activities are examined as well. There are two streams of motivation that governs a student's desire to learn: intrinsic motivation and extrinsic motivation (see diagram below). Intrinsic motivation is influenced by the student's need to fulfil an interest, thus learning is for the student's own sake and for the joy it brings, and the feeling of accomplishment in what learning brings. Extrinsic motivation is influenced by the need for recognition, praise and/or reward, thus learning is for economic and social reasons. Student's motivation is also related to student's perception to learning (Prosser & Trigwell, 1999).

Accessed from Savage, Birch, & Noussi (2012)



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Educational Theories on Learning Styles

1. Felder & Silverman's Models of Learning & Teaching Styles

Felder & Silverman (1988) defines a student's learning style in terms of five aspects of information, namely, *Perception*, *Input*, *Organisation*, *Processing*, and *Understanding*.

1. *Sensing / Intuitive* – a Sensing Learner prefers information that is concrete, such as facts, data and case studies, whereas an Intuitive Learner prefers information that is abstract, such as principles, theories and possibilities.
2. *Visual / Verbal* – a Visual Learner prefers receiving information visually, such as using pictures, diagrams and experimentation, whereas a Verbal Learner prefers receiving information verbally, such as using words, sounds and discussion.
3. *Inductive / Deductive* – an Inductive Learner prefers learning through observation and discovery, from which they draw inferences gradually, whereas a Deductive Learner prefers learning general principles and then applying these principles to real-world problems and scenarios. **Please see note below.*
4. *Active / Reflective* – an Active Learner tends to be an active experimentalist who likes group activities such as discussion, whereas a Reflective Learner tends to be a passive theoretician who likes to observe and think about the information being presented.
5. *Sequential / Global* – a Sequential Learner tends to be better at convergent thinking and progresses towards understanding in continual steps, whereas a Global Learner tends to be better at divergent thinking and sometimes jumps directly to the solution.

Note:

* *In June 2002, the author added to the original paper a preface describing the Deletion of the Inductive / Deductive Dimension. Such a modification was due to the author's belief that Induction is a better teaching method than Deduction, although many students have reported that they prefer Deductive Learning. Traditional higher-education instructors are often tempted to use the less effective Deductive Teaching method, overlooking that Inductive Teaching encourages problem-solving, discovery and inquiry learning. Therefore, the author announced to omit this dimension from the model.*

Dimensions of Learning & Teaching Styles

Preferred Learning Style		**Corresponding Teaching Style**	
Perception	Sensory	Content	Concrete
	Intuitive		Abstract
Input	Visual	Presentation	Visual
	Auditory		Verbal
Organisation	Inductive	Organization	Inductive
	Deductive		Deductive
Processing	Active	Student Participation	Active
	Reflective		Passive
Understanding	Sequential	Perspective	Sequential
	Global		Global

(Accessed from Felder & Silverman, 1988)

Because students tend to be different in how they prefer to learn, corresponding teaching styles should be considered and used accordingly, in order to help students maintain their motivation, concentration and confidence in learning. An effective curriculum is arguably the one that addresses all learning styles in terms of *Content*, *Presentation*, *Organisation*, *Student Participation*, and *Perspective*.

Kolmos & Holgaard (2008) investigated the preferred learning style of engineering students and their findings suggested the subjects' overall profile as being active, sensing, and visual. Apparently, most engineering courses (apart from laboratory work) emphasise on teaching abstract concepts rather than facts, and present information predominantly in verbal forms such as using lectures and readings, and students are not encouraged to actively participate in the learning process (Felder & Silverman, 1988). To identify the mismatches between learning and teaching styles is therefore crucial and may help to explain students' poor performance and frustration despite their excellent potential in the engineering profession. The following is a list of examples of Teaching Techniques that are recommended to address the diverse learning styles.

