Retention in Engineering

A look at issues confronting teaching and learning in engineering and beyond

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Outline

Introduction

Why Me?

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The Retention and Progression Issue in Engineering

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The Mathematics Issue

These issues also appear when teaching mathematics to students for whom it is not their principal subject, for example, to

1. Scientists (Physicists, Chemists);
2. Engineers (both “Hard” and “Soft”);
3. Social Scientists.

Constraints

The Stigma of Mathematics

Mathematics holds an especially reviled place in the heart of many. They may have been taught in ways that make little or no sense to them, and the particularly cumulative nature of the subject means that they quickly become disillusioned.
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Therefore...

Frequently the students who need the most help are precisely those who will not ask for it.
Just as in trauma triage, we may have to look for the “quiet” as those most as risk.

Constraints

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Therefore...

- We cannot afford to ask for these "hard" disciplines in recruitment (generally) any more.
- The students who have 'A' level are weaker than before, and the GCSE in mathematics is now valueless (IMNSHO).

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Therefore...

- We should consider ways of stratifying or streaming these students to enable them all to succeed individually to the greatest extent possible.

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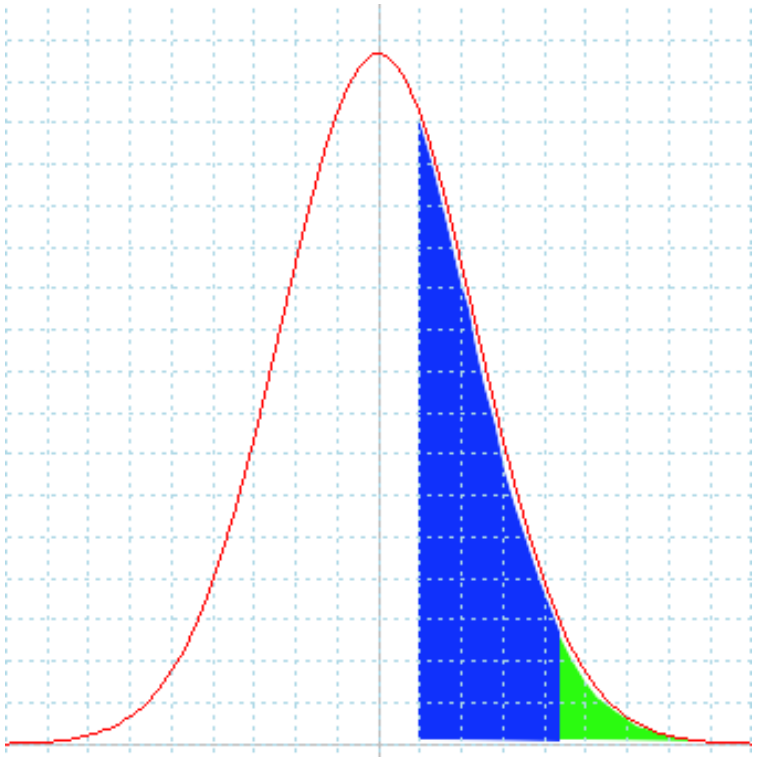
Widening Participation

Consider the green in the figure to represent what was 10% participation, and the blue as the extra 30%. Picking whatever statistic you like on the x axis, can we really treat these as a homogeneous whole? If we do, this is a problem for all students.



Constraints

Changing Lifestyle

Students now spend considerably more time (and money) on their lifestyle in one way or another. This has also led to an increase in part time work.

Therefore...

- Students are often not aware of the need of work outside of the class;
- Students often do not attend even scheduled class time.

Statistics

Dr Clare Carter has compiled very revealing statistics on this issue. Here are some of the highlights.

- Most students came with a job, more obtain one during their studies. A significant proportion of students work more than 20 hours a week outside university;
- 70% of students went out once or twice from Monday to Thursday;
- Fewer early leavers joined clubs or societies;
- Early leavers have even more unrealistics notions of required study hours (than most students);
- No significant correlation with socialising hours;

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1. module content;
2. content delivery;
3. assessment.

Outline

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However, the most vital thing to consider, is the real baseline condition of the students, because much of the information above may be misleading in this regard.

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There seems to be little way to avoid the obvious conclusion that we must actually talk to the students, individually, or in small groups for classes with many students.

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Questions

- Is it better to teach 10 topics and have the students learn 3, or to teach 8 and have them learn 6?
- Are you teaching a topic that will have to be taught again, in its entirety at the next level?

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Conversely, lab based study has become very popular, especially where work is structured to allow students to learn for themselves.
This may or may not be true, but resourcing issues also impact highly on these decisions.

