University of Leeds

SCHOOL OF COMPUTER STUDIES

RESEARCH REPORT SERIES

Report 95.22

Bringing Professionalism to Computer Science

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July 1995

Abstract

Computer Science departments have a good track record of sending out well qualified graduates, but employers complain that they are lacking in skills regarded as necessary - these are such as reporting, negotiating, organising and scheduling that are finding their way into many syllabi under the heading 'Inter-personal and Transferable Skills'.

The School of Computer Studies at Leeds has been one of a number of departments to institute a 'Professional Development' module in this area, first delivered in 1992/3.

We report here on a radical approach that reduces content to a minimum in an effort to raise experience to a maximum. The module has been delivered for three years and has evolved radically in that time in response to perceived shortcomings and student reaction. In its first year, there were some powerful and hostile opinions, but latterly, the experience has been recorded as very positive and explicitly useful.

We describe the module structure, and outline course-work and delivery issues that mark the module out as a unique experience for nearly all our students. The assessment techniques are an integral part of the experience, and include group activity and peer assessment as a major plank. We also describe a large scale peer tutoring scheme in which finalists take control of first year students as an assessable exercise in management, an innovation that has been greeted with near unanimous enthusiasm, and which has provided experience of critical importance.

Comments and opinions on the development are presented in the form of student feedback, and external assessors (HEFCE and BCS) opinion. We believe our model for delivering and assessing this important material is a success and widely applicable elsewhere.

1 Introduction

The School of Computer Studies at the University of Leeds is similar to most other departments that offer degrees in Computing and related disciplines; overlooking specifics in the nature of intake and details of syllabus, most such degrees consist of a core on which there is broad agreement, and some number of options that reflect the particular strengths and interests of the host department. Usually the study is conducted over three years, and is augmented by a sizable project.

This format is common in general profile to many science and engineering subjects and seems to have served computer science, albeit for a shorter time, relatively well inasmuch as the staff took some satisfaction in teaching what the students (largely) wanted to learn, after which the great majority of them moved into a career path of their choice.

Times change. The last ten, and particularly five, years have seen various factors alter our perception of what should be in the core. In particular, the expansion of numbers, aside from the well known problems it brings [Gibbs 92], has changed the nature of the student population [MacFarlane 92, Habeshaw et al. 92] such that we may no longer take for granted skills of organisation and presentation (if we ever could), and secondly the pervasion of IT through all syllabi means that it is necessary to produce the 'value added' computing graduate if we are to give them a fair chance in the employment market – employers faced with a choice between an articulate and erudite graduate in Underwater Needlework who

can easily be trained to use Access and Word, and a IIii graduate in Computer Science, with some flair for C++, will make a decision very quickly.

These changes had been perceived, but a spur to immediate remedial action locally came with a BCS accreditation visit in 1990; the BCS were happy to endorse the scheme they inspected, but noted in their report [BCS 90]: *'A more formal approach should be taken to professional issues'*, indicating that the production of skilled technicians was not enough, and that their next inspection would pay heed to this fact.

We thus identify a need to build a different kind of material into our scheme than had been there before; this change would be designed better to equip graduates for their destination after university. In this paper we describe the approach taken at the University of Leeds to making this change – in Section 2 we establish the basis and aims of the work, in Section 3 its implementation, in Section 4 we overview the results of the experiment, and in Section 5 we look at documented reactions, internal and external.

2 Background

Students attending university to study computer science have particular preconceptions that rarely include the need to acquire study skills or verse themselves in professional issues. An early view was taken therefore that changes to the syllabus would need to be incorporated within mandatory modules, or to occupy a mandatory module. The BCS noted [BCS 90] *'...professionalism should not be seen as peripheral by the students ...'*.

This raises issues of embedding [Brown and Atkins 88, MacFarlane 92], – ensuring the relevance of material that is not seen by the students as core to the discipline; computer science often suffers an analogous problem with the delivery of mathematics. Stand alone modules delivering material that is not seen as being of immediate relevance, especially if mandatory rather than optional, have difficulty achieving their objectives, and often fail to establish the transferability of their content. In our context, incremental introduction of professional development does take place in many other modules in the form of organised group activity, reporting etc., but the view was taken that the significant change required, and the importance accorded by the BCS to what we were hoping to do, was such that specific new modules were in order. This established, it was clear that the perceived relevance of the module to the students would be a critical factor. There remains an argument over whether this is, in the long term, the correct solution, and undoubtedly a complete embedding of all this material, together with a culture change in all the traditional modules, would be preferable, if difficult to achieve in an acceptable timescale.

We have thus established two compulsory modules; the first is taken in the first semester of students' first year and the second in the first semester of their final year.