Teaching Techniques to Address All Learning Styles

1. Motivate learning. As much as possible, relate the material being presented to what has come before and what is still to come in the same course, to material in other courses, and particularly to the students' personal experience (inductive/global).
2. Provide a balance of concrete information (facts, data, real or hypothetical experiments and their results) (sensing) and abstract concepts (principles, theories, mathematical models) (intuitive).
3. Balance material that emphasises practical problem-solving methods (sensing/active) with material that emphasises fundamental understanding (intuitive/reflective).
4. Provide explicit illustrations of intuitive patterns (logical inference, pattern recognition, generalisation) and sensing patterns (observation of surroundings, empirical experimentation, attention to detail), and encourage all students to exercise both patterns (sensing/intuitive). Do not expect either group to be able to exercise the other group's processes immediately.
5. Follow the scientific method in presenting theoretical material. Provide concrete examples of the phenomena the theory describes or predicts (sensing/inductive); then develop the theory or formulate the mod (intuitive/inductive/sequential); show how the theory or mod can be validated and deduce its consequences (deductive/sequential); and present applications (sensing/deductive/sequential).
6. Use pictures, schematics, graphs, and simple sketches liberally before, during, and after the presentation of verbal material (sensing/visual). Show films (sensing/visual.) Provide demonstrations (sensing/visual), hands-on, if possible (active).
7. Use computer-assisted instruction—sensors respond very well to it (sensing/active).
8. Do not fill every minute of class time lecturing and writing on the board. Provide intervals—however brief—for students to think about what they have been told (reflective).
9. Provide opportunities for students to do something active besides transcribing notes. Small-group brainstorming activities that take no more than five minutes are extremely effective for this purpose (active).
10. Assign some drill exercises to provide practice in the basic methods being taught

(sensing/active/sequential) but do not overdo them (intuitive/reflective/ global). Also provide some open-ended problems and exercises that call for analysis and synthesis (intuitive/reflective/global).

11. Give students the option of cooperating on homework assignments to the greatest possible extent (active). Active learners generally learn best when they interact with others; if they are denied the opportunity to do so they are being deprived of their most effective learning tool.
12. Applaud creative solutions, even incorrect ones (intuitive/global). Talk to students about learning styles, both in advising and in classes. Students are reassured to find their academic difficulties may not all be due to personal inadequacies. Explaining to struggling sensors or active or global learners how they learn most efficiently may be an important step in helping them reshape their learning experiences so that they can be successful (all types).

(Accessed from Felder & Silverman, 1988)

2. Kolb's Models of Experiential Learning Cycle & Learning Styles

Regarding how a student's learning style is developed, Kolb & Kolb (2005) suggests that the learning styles are increasingly shaped and influenced by *Personality Types*, *Educational Specialization*, *Career*, *Job* and *Task Skills*. The table below shows the relationship between learning styles and the five levels of behaviour.

Relationship between Learning Styles and Five Levels of Behaviour

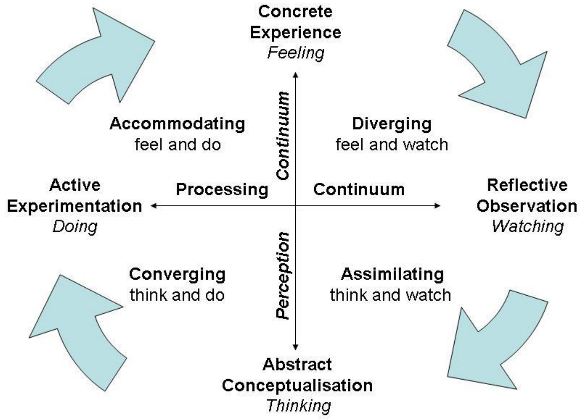
Learning Style	Diverging	Assimilating	Converging	Accommodating
Personality Types	Introverted Feeling	Introverted Intuition	Extraverted Thinking	Extraverted Sensation
Educational Specialisation	Arts, English, History, Psychology	Mathematics, Physical Science	**Engineering**, Medicine	Education, Communication, Nursing
Professional Career	Social Service, Arts	Sciences, Research, Information	**Engineering**, Medicine, Technology	Sales, Social Service, Education

Task Skills	Valuing Skills	Thinking Skills	Decision Skills	Action Skills

(Accessed from Kolb & Kolb, 2005)

Students in a specialised discipline are often exposed to specialised culture, professional problems and strategies. According to this model of Kolb's, students practising Engineering are more likely to belong to the *Converging* learning style, which is an adaptation from the earlier, classic model of Experiential Learning Cycle (Kolb & Kolb, 2005) as follows.