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It may well be that many of the failings found in lectures are down to the passive way in which most students (and some staff!) approach them.
However, we must always keep in mind that it will be the weakest students who will be the most likely to remain silent when they have problems.

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- With multiple boards it is much easier to lay out a large portion of a problem, allowing the context to be clear to the students.
- It allows students to pause and consider particular steps.
- The students think so too!

Strategies
Content Delivery - Tutorials

Most mathematicians agree that tutorials are a vital part of the learning process.
It is interesting to note that the correlation between tutorial participation and exam success is low. This is often a reflection that students with strong entry qualifications can often succeed well without them. For the weaker students they are invaluable, and we have to engage these (often shy) students with care; it is often the case that (paradoxically) they will stop attending when they feel they are getting lost.

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- there should be a wide range of problems;
- the approach should be very non-confrontational;
- students should be encouraged not to be afraid to try problems they are unsure of.
- If possible the lecturer should attend some sessions, this can help underline his/her willingness to engage with individual students and to answer questions without humiliating the questioner. This improves interaction with the lecturer in “formal” lectures.

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Lab classes can be a very helpful way of learning, like tutorials they focus on allowing students to discover things for themselves.
On the other hand, they are often very resource intensive.

Examples

Some examples of my attempts at designing amid these constraints can be found in my (suspiciously familiar) curriculum design talk at `http://newton.engj.ulst.ac.uk/crt/talks/`.

Outline

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First of all we can carefully consider the module diet for the student cohort. However, module material is not enough, it is useful to spend time systemically dealing with the identity and other issues of the cohort.

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- a coherent overview of the course will show if this is looked at across several modules;
- other initiatives can help...

Strategies - Studies Advice

Studies Advice

We had a faculty wide studies advice programme for first year, first semester students. It revolved around 30 minute sessions where we gave information to the students, or extra tutorials.

Problems

- It was resource intensive (data projectors required for instance);
- It often bored the students, and sometimes the staff too;
- We didn't learn much;
- The core issues didn't seem to be resolved;
- The extra tutorials were also problematic.

Strategies - Studies Advice

Studies Advice

I, together with Dr Alan Leacock, redesigned this programme for our school. We created much lighter resources, with (at most) four slides for the students and two to five pages of briefing notes for staff. We did away with module tutorials.

Improvements

- It was much easier for staff to prepare for, they felt their contribution to be more valued.
- The format was a talk, chaired by the staff member, encouraging much more participation.
- We took care to promote social cohesion, and that worked.
- We learn't a lot, and linked into the PDP process.

Strategies - Studies Advice

The whole programme can be found on-line at `http://newton.engj.ulst.ac.uk/crt/teaching/sag/`. Source is available on request, and we will be creating a CD in the next few weeks. All feedback is welcomed!

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Many of the answers were misinformed, but astonishingly between 14-20% (depending on course) couldn't even define mathematics at all, and an even more startling 14-34% of students couldn't define engineering, despite being enrolled on a degree with "engineering" in the title. Clearly this was a cohort of students with serious issues of identity.

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1. promote cohort identity and cohesion;
2. build skills and confidence;
3. be fun.

We held the competition in week 11 of the first semester. It was a lot of fun, we learn't a lot, for instance, students don't want to start a task when they can't see through to success. This is affecting our module design.

Strategies - School Competition

You can find details of our last competition here `http://newton.engj.ulst.ac.uk/challenge/`, but we will soon be ramping up for the next time. There are also some pictures here `http://newton.engj.ulst.ac.uk/challenge/pics/`.

Outline

Strategies

Some issues are best dealt with at the institutional level, or perhaps above!
However, there is also the possibility to use institutional and national strategies to help us. For example PDP[1] is a national strategy that we might regard ourselves as stuck with. On the other hand we can use the momentum behind these issues and build them into our own initiatives (for example, this is very cognate with studies advice). Indeed, the PDSystem (`http://pds.ulster.ac.uk`) provides increasingly good support for interacting with students, and more technology may help — much of our current IT systems sap time from us rather than help us.

[1] Interest declared: I am the university's undergraduate PDP coordinator

Strategies

We face many other challenges above the programme remit:
For instance, strategies to deal with the greater participation at university level should probably go hand in hand with an examination of “streams” of provision.
Right now the future of intermediate programmes, the ordinary degrees and the AB degrees for example, is uncertain within Universities.
However, a belief that “one size fits all” honours degree programmes can be made to suit all these students without damaging opportunity for any of them seems misguided.

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Whatever you do will be insignificant, but it is very important that you do it.

Mahatma Gandhi