

Are you being serviced? Promoting quality service teaching

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Introduction

If we accept a definition of physics service teaching as that which is provided to those not majoring in physics, then the teaching done by physics departments in Australian Universities is dominated (at first year level at least) by service teaching. It is of such importance that the sustainability of a physics department can be dramatically prejudiced by a modest change in attitude of, say, a Dean of Engineering towards the amount of physics s/he believes should appear in the undergraduate Engineering curriculum and who should teach that physics. At UTS we estimate that between 70% and 80% of the recurrent money earned yearly by the Department of Applied Physics derives from service teaching. A fair question to ask is ‘are those being serviced getting value for money?’. Positioning academic, rather than financial, values to the fore we might also ask ‘are we aware of what make service teaching distinctive, what are the special features of the groups of non-physics majors we teach, and do we have effective mechanisms for evaluating, reforming and adding value to the service teaching we do?’

Issues of quality and accountability of service or cross-faculty teaching are not confined to departments of physics. During a recent ‘academic profiling’ exercise at UTS (goals of which included reviewing teaching and research at UTS with a view to informing decisions on strategic directions for the University), concerns were expressed about the organisation, quality and effectiveness of cross-faculty teaching at UTS.

While the notion of the teaching of physics by academics other than those residing in departments of physics is troubling to many in the physics community, this is by no means the view of all. Notably, the views of policy makers are often not congruent with those held by a majority of physicists employed in academia. For example, as part of his considerations of the academic profiling exercise, the then VC at UTS made the observation in his paper *The UTS Academic Profile* that:

Subjects in the discipline areas of, say, mathematics and physics, [are not necessarily] the sole preserve of academics located in a Department of Mathematics or Physics.

VC, UTS, 2001

It is against this backdrop that a group of academics from the Departments of Mathematical Sciences and Applied Physics at UTS embarked upon a consideration of matters relating to service/cross-faculty teaching, such as staff attitudes, student expectations and experiences, and use of technology for teaching and learning. This included a review of the possible benefits of teaching contracts between servicing and serviced faculties. Through our collective experiences of service teaching, we anticipated that other issues affecting students learning would emerge during our study, such as the effect of timetabling, large class size, student behaviour and the usefulness of ubiquitous subject feedback surveys for charting subject weaknesses. Much of this paper is concerned with work done in 2002/3 as part of a cross-faculty Teaching Initiative (CFTI) and some elements have been reported elsewhere (Kirkup, Wood, Mather and Logan 2003; Wood, Mather, Logan and Kirkup 2003). We also draw on our previous published and unpublished works relating to service teaching of physics to engineering and bio/medical science students (Cheary, Gosper, Hazel and Kirkup 1995; Kirkup, Johnson, Hazel, Cheary, Green, Swift and Holliday 1998).

Academic perspectives

Our primary mode of consultation with academics in the CFTI project was through focus groups. Those interviewed were from University departments who were providers and recipients of service teaching in New South Wales, Queensland, Scotland and England. To preserve anonymity we identify responses by the general location of the academics. Essentially we looked for as broad a conception of physics service teaching as possible, with a particular focus on what academics from physics departments perceived the role to be of physics within (say) an undergraduate degree in engineering. Specifically, questions we asked included:

- How should physics contribute to the education of an engineer?
- Have you introduced web-based learning into your subjects?
- Are you aware of any chronic difficulties which adversely affect student learning in the context of cross-faculty teaching to engineering students?

The articulation of the contribution of physics to the education of engineering students is assuming increasing importance at a time when Engineering Faculties continue to look closely at what they do to their undergraduate students, as well as how they do it (IE Aust 1996). We found that, except in situations where physics departments had merged with (larger) engineering entities, an appreciation of the philosophy of many of the major reforms in engineering (such as a shift towards problem-based learning) and the role that physics might play in those reforms was partial. There was recognition that the professional associations have a large role to play in setting the agenda at least as far as the contents of an undergraduate degree in engineering is concerned. As one physics academic expressed it:

I think from the engineers point of view there are very specific things – there are lists of topics that they can itemise and part of that's driven by the professional associations. From a physicist's point of view I'd rather see us teaching them to understand what an experimental science is and how physics differs [from Engineering] ...

Senior physics academic from an Australian Metropolitan University

On the related matter of context, the same academic was conscious of the need to assure engineering students of the relevance of their studies in physics to their development as engineers, while sensing some resistance of students to his advocacy:

One of the other things I think is to convince the students in first year that physics is relevant to their studies and that it will be important in higher years, and I really try to underline that in my lectures by giving examples of physics in context in engineering all the time. So, that is a challenge, actually, because they really don't believe it.