1. Professional Development I (PD1) is one of the first modules that new students encounter, and therefore has the advantage of being able to mould attitudes before their opinions are too firmly formed. There is a mixture of traditional material (Data Protection Act, codes of practice, a formal examination) and innovative approach (practical report writing, verbal presentation and group organisation). The class is at its most

varied in terms of preconception and prior knowledge, and the module cannot hope to extend beyond a very elementary level.

2. Professional Development II (PD2) is a final year module taken by students just as they are focussing on their career after graduation. There are, therefore, two advantages we can deploy – the students have a significant technical background as a result of two years HE, and they are aware (or at least more aware) of the need to gear themselves for the outside world. This provides the potential for a more advanced approach with higher student motivation.

Representing the general requirement from the accrediting body for the introduction of 'professionalism', the drawbacks in our graduates perceived by staff, employers and themselves were

- Under-rehearsed presentation skills, verbal and written.
- A failure to see their studies in context – little appreciation of cost, personnel and political constraints.
- Little if any idea of what 'employment' actually meant, and therefore little to go on in choosing potential careers.
- Little if any idea of what their degree actually represented; an inability to express what they did and didn't know.

They were, however, largely very good on the technical front. A senior personnel officer from a major employer once said *'Your students are fine technicians, but they have no common sense'*. With this in mind, the PD2 module set out to deliver common sense rather than technical skills.

3 Implementation

A simple approach, already widely used [Bott et al. 91, Rose and Linz 92, Myers 95], is to establish a syllabus, deliver it in the formal lecture manner, and then examine in the traditional way. This approach was rejected at an early stage since firstly it was felt that this merely accentuated student attitudes to cramming and testing, at the expense of learning, and secondly it failed to provide any element of 'professional experience', the factor that seemed to be absent from much of their education.

Given carte blanche to develop an innovative module, there is a great deal one might do. With no personal experience, and no record of a similar job being done elsewhere, we drew a list of objectives and developed activities that were a shot in the dark. Accordingly, the finer grained aims of PD2 were summarised as

- A need to learn to look for information by initiative rather than direction
- A need to learn the skills of large scale project reporting

- A need to learn to apply taught knowledge in a new domain quickly
- A need to learn the real value of hardware and software
- A need to understand the realities of the modern IT industry
- A need to appreciate the relevance of what had been learned

This is not presented as a complete list, and doubtless any professional could add to it; in particular, we omit, for example, the technicalities of computer legislation. The feeling, however, was that these technicalities were always available to those who wished to acquire them, but that the rough skill set outlined could make a large difference to the professional profile of many graduates – that is, it could give them some 'common sense'.

3.1 First attempt, 1992/3

We presented a module with no more than three formal 'lectures' in the accepted sense; instead there were a number of exercises, some conducted in the class and some outside after in-class briefing. These were

1. An exercise in setting an examination question that was *not* specific to any one other module – a general 'problem'.
2. A group exercise in costing and tendering for a significant software development
3. A group exercise in specifying a software solution (a live example, set by an external professional)
4. An exercise in assessing a final year project from an earlier year
5. An exercise in selecting, reading and reviewing a journal article

Mindful of the need to establish relevance, the first hour of contact is given over to the simple question *'What is a degree?'* to elicit from the students what their own expectations of the qualification are, and what those of employers, the university, HMG and others may be. The output of this session makes productive feedback at the end of the module.

Since most of the sessions provided no traditional notes, a stick and carrot' approach was taken to enforcing attendance; the carrot was that a sensible approach to assessed exercises usually depended on live briefings, and the stick was that 'attendance tests' were sometimes issued. These were trivial exercises that scored assessed credit, but which were only available to those present.

In addition, there was a program of 5 sessions delivered by a range of external speakers from the industry, ranging from a local software house to senior IBM personnel, and the module ended with a 'test' held as an open-book examination, which posed questions similar to those produced by the first exercise.

Section 4 discusses the outcome of this initial approach, but we note here that student reaction was highly variable, and while the various exercises were designed in a moderately

obvious way to attack the stated aims, and some were successful, some were certainly not. The course was not a failure, and the exercises above are listed in approximate order of 'success'.

3.2 Later attempts, 1993-5

Careful thought was given to the problems experienced in 1992/3 – these were due to a number of causes, but notably over-ambition in what a suspicious audience could and would accept, some ill-devised exercises, and inexperience in radical delivery.