Model of Experiential Learning Cycle



(Accessed from Clark, 2011)

Kolb's Experiential Learning Cycle Model is based on the *Perception Continuum* (Thinking / Feeling) and *Processing Continuum* (Doing / Watching), which form a quadrant, each representing a learning process in a learning cycle – *Concrete Experience*, *Reflective Observation*, *Abstract Conceptualisation* and *Active Experimentation*.

The theory of Experiential Learning Cycle proposes that learning is a continuous movement of relearning and transformation of experiences, where students' beliefs and ideas are constantly examined, tested, integrated and refined. The combination of the four learning processes result in the definition of four learning styles or modes – *Diverging*, *Assimilating*, *Converging*, and *Accommodating*. Although a student may favour one learning mode over another, learning modes are not fixed traits and learning is thought to be most effective when all four modes are practised and balanced with each other. Indeed, Kolb (1984) argues that the process of learning relies on the resolution of conflicts experienced when moving between the different learning modes, and that students can enter the learning cycle at any point of the learning process.

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Methods in Motivating Our Students

How can teachers motivate students' learning? It is necessary to identify pedagogies to motivate engineering students' interest in learning (see "Tips for motivating our students" [http://hke3r.cetl.hku.hk/tips_motivate.php] and "Tips for 'waking up' our students" [http://hke3r.cetl.hku.hk/tips_wake_up.php]) and increase the possibility of engagement, retention and progression. Below, we have identified some alternative and innovative strategies to motivate engineering students from around the world.

Organizing Motivation Programme

Students who perform poorly in their academic studies may have the tendency to drop out and lose the initiation to study their designated major. Thus the establishment of a motivation programme aims at helping students to improve their grades and to increase the possibility of retention. The University of Malaya's Faculty of Engineering (Siraj, Ali, Mahadi, Soin, & Dawal, 2007) has initiated and proposed to organize such programme in order to attend to such kind of situation. However in their case, the academic staff are not trained counsellors, therefore motivation workshop is organized for academic staff who are interested in conducting such kind of work in order to prepare them with the necessary knowledge.

Motivation programme is a platform for students to talk over what is on their mind with a person who has expertise and experience in the respected field. The students can benefit from the experienced person who will advise and help them change their attitude and look at negative situations in a new and more positive way.

Before proceeding to discuss their problems and ways to solve them, it is essential for the academic staff to try to understand the student and to clear their initial anxiety.

Academic staff in the motivation workshop will be exposed to the following topics:

1. **"Recognizing self-defeating problems"** i.e. anxiety, difficulty in concentrating, poor time management, indecisiveness, procrastination, and absenteeism in lectures.
2. **"Motivating the students"** i.e. instilling students with the right positive attitude towards course materials and living skill.
3. **"Recognizing how to improve student's studying skills"** i.e. encouraging students to seek instructor's assistance when needed.

4. **“Handling personal problems”** i.e. time management, social, and financial
5. **“Recognizing how to nurture student’s self-confidence”** i.e. finding ways to instill positive attitude on one’s achievement and ability.

References:

- Siraj, S. F, Ali, N. Md., Mahadi, W. N. L., Soin, N., & Dawal, S. Z. (2007). A proposed motivation programme for underachieving students at the faculty of engineering, University of Malaya. *AEESEAP Journal of Engineering Education*, *31*(2), 47–54. Retrieved from http://ejum.fsktm.um.edu.my/article/562.pdf.

Development of an Interactive Chatbot

The approach to discover what will motivate and engage students with respect to their interests, goals, aspirations and values was the starting point in the development of an online artificial intelligence (AI) or “chatbot” named Anne G. Neering (EnGiNeering) (Crown, Fuentes, Jones, Nambiar, & Crown, 2010). The chatbot is a computer program delivered on course websites that serves as a text based conversational medium. The purpose of this interactive online setting is to encourage students to think reflectively on the fundamental concepts in the course. The value in developing this chatbot is related to students’ motivation and engagement in developing the chatbot’s knowledge base. Having students get involved in the process of building that knowledge base has proven to be instructional and fun. The knowledge base is built from students interactions that are individual and cooperative.