Senior physics academic from an Australian Metropolitan University

On the matter of embracing the use of web-based and other technologies to improve student learning through flexible delivery, feedback and assessment, the academics we surveyed remained to be convinced of the efficacy of this approach especially for first year, novice learners. As one (mathematics) academic who had not embraced computer technology remarked:

[using the technology] is too difficult here, unless you are really dedicated... In the first few lectures, with certainly the foundation students I give them, if you like, abbreviated notes... then they can develop their own style. At the beginning of the year they get a little dossier which will say that in this week we are going to cover these topics. After the lectures they get small group tutorials – we will try an intellectual exercise together where I am trying to point out where they have to watch their footing and where there is something interesting to see and so on.

Senior mathematics academic from a British University

The same academic was perceptive of the attitude of some of his students to the flexible learning material available:

[there is]... quite a lot of [flexible] computer-based material, but paradoxically [students] don't want to use it. I guess they use a computer in their own leisure activities and whatever and they really want human contact.

Senior mathematics academic from a British University

What emerges in several of the responses of academics to queries about learning at first year level is the importance of direct human to human contact, especially in small group setting. This appears to be one of the matters that the students and academics surveyed during the CFTI project were unanimous about.

One physics lecturer from a regional University with a track record of providing both distance and flexible learning materials remarked:

... we have our material, study guides, online as sources for the students... there is an electronic copy of the same stuff as they can get in print media. We've got a push to adopt the software we've been using *WebCT* particularly in 1st year courses ...[but] we also found that the Web could not replace 'face to face'. 'Face to face' was just so important.

Senior physics academic from an Australian Regional University

While the effectiveness (or lack of it) of conventional lecturing in physics is well documented (Laws 1991; Lindenfield 2001; McDermott 2001), there is an issue likely to impact on student learning which recurs indirectly sufficiently often to be given some consideration. Chronic disruptive behaviour, or what Boice calls 'classroom incivilities', (Boice 1996) often prevails in first year service classes with large student numbers, such as those delivered by physicists to engineers. While academics are quite willing to discuss matters relating to effective teaching and learning, there is less eagerness to recount first-hand experiences of disruptive behaviour and so its influences and true prevalence are more difficult to establish. What *was* clear was that most had experienced such disruptive behaviour sometimes in extreme form, at least when they were students and as one academic put it 'such behaviour is nothing new':

... when I was an undergraduate ...there was one particular lecturer who taught us. He was one of these people that life just picks on and he was a nifty kind of individual. People used to go berserk and just start bombarding him with things like rolled up pieces of paper, pencils and god knows what and sometimes he left the lecture theatre...

Senior physics academic from an Australian Metropolitan University

Student perspectives

To bring balance to our study, we canvassed the expectations and reflections of engineering students who are recipients of physics service teaching. The largest group (consisting of 400 to 500 students) to be serviced by the department of Applied Physics at UTS consists of first year engineering students who must study the core subject called *Physical Modelling*.

Physical Modelling is offered in two modes in order to accommodate variability in students' background (in physics and mathematics), personal circumstance and work commitments. In one semester mode, *Physical Modelling* is a conventional 6 hour subject consisting of three lectures, a tutorial and a laboratory session each week for a whole semester. The other mode spreads the same material and laboratory work over two semesters. The motivation for the flexibility in modes originated from the recognition that some students enter University with insufficient background to successfully complete the subject in a single semester, as well as acknowledging the reality that many engineering students work part-time and have commitments that make attendance for six hours every week all but impossible.

Upon consideration of the background of every student, each is advised as to which mode of study is likely to be most suitable. Student may choose to ignore the advice as well as switch between modes if their circumstances change or if they find the material particularly 'easy or hard' (so long as



the decision to switch is made early enough in the semester). Students support outside normal class hours is provided at the Physics Learning Centre at UTS. More recently, a Web-based utility, *UTSOnline* (which is a local derivative of the web-based utility *Blackboard*) has been used by most, though not all, lecturers of *Physical Modelling* as a means of mass communication with students, a repository for lecture notes, extra tutorial/past paper problems and to provide opportunities for students to communicate with others enrolled in the same subject. Students' views were canvassed through the device of focus group sessions.

Physical Modelling students in both one semester and two semester modes were surveyed as separate groups. We draw out some of the central themes that emerged from the focus group discussions.

The role of physics

For many students, the role of physics in their engineering studies was not in doubt:

.. [physics] is a good subject, because it forms a foundation for the rest of the course. It gives you the basic principles of the world around us, the universe, how things work, in mathematical senses and also gives us an understanding of how the world exists ... there's certain equations which determine pretty much everything ... and I think it's good to form that foundation.

