Responses to questions from L&T Conference, 22/4/10, University of Glasgow

Simon Bates

Apologies that it has taken me a while to get around to replying to these. I'd like to thank everyone who submitted queries for waiting patiently for a response. I have tried to group the various question into themes according to the three main areas of my presentation. I've tried to strike a balance between brevity and completeness in the responses, but am happy to discuss any points further via email (s.p.bates@ed.ac.uk)

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1. On 'expert-like' thinking and our study using the Colorado Learning Attitudes about Science Survey (CLASS)

- More about "expert-like thinking" clear definition.

- What do you mean by the term 'expert'.

The presence of questions like these suggested that I should have done a better job of explaining the reference point for 'expert-like' thinking that is used as the basis for comparison in the CLASS instrument! Student responses to the items on the survey are compared to the responses of various Physics faculty, who exhibit a consensual, though by no means unanimous view, of expert thinking in the discipline. On the 'agree-disagree' plots that I showed, the responses from faculty lie in the upper left portion of the graph (though not on the axis!)

In one sense, you could argue that this is only one way of characterising 'expertise': by using the views of Physics academics. It's a rather particular demographic ("you're comparing your students to a bunch of old men" is how someone once put it in a question session after I had presented this work!) But I can see why the group at Colorado chose this as their measure of expertise when they were developing the survey.

Doesn't your 'expertness' survey show that u/g students are more aware of their own ignorance as they go through the degree?

- Is it possible that the apparent drop in "expert thinking" of physics students was actually a drop in over confidence in their own expert thinking ability.

It's certainly the case that some of the survey items directly probe student confidence in a particular area (for example. "If I get stuck on a Physics problem, there is no chance I will figure it out on my own") So in that sense you could say that we are measuring their confidence or lack thereof directly. But I think that the survey also asks them to take a viewpoint on topics from which we infer their expertise by comparison to the responses of faculty. The study by the original authors where they used a modified version of the test gives an interesting perspective on this. Students were asked to rate not only their views but also how they thought an expert Physicist would respond. The discrepancy between paired answers gives a direct insight into their view of their own ignorance.

Also, I think that some of our students do arrive somewhat over-confident of their own abilities and level of expertise. I saw a study that asked all entrant students to gauge their place in the class on entry: all students rated themselves as between the 55th and 75th percentile whereas of course the distribution was much wider than that! As we expose students to more of the subject through their undergraduate degrees some will certainly become more aware of their relative ignorance of both the subject breadth and their level of expertise of it.

- Do we ever ask students in year one whether they would classify themselves .as enthusiastic or non-enthusiastic learners - & the same question in year 4.

I don't think that we do – I think we take it for granted that the majority of our students stay broadly enthusiastic for their degree choice / discipline for most of their undergraduate career. Of course, in third and fourth year, we don't see the ones who have changed programme or dropped out because they realise that a degree in X is not what they thought it was going to be like or is not for them.

An interesting quick and dirty experiment would be to ask a common series of questions relating to enthusiasm / self-interest for study to years 1-4 of a programme using the clickers (an anonymous and efficient way to collect this kind of data). If you did it at the start and the end of the academic year, you would have inter- and intra-year data for comparison. Even more interesting would be to ask staff to predict the student responses to the questions in advance…..

- The data that suggests that students experience a "decrease in expert-like thinking" is, of course, rather surprising. Have you, (or any of your colleagues who have run these tests) any explanation for this, or any qualitative, (eg. interview) data that might help explain it?

Most of the published work using this survey instrument has focussed on the drop in expert like thinking in the first year at University. Here, there are some clear parallels with the work of Perry on intellectual development and the stages that students pass through, from certainty and unambiguous knowledge to more relative and context-dependent alternative views.

Wider studies, for example across several years of a degree programme like we have tried to do, are much fewer. The one I am aware of had a very small data set and no

qualitative data. We have tried to triangulate some of our findings with focus group and interview sessions. It's hard to get a general picture with small numbers of people who may have very different views and or experiences, but a general picture that seems to be emerging is that the sorts of expert-like skills and attitudes take time to develop – time that should be made space for in the curriculum. A programme of courses stuffed full with more and more content will not encourage the development of these attitudes.

It's a little bit like discussion of the development of expertise in Malcolm Gladwell's "Outliers". Yes it takes practice (10000 hours of practice, according to Gladwell) but the most effective form is *deliberate* practice. For a chess player, for example, this doesn't just mean playing lots and lots of chess games, but studying the games of grand masters to learn their strategies and approaches and to integrate these into your own games. Likewise, I think the best kind of effective or deliberate practice for students involves more than just week after week after week of problem sheets on a course.

- The stats on the lack of problem-solving development are shocking. How widespread do you think this problem is and what can we do about it?