References:

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An Evidence-Based Predictive Tool for Motivating Freshman Engineering Students

At Unitec Institute of Technology (Fernando & Mellalieu, 2011) in Auckland, New Zealand, in order to encourage their students to engage early with their learning during the course of their study, the teachers use several methods such as (i) presenting the pass or fail grades of students from previous years; (ii) showing feedback from previous students; (iii) presenting evidence suggesting that active engagement, punctuality, and good performance in interim assessments will contribute to success.

However such methods may not provide strong incentive in engaging students with their learning, which lead to the creation of the predictive tool. The creation of the predictive tool was sparked by an interest in finding the best way to motivate and engage engineering students to achieve better course outcomes supported by quantitative evidence. The designers of the tool presumed that with the use of the tool, engineering students are provided with a method to predict their final grades and academic achievement. Based on the prediction, students may opt to change their study habits to achieve their target outcome. Although its intention is to maximise students' efforts for a maximum pass grade, there is a risk that students' will use the tool to optimise efforts to achieve a minimal pass. However this all depends on the choice that the students make.

The predictive tool, "MECS (Motivation, Engagement, Completion, and Success) tool", is an Excel spread-sheet comprised of five sheets representing five component tools (Fernando & Mellalieu, 2012). These five component tools are namely early detection tool, attendance tool, assignment to exam tool, test to exam tool, and coursework to exam tool (Fernando & Mellalieu, 2011). In 2012, students were given the tool to help them to achieve their desired outcomes at the beginning of the semester. The tool was uploaded on Moodle and they were encouraged to use the tool as they progressed throughout the semester.

The development of the tools (Fernando & Mellalieu, 2011) was based on a data mining (WEKA® data mining workbench software) analysis conducted on students enrolled in the course of Fluid Mechanics in 2010 with respect to their class attendance and assessment performance records. The tool facilitated the teaching of the course in the following ways. The tool offered empirical evidence suggesting that increased improvement of attendance in lectures and increased improvement of students' performance in assessments are related to higher grades in final examinations. Moreover, with the "early detection tool", the teacher was able to utilize the tool to detect students who are on the brink of failing or students who are struggling with the course in which the teacher could provide extra assistance to those students in hope of changing their attitude or behaviour.

The study conducted in 2012 validated the MECS-tool that was developed using the data from 2010 against the data from 2011. The validation was conducted by testing the applicability of the model on a similar cohort of students that operate under similar conditions. Although there were a few differences in terms of class size, the duration and frequency of lectures, which may have an influence on students' performance. Consequently, the assignment marks were compared to see if there are significant differences between students' cohort from 2010 and 2011. Results obtained from the students showed no significant differences between students from 2010 and 2011 assuring that the marks' distribution across these cohorts are similar.

Apart from comparing the significant differences in assignment marks between students' cohort from 2010 and 2011, the ability of the five components within the MECS-tool to detect students who are "at-risk" of failing were also examined. Results indicated that the component tools were effective in detecting the students at-risk of failing. The two most useful component tools in detecting "at-risk" students were "early detection tool" and "test to exam tool". Students who were detected by the two tools to be "at-risk" were notified and encouraged to attend several catch-up tutorials organized and conducted by the teacher.

In conclusion, the following are some key findings from their study:

1. Data mining is an effective process that enables the user to distinguish associations between "in-course performance attendance" and "final course outcomes".
2. The associations as a result of the data mining analysis allow the utilization of a quantitative tool that attracts engineering students to use it to guide their study behaviour.
3. Development of the tool using the data from 2010 cohort was valid in predicting the course outcomes for 2011 cohort. In validating the 2011 cohort, students did not have access to the tool; in addition, the teacher offered no extra classes "informed by the tool". Variations observed between cohorts from 2010 and 2011 were mainly because of the increased class size and the teacher's changes in delivery methods of the course.
4. Teachers and students using the MECS-tool in 2012 reveals that it positively influences retention and the completion of a course.
5. Students expressed changed behaviour with the use of MECS-tool, indicating they "worked harder on remaining assignments", "allocated more time for revision and tutorials", "determined not to miss lectures", "chose to attend additional catch-up tutorials" , "decided to undertake assignments to a higher standard" and "started

revising on previous years' examination questions early". (Gathered from the qualitative questionnaire from 2012 students at semester end).