Engineering student (2 semester mode)

Nevertheless, the ever increasing breadth of engineering led some to question the relevance to their chosen stream of engineering:

I'm not sure [physics fits into] to every kind of engineering. Definitely for electrical and civil and mechanical, physics does definitely apply..... but for computer systems I'm not too sure.

Engineering student (2 semester mode)

Response to flexible elements

The inherent flexibility of the one and two semester modes in which the subject was offered was appreciated by students.

I think it's pretty good [spreading the subject across the whole year] because .. even though it was still quick for me, it eased me into the studying style.

Engineering student (2 semester mode)

The flexibility that *UTSOnline* offered was commented upon positively by those at the focus group session, though there were concerns about the lack of standardisation of offerings between academics.

The stuff that they put on [*UTSOnline*] was good and it would have been better if they put more stuff on.

... one lecturer puts all the stuff up on *UTSOnline* so you can finish it off and then sort of make notes on top of his notes so you can understand what's going on.

One [lecturer] ... has all these *PowerPoint* things and he's doing the more challenging topic and he doesn't put them on *UTSOnline*. So you're trying to scribble down all these formulas and you don't have time to do [that]...

Engineering students (1 semester mode)

The greatest emphasis was on the desire for lecture notes, worked examples and past papers to be posted. Though *UTSOnline* does offer provision for discussion, these features were little commented upon by students. However the face to face availability of lecturers was commented upon:

It's always good to know that your lecturers are there to help you out. On numerous occasions I've asked them, I've said, 'look, if I need assistance, can I call you?' and he goes, yes, let us know a time and we'll meet.

Engineering student (2 semester mode)

Effects of timetabling and class size

Timetabling and class size were chronic sources of difficulty impacting on the way both students and staff perceive any subject as well as having a detrimental effect on opportunities for facilitating effective learning. As service subjects have to fit into time slots advised by the serviced faculty or department, there is little that can be done by those at the chalk face to ameliorate the situation. Most *Physical Modelling* students involved in the focus sessions took the opportunity to express their disquiet that around seven hours of mathematics and physics were being taught to them each Friday.

I myself didn't like the physics and maths on the one day ... we had maths then physics and then physics and maths ... so the last few weeks when we had maths, half the room would muck up, and I can't concentrate ... physics and mathematics shouldn't be on the same day ...

Engineering student (1 semester mode)

The unhappiness regarding timetabling may have been a factor to that caused half the room to 'muck up'. Class size is arguably an even more important factor in this regard with not unreasonable suggestions offered:

They should split the physics class in 2, it's too big, they couldn't answer everyone's questions within the time...

Engineering student (1 semester mode)

Nevertheless, not all students expressed dissatisfaction with large class sizes:

The large lectures are good because you can sleep and talk – that's the good thing about it so you can get your mind off things that [are] stressing [you].

Engineering student (1 semester mode)

Conclusion

The importance of service teaching to physics departments cannot be denied, as without it the continued viability of those departments in Australian Universities (and in many other universities around the world) would be jeopardised. This, along with the view expressed by senior policy makers that physics teaching is not necessarily the sole preserve of academics in physics departments, is an encouragement not to take the servicing role for granted (or to regard service teaching as a 'cash cow' which supports less profitable elements of non-service courses).

Though physicists sometimes assume that students see little relevance in the physics they do, this was not born out in discussions with engineering students at UTS who spoke positively about the foundation that physics provides for their engineering aspirations. They expressed less satisfaction with class sizes, the dearth of tutorials and dreadful timetabling. On the whole students were enthusiastic about the use of web-based materials, which allowed them flexibility in their studies, though the consistency of quality and availability of materials provided by lecturers was an issue. The most important flexible element of *Physical Modelling* acknowledged by students was its availability in a one or two semester format. While one facet of flexibility may be the increased accessibility of learning materials through the Web, student and staff were forthright in expressing their convictions that the opportunity for face to face interaction with academics was at least of equal importance.

The more than occasional hint at disruptive behaviour in large classes suggests that 'classroom incivilities' is an issue worthy of more sustained consideration.

An aspect that does appear to require further reflection by physics academics is that of the role of physics in an ever changing Engineering environment (and we may broaden this to a consideration of physics for other groups such as bio/medical science students). At the heart of the matter we need to articulate more clearly the way in which physics should contribute to the education of an engineering student perhaps by focussing on the specific contributions that physics can make to the development of desirable graduate attributes.



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