On the one hand, it's clear that our students do become more proficient at solving much more complicated and difficult problems as they pass through their degrees. (We could have a discussion here about the difference between 'problems' and 'exercises' but that is a whole other topic!) When they arrive, they know about Newton's view of the world (though many are resolutely pre-Newtonian in their thinking, but that's not their fault…) and as they progress they are shown Maxwell's, Einstein's and up to the current frontiers of the subject. But I think what our study points to is the fact that they might get better at solving the problems that we set for them, but this is not necessarily accompanied by the concomitant development of expert attitudes that you might expect.

As to how widespread it is, I think that it is probably quite prevalent. Good testing instruments allow you to lift up all kinds of stones to see what is underneath (just be prepared to deal with the nasties that you might find). We're having a similar experience at the moment with a diagnostic test of data handling skills that we have been developing and piloting with over 1000 students across all levels of HE in Physics and Chemistry across the UK (this was originally going to be part of the talk too until I realised it would take me way over time).

What to do about it? The first stage is to recognise that the issue exists and take a long hard look at aspects of the way the programme / courses are designed that might be causing this or responsible for it.

- Do you relate/have you related the reduction in problem-solving expertness and confidence with Carol Dweck's work on mindset – attitudes to learning?

Not explicitly, no. I am aware of some of her work in this area, but haven't had a close look yet to try and find out more about her work.

2. On first year maths classes in our Physics programme

Please could you give a little more detail regarding the practicalities of running these sessions eg:

- Overall class size
- Maths groups sizes
- Activities involved
- Resources required
- Did the students provide feedback on their opinions of the session?

This will be a pretty brief answer, but please get in touch for more info if you would like:

- 150 students per year on Physics degrees
- 75 students per workshop session, working at tables seating 6 or so, in a recently refurbished 'teaching studio'.
- Problem solving – and lots of it!
- Biggest resource is staff time – we populate the classes with many postgraduate TAs and academic staff and all students get some 1-to-1 discussion each week.
- Feedback – mixed. It was an experimental year and we were sharing the teaching of the course with maths – they did the lectures, we did the workshops. It didn't always work as well as it might have done regarding synchronisation of topics etc. Also we don't feel like we have a good enough safety net in place to catch students who are not keeping up with the work and attending the sessions.

Although I meant to put a question in to the keynote speaker about the evidence re A level maths. Presumably if they continue to give the same 'entrance test' when the syllabus has changed they may be asking students about elements of the syllabus which are no longer covered in the same depth – so is this another example of 'doing things the way we did them when we were at university' and not recognising that the world has changed? Not sure we can assume that A levels have got 'easier' - maybe just 'different'?

Some of the drop in performance has indeed been attributed to 'syllabus drift' I've a hard copy of a paper by Matt Probert at the University of York that I don't seem to be able to find a proper citation for, but he's done a very careful study of just how much of the decline is for the reasons you state- things not being covered in the

same depth or indeed at all. So it is part of the story, but doesn't account for all the decrease.

- Do you think secondary schools should be more active in easing the transition to H.E. & if so, what provisions should be made for S5/S6 leavers?

I could go on at length about what secondary schools could be doing, but in fairness an awful lot of what needs changed is outwith the locus of control of an individual school. No, here I think we have to be a bit more honest with ourselves and face up to the things that we can do to help students settle into learning at University most smoothly. In many respects, we are lucky in the Scottish system to have a 4 year Hons programme, giving us space to do this in year one.

- What role, if any, does Simon see central support services like student learning service and information specialists, playing? Does he fully integrate their skill sets and contributions into his classes? If so….how?

In the first year at University, these services have a huge role to play in supporting students learning. They are not integrated into the classes per se, but we do frequently highlight their presence to students and encourage them to avail themselves of these services.

How realistically can we encourage / get institutional support for developing our teaching methods etc, to respond to the changing landscape of education? How can we realistically develop teaching & scholarship as a career path? Do you think it should be mandatory (eg) for eg: senior management / institution representatives to attend these conferences?

So, the $64000 question to end with! In fact, several of these sorts of questions. I am afraid I don't have answers here…ideas maybe, but not answers. I think it is important for senior management within the University (yours, mine…any) who are serious about taking teaching and learning seriously to do more than just attend these sorts of events. It seems to me from looking at the abstracts for this conference that there is no shortage of bottom up ideas to develop and enhance teaching and learning, and for greatest effect and impact this needs to be matched with top down support. I've often heard people say that the biggest impediment to real change at the coalface is lack of a proper structure to recognise and reward (i.e. *promote*) staff who pursue teaching and learning as a scholarly enterprise within their own disciplines. Changing institutional procedures for recognition and promotion takes time and effort, and sometimes progress can feel glacial in its pace, but I do see evidence of it happening at my own institution and elsewhere.