As a result of this, significant changes were put in place – in summary, these were

1. Withdrawal of the exercises numbered 4 and 5 above, and significant change to number 3.
2. Withdrawal of the examination, but introduction of snap 'tests' of a similar nature.
3. Introduction of significant self and peer assessment under close supervision, with great stress on feedback.
4. Introduction of an exercise in management of first year students.
5. Introduction of an exercise in composing a departmental prospectus, based on the students' own experiences.
6. Introduction of a group exercise that culminated in a verbal presentation to the remainder of the class.
7. Introduction of various interactive activities that were usually low on 'content' but high on activity.
8. The retention of presentations by external speakers, but with fewer mature professionals and more recent graduates.

Some details of the key points here are given in Section 4

4 Discussion

Our efforts at presenting 'professionalism' as part of a Computer Studies syllabus have evolved a lot in a short time, and resulted in a 10 credit module (one twelfth of the final year) that is very low indeed on formal content, but which the students will report as among the hardest work they undertake; simultaneously, most of them will report very positive attitudes toward it.

We have come to this position via some early important mistakes which may be documented as;

1. The broad mass of students are simply not prepared for the kind of material that was being offered; over two years of 'computing' in its traditional sense created an attitude to what university study was, and did nothing to pave the way for an 'awareness' module.

2. Some of the significant work was unsuitable; exercises related to journal study and project assessment, while acceptable in principle, did little to key into students' experience or expectations, and would have needed very significant prior preparation to succeed. The few who did it well were those who were not in need of the experience in any case.

3. Simply too much work was set – a common mistake in misjudging how much was necessary to acquit exercises. This turned the module into a treadmill rather than stimulation.

4. We were over ambitious in our expectations of what the students could absorb and do. This was particularly noticeable in an address by two very entertaining and senior IBM speakers who held the staff and postgraduate sections of the audience spellbound with their insights into the industry and its prospects – regrettably the material went over the heads of much of the audience who did not have the vocabulary, experience or maturity to comprehend much of the material.

5. The terminating exam was unnecessary, and only served the purpose of standardising assessment; this was clear to the students.

These problems were immediately clear from an efficient and reliable feedback collection exercise, and resulted in many changes, the major ones of which are outlined in Section 3. The key successful features of the current offering may be noted (in an order of approximate priority);

1. The reduction and change in the number and nature of exercises. We retain the tendering exercise (of great value), and introduce the requirement to prepare a public talk on a general topic in the subject area (for example, *'The provision of PCs within the University of Leeds'* or *'The increase in undergraduate numbers'*). We have also introduced a major and highly successful exercise that deploys finalists as managers of a first year PD1 activity. While there is an element of peer tutoring in this, it is the management of juniors that makes it most valuable – the reaction to this has been very positive, and it has generated some excellent work in developing, reporting and logging skills, personnel issues aside. This is documented fully elsewhere [Boyle 95].

2. Very significant use of self and peer assessment has been developed, both individually and group based. This is heavily briefed and debriefed, with a process rather than content stress; the result is a much clearer student understanding of assessment mechanisms and reliability.

3. External speakers are retained for the value of their contributions, but most of them are now young recent graduates, often known personally to the audience. The ability of these people to explain in a way that is understood far exceeds that of the most experienced lecturer in the areas of maximal interest, such as '*Which career?*', '*How to apply?*', '*What is it really like?*'.

4. We aim low, erring on the side of under- rather than over-ambition. This produces comprehensible and assailable tasks, with a sense of achievement on both sides, that often receive disproportionate amounts of student effort simply because they are well understood.

We see here a concentration throughout on process rather than content; it is possible to point out to the students at the end of the module that they have actually *done* something, even though they have no fact list to attach to it. This debriefing is critical – lengthy sessions dwelling on questions such as *'What is a Computer Science degree?'* or *'Why is COBOL still widespread?'* (both of which we use) are stimulating and rewarding to all, but the benefits need explicit statement. This is an immediate bonus to those completing application forms demanding details of 'experience'.

This is emphasised by the group-work experience; group activities are often deeply unpopular among students, but we have managed to establish a format that finds broad favour with the class. This has in turn generated guidelines for the setting of group-work that have been adopted as departmental policy, providing a beneficial knock-on throughout our teaching.

There is a natural academic suspicion of this kind of innovation; in the absence of a fact list or coherent syllabus, the question *'So what* do *you do?'* is natural; a good counter question is then *'Well what* is *professionalism?'*. Having lifted ideas above the level of rote knowledge of the Data Protection Act, it then becomes clear that one is not learning 'facts'.

A natural, but mistaken, reaction to this is to create a lot of (potentially interesting and valuable) assessed work, to ensure that the students are kept 'busy' – this is certainly part of what was wrong with the first running of PD2. It is the case, however, that the adage 'teach less, learn more' is as true in this domain as any other, and giving time for the project work is rewarded by very good work indeed more often than not; we contend this is attributable to real interest and hence motivation, based on an understanding of relevance.