References:

- Fernando, A., & Mellalieu, P. (2011, December). *An evidence-based predictive tool for motivating engagement, completion, and success in freshman engineering students*. Paper presented at the 2011 AAEE Conference, Fremantle, Australia. Retrieved from http://unitec.researchbank.ac.nz/bitstream/handle/10652/1890/Fernando%20-%20evidence-based%20predictive%20tool.PDF?sequence=1
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Informal Instructional Design to Engage and Retain Students in Engineering

Universities located in Australia, Europe, and the US have devoted efforts focusing on ways to reach an understanding on the issues regarding student underperformance, student retention, academic success of student in engineering and science disciplines. These various universities across the globe have been introducing interventions in the curriculum and instructional design that attempted to provide more support for the students with respect to the mentioned issues.

Data gathered from the Science, Technology, and Innovation Awareness Programme in Ireland reveals that there are less people pursuing the field of engineering and science because they find engineering and science disciplines to be less attractive as it emphasizes too much on theory and it lacks connection to everyday life. Some respondents are reluctant to pursue the following disciplines because they feel that it is hard to make a future career out of their discipline. Moreover, they believe that it is a lot easier to obtain higher grades studying subjects that do not involve mathematics. Therefore these results constitute to the low enrolment of students in the engineering and science discipline.

A study was conducted by Chan & Colloton (2013) at the Institute of Technology (IoT) in Ireland, in order to develop a model to engage and retain students in engineering. The student population of IoT constitutes nearly 21,000 undergraduate students and 1000 post-graduate students. The institution offers degree programmes focusing more on application and less on research. Students enrolled in the 3-year electrical engineering degree programme took part in the following study. The average class size was about 35 students, and their ages ranged from 17 – 40 with diverse backgrounds. At the following institution, student retention has been critical from the late 1900s to early 2000s, with an average retention rate of 45% by the end of the first years and with less than 30% student cohort of the original class that actually graduated. In order to gain in depth understanding of the situation, interviews were conducted on the students who withdrew from the programme in a five-year period. Ideas for a retention strategy model to engage students in the curriculum are also presented along with some instructional approaches.

Step 1: Getting to know them

Develop a relationship with the students – a leadership, a helping hand and more important, a friendship.

- Find out some personal information such as mobile number, hobbies, does he or she work.
- Develop a sense of trust and friendliness, so the students can approach you easily especially at the start of the term. Don't forget, the transition between secondary to third level can be very remote for some students, by being there for them, you can slow down this changing process, and let them ease into the environment slowly.
- Ensure they know where they can find you, don't assume they know how to use email, cause most of them don't!
- Talk to them like friends. Ask them about their interests, why did they pick the course etc. They will not drop out without coming to talk to you first.
- And try to remember their names.
- Students expect the tutor to know everything, from visa to grants support to accommodation and to where to get student travel cards. Be prepared, but don't bluff or send them away just because you don't know, try to find out for them.

Don't just be their lecturers, be their friends!

Step 2: College is supposed to be fun

Encourage and organize social events, allowing them to integrate between them. So they feel they are part of a team and have a sense of belonging!!!

- Allow and encourage more interactive tutorials or labs that allow the students to interact with each other such as designing a presentation for a Microsoft PowerPoint project.
- Organize social events – soccer competition against other classes, ice-skating, meeting etc. Their hobbies can be determined from the information sheet in step 1.
- Nominate a good class student representative could assist a lot of unnecessary running around.
- Invite past graduates to present informal talk about their careers to-date to the first year students, to help them be more aware of their career paths.

If you can get them all integrated, they will enjoy college more, and that is 1/3 of the battle gone!

After all, going to college is like going to work, if you don't like what you do at work or people in your work, you don't feel like getting up in the morning and will eventually quit.

Step 3: Help them to motivate academically

- Record all attendance for student tracking, maybe even introduce attendance award.
- Give them a target, stress on the amount of marks they will get if they do a good job.
- Most of these students have very short attention span and lack of imagination. It is important for us to relate our labs and lectures to real life applications, give good examples, how the theories are related in real life. Sometimes it is good to tell a story, it helps the students to remember and understand.
- Ask for inputs. 50 minutes can be a long time to sustain anybody's interest especially when they are 17 and 18 years old. Nobody wants to just sit there and

listen whole day long, sometimes it is more effective to make it a 2-way conversation. Call on students for answer to shake students out of their passivity.

- Be tolerant and treat the students as adults. If you give them respect, they will give you respect also.
- Offer to help academically weak students.
- Encouragement and reward with positive response. We humans tend to be motivated when our performance is followed by rewards.

If they are given positive encouragement at the subjects, it doesn't matter if they are interest in it or not, they will like it.

Informal retention strategy approach (Accessed from Chan & Colloton, 2013)

Investigation in tackling retention issues have been conducted extensively. Some major reasons constituting student withdrawal include transition from secondary to tertiary level, socio-economic background, lack of motivation, uncertain or lack of student support, mismatched expectations, and poor adjustment to the challenges of tertiary level learning environment. However, the Higher Education institutions' or faculties' failure in recognizing and understanding the root of the problem in retention is often an issue. A typical example of such failure happened with the peer-mentoring scheme offered by the Faculty of Engineering at IoT. After implementing the scheme for five years it faded away without achieving anything significant. Even though it was a failure at the institution, peer mentoring does have its potential in retaining students because it can offer students a sense of being connected to the larger community, therefore the successfulness of such activity highly depends on whether the activity implemented is performed structurally by focusing on factors that leads to success.

Therefore in order to address the retention problems, it is important to first figure out the root of the problem before actually tackling the problem, or else the adoption of any scheme or activities to target retention issues would be insignificant.

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- Chan, C. K. Y., & Colloton, T. (2012). Informal instructional design to engage and retain students in engineering. In T. M. Sobh & K. Elleithy (Eds.), *Emerging trends in computing, informatics, systems sciences, and engineering* (pp. 619–627). New York: Springer

An Evaluation of Motivation in Engineering Students, Employing Self-Determination Theory

The following study conducted by Savage & Birch (2008) examines the motivation of 210 undergraduate students in the Department of Electronic and Computer Engineering at the University of Portsmouth. The study aims to measure “intrinsic” and “extrinsic” motivation of students using questionnaires and semi-structured interviews. In addition, the data gathered can be utilized as evidence for the purpose of discovering how to further assist teachers in the department to plan and design pedagogical interventions that will support students’ active engagement. Historic data such as the personal statement, the grades, and the subjects obtained prior entry has been sought as additional evidence, which facilitated the identification of the major influences in students’ motivation.

The undergraduate students who took part in the study were selected to receive the questionnaire according to these criteria: (i) they had spent the majority of their education in the UK; (ii) they had not attended independent schools; (iii) they were not direct entry students; or (iv) they were not transferred students from other universities or departments. Although the questionnaire was sent out in a word document to their corresponding email addresses, students could opt to complete the questionnaire online through the link provided along with the attachment. A reminder was also sent out a week later to prompt students who have not completed the questionnaire.

The results obtained from this limited study reveals that many of the students in the Department of Electronic and Computer Engineering at the University of Portsmouth were intrinsically motivated. Therefore if students are given the freedom to choose the topics for their assignments and laboratory work that draws on their personal interest, students will be more motivated and interested in the course they are pursuing.

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http://www.heacademy.ac.uk/assets/documents/subjects/engineering/EE2008/p012-savage.pdf

Use of Service Learning to Motivate Engineering Students

A study conducted at Boise State University in Idaho, USA (Sevier, Chyung, Callahan & Scrader, 2012) compared the effectiveness of using service learning and non-service learning method to influence freshman engineering students' motivation and ABET program outcomes. Service learning is a type of experiential learning where students apply their knowledge and skills to solve problems in the community through group work.

ABET Program Outcomes:

a. an ability to apply knowledge of mathematics, science and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively (both oral and written)
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The sample consisted of 214 students who are enrolled in the course, "Introduction to Engineering" during the fall semester of 2009 and spring semester of 2010 and has completed both service learning projects (69 students) or non-service learning projects (145 students). The course on "Introduction to Engineering" is a project-based lab course designed to teach first-year students to understand the overall engineering design process, to allow them to gain insights into activities and challenges that engineers encounter in their jobs, and to make them feel "motivated" in completing an engineering project for a client.