5 Reactions

5.1 Internal

An innovatory feature of the module, since extended to many others with an aim of making it general practice, is to make feedback collection an integral part of delivery – this means devoting at least a session to it, and analysing it in detail. This is counter to the common 'questionnaire' approach which is quick and quantitative, but of arguable reliability and value. We are confident that the feedback obtained from students is an accurate reflection of their reactions and feelings

Reactions to the first offering were highly bimodal – extreme responses were *'This is what I thought University would be like, not just copying notes from slides'* and *'Weren't told anything, it was c**p'*; the problem was that the former response was made by the stronger students who were less in need of the material, while the broad mass tended toward the negative view. These negative responses illustrated a failure to comprehend the purpose of the activities – a more considered complaint was *' He only told us what we* don't *know'*. The

content of responses was extremely useful in informing the changes that followed.

Corresponding responses in the subsequent two years have been overwhelmingly positive, with various mature observations such as *'Many of the presentation skills of the speakers were lacking'*, *'I began to enjoy group work'*, *'Difficult and interesting'*, *'Shouldn't this stuff be more integrated into other modules?'*, *' .. people are so difficult sometimes ..'*, *'Graduates still have so much to learn'*, *'Group-work definitely successful'*, *'Some experiences were very good but not pleasant'*, *'Objectives were met through failing - learning from mistakes'*, *'Only module I didn't miss a lecture in my entire time at Leeds'*, *'Found I could apply unrelated experiences quite appropriately'*, *'.. a very traumatic experience .. '* We see here some definite developments in abstract understanding of the graduates' role in the world they are entering, with the more critical remarks betraying valuable experience. These remarks, and many other, finer grained, comments index directly into the aims originally spelled out, and in the majority of cases provide tangible evidence of success in meeting them.

A recurring observation in the feedback is the time expended – this is a common feature of course-work biased modules usually associated with bitter complaint. It is notable that these classes did not often complain about the load, but instead produced remarks indicating that they were persuaded of the relevance, interest and use of what they were being asked to do.

5.2 External

Along with most similar departments, we have been subject to scrutiny from HEFCE teaching assessors, and have also recently been re-assessed by the BCS. In addition, external examiners have a role in monitoring curriculum developments, and have paid particular attention to innovatory changes.

Teaching assessors (who coincidentally were able to spectate on some of the activities) regarded the module very positively, a useful observation in view of the wider perspective they were able to bring to their judgements. Likewise, external examiners reports indicate interest in the approach and satisfaction with its outcomes. Perhaps most consequentially, the 1995 visit of the BCS paid close attention to the changes they had requested five years earlier, and were wholly positive about what they saw.

The issue of 'standards' in HE is a topic of great current interest; frequently it is noted [HEQC 95] that the most objective judgements that are possible come from TQA, or external examiners, or accreditation by professional bodies. We can present acceptance of our developments by all three.

5.3 General

The proof of the pudding is in the eating, and positive remarks by students or assessors do not necessarily translate into 'success'. In this regard, the evidence we have is necessarily less tangible, but we can note

- Many students, on return from interviews for jobs, report the experience of PD2 to be useful, both in preparation and in the positive interest displayed by employers, often

surprised to learn what is being delivered within the institution.

- Recent graduates have reported anecdotally the value of the module; one, as a speaker to a subsequent year, noted it was the most important thing she had done at university.
- We see a far better quality of CV being produced by the students' own efforts – partly because they have more they can write down, and partly because of a better understanding of what should be presented.

  We may also note significant success among our graduates in finding jobs, but it is possible this is attributable also to a general upturn in the IT jobs market.

6 Conclusions

We have described a need for the delivery of 'professionalism' within the syllabus of an IT degree, and presented one approach to this. We chose to establish two mandatory modules, rather than options or an 'embedded approach'; this is vindicated by the unpopularity of the modules among those permitted to choose them as options or electives, meaning that the benefits are not clear to the students until completion, and the fact that incremental embedding of 'professional' issues in established modules is a slow process that is difficult to co-ordinate.

We have described how the module has evolved significantly in the light of experience toward being perceived as a significant load, but enjoyable and stimulating, with minimal accent on content and much experience that the students can deploy immediately in their pursuit of careers.

In closing we note that we are implementing a third 'Professional Development' module for second year students, to bridge the gap between those we have established. Further, the BCS accreditation team, a primary motivator for introducing these modules, have re-assessed our scheme and drawn particular attention to their pleasure with the approach we have used [BCS 95] – *'...coverage of this area was now exemplary'*. They conclude by asking for the developments to be extended as a mandatory element of our accredited MSc delivery.

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