Coursework are mostly in the form of group work. Majority of the students, who took part in this study, majored in Engineering (Civil Engineering (n=56), Mechanical Engineering (n=50), Electrical Engineering (n=33), Engineering General (n=31), Materials Science and Engineering (n=13), and Computer Science (n=6)). The rest of the 25 students majored in other science disciplines.

Students were asked to complete two sets of surveys, motivational attitudes survey and the ABET program outcomes survey, at the end of the course. The motivational attitudes survey consists of two parts, the quantitative data consists of nineteen questions that measures motivational attitudes using 7-point Likert-scale questions (where ‘1’ is strongly disagree and ‘7’ is strongly agree). The motivational attitudes were then measured against the ARCS (Attention, Relevance, Confidence, and Satisfaction) factors. The qualitative data consists of three open-ended questions. The ABET program outcomes survey consists of quantitative data only. Students were asked about how participating in class project-based activities help them improve each of the ABET program outcomes (a-k) through 7-point Likert-scale questions (where ‘1’ is no improvement and ‘7’ is a lot of improvement).

The results obtained from the surveys reveal that the use of service learning method is more effective than non-service learning method in influencing students’ (i) interest in engineering, (ii) recognition of relevance to their current studies and future career, (iii) satisfaction in learning, and (iv) perceived engineering abilities (i.e. ABET outcomes of (c), (e), and (k)).

References:

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A Sharing on Motivating Students

The following section is a sharing by an Engineering professor from James Cook University (Tuladhar, 2011) on motivating engineering students. The teaching approaches and other methods suggested are adapted from his sharing in motivating and engaging students to learn.

The author discusses his teaching philosophy by reflecting on his interest to create a student-centred, active teaching and learning environment that encourages a two way channel between students and teachers that facilitate interaction and learning. He also tries to effectively integrate his research and industrial experience into his teaching. Apart from making efforts in teaching, he also facilitates students to conduct collaborative projects with industries and regularly invite professionals from local industries to conduct sharing and lectures. Thus his emphasis in placing students first and exposing students to the real-world industries are effective ways to motivate student's learning and to develop their transferable skills (i.e. communicative and teamwork skills).

A contextual teaching and learning approach

A contextual teaching and learning approach is effective in teaching engineering students as students can relate their learning with the problems that they will encounter when they enter into the professional field. Before introducing any new concept to students, his practice is to relate the topic to everyday problems that students are familiar with because associating real-world examples with the concept can help students understand its relevance and inspire students to learn. For instance in order to teach students issues related to hot-weather concreting, he showed students actual pictures of constructing concrete aquarium tanks which used the technique of injecting liquid nitrogen into the concrete mixing trucks to reduce the temperature of concrete mix and avoid cracking.

A multi-sensory teaching and learning approach

He has used the following teaching approach in teaching engineering design courses in order to sustain the students' interest because often these courses are thought of to be dry and monotonous. A multi-sensory teaching and learning approach adopts the use of visual illustrations and demonstrations in teaching. In teaching design courses, he strategically used pictures, videos, animations, and props in order to explain the underlying concepts. For instance he used videos to show practical examples to illustrate sustainability in concrete engineering. The examples he selected were about the collapse of civilization in Easter Island due to unsustainable development practices and collapse of Tacoma Narrow Bridge in the United States due to wind loading. Again, he continues to apply real-world examples into teaching concepts.

Initiate students to participate in solving engineering problems

The creation of an active learning environment is essential in order to facilitate students to develop their critical thinking and problem solving skills. For the tutorial sessions in his design courses, he formulates sets of original and realistic problems which challenge and encourage students. To begin with, he outlines strategy to solve these problems and initiate and encourage students to discuss among themselves. After the discussion students will be selected at random to present their solution. This form of interaction encourages participation and certainly gives students a motive to learn because students will have to be prepared to solve the problem.

Administer informal quizzes

Revision of the course content is conducted periodically. After the completion of each section, short oral quizzes are administered as a means to foster an enjoyable learning environment. For his class on concrete engineering, he divided his class into two groups and the group who wins will get a reward. Although the quizzes are not for grades, students are enthused to participate in these activities because it helps them review and reflect on the subject matter as well as reinforce their memory.

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