Perspective

The Sussex 'Degree By Thesis' In Retrospect

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Introduction

"*University chemistry courses are attracting a decreasing proportion of students and must be made more attractive*." This familiar problem formed the opening sentence of an article in Chemistry in Britain in 1970 that Colin Eaborn wrote describing the Chemistry Degree by Thesis. This novel degree programme was conceived against the background of falling numbers. With the current decline in the numbers entering chemistry, there is a pressing need to retain students in chemistry. Consequently, it may be helpful to look again at the experiences gained from the Degree by Thesis (the CT degree). Students, who undertook this degree programme, had to pass tests on the lecture courses, but the class of their degree was based on their performance in research work carried out from the Easter of their first year to the summer of their third year. Their primary commitment was to their research project. The assessment of the degree was on the basis of a student's thesis and performance in oral presentations and a viva-voce examination. The underlying philosophy and student experience of the degree has been the subject of a number of earlier articles.[1, 2]

Problem-based learning builds on the motivation that is generated by the student's need for new knowledge to achieve a solution to a specific problem. It is claimed that problem-based learning affords students a deeper understanding of the subject, independence in learning and a better retention of the knowledge that they have acquired.[3] It plays an important role in the teaching of medicine. Whilst individual courses within chemistry programmes have used problem-based learning and case study approaches to develop student enthusiasm and motivation, the Chemistry Degree by Thesis scheme (CT) used this as the underlying philosophy for the whole programme.

The Sussex chemistry 'Degree by Thesis' (the Eaborn degree) ran for almost twenty years through the 1970s and 1980s. The proposal for this degree was made by Colin Eaborn in the light of evidence that he had received as Chairman of the Royal Institute of Chemistry committee of enquiry into the relationship between university chemistry departments and the needs of industry. The report of this committee was published by the Royal Institute of Chemistry in December 1970. Colin Eaborn was impressed by the enthusiasm for chemistry that a student's research project generated and wanted to build on this enthusiasm throughout the undergraduate degree to increase the appeal of the chemistry degree. The emphasis of the CT degree was to move away from assessing the ability of a student to recall information in an examination context, and towards assessing their original creative efforts in research against a background of a broad basic knowledge of chemistry. Colin Eaborn argued that the best measure of a course was not the marks that students obtained in an examination at the end of the course but the extent to which they retained and used the material later in their chemistry career.

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The degree scheme

Chemistry is a systematic subject and in the initial discussions on the degree programme there was conflict between what some feared might become a selective, random walk through the field of knowledge driven by the needs of research rather than a balanced and logical development of the subject. This was resolved by requiring the students to attend the normal chemistry lecture programme alongside their research. The CT students took the end-of-course tests. Although they only had to pass these tests, in practice many of their marks were in the excellent category. Over the years it became apparent that this course content posed too heavy a burden and in later years the number of courses that the CT students attended was reduced.

In the first two terms all students (conventional and CT) took the same lecture courses and practical work. Those entering the CT stream did not do so until the Easter of first year. The students had to achieve a particular level in the preliminary examinations. They selected their project after discussions with the various supervisors on a 'first-come, first-served' basis. Although students could move out of the programme, they did not move into

the programme at a later date. Typically five or six students followed the programme each year.

The projects

Each of the projects had two supervisors drawn from different areas of chemistry, although inevitably one became the dominant partner. There was also an independent advisor. The projects were chosen to have the potential for providing experience across a broad area of chemistry and to have sufficient technical simplicity in their early stages to allow a student with a limited experimental background, to make progress. For example I and a physical chemistry colleague supervised a project on deuterium isotope effects in the ^{13}C NMR spectra of aromatic amides. This involved both synthetic aromatic chemistry and NMR spectroscopy. The projects had to be approved by the CT examination board. Although many students started with limited experimental experience, on the whole they rapidly developed competence and confidence. In their research they even saw some aspects of their chemistry coursework in practice. They gave oral presentations on their work at the end of the second year and at the end of the degree programme as well as presenting written reports and a final thesis. Their commitment to the research often extended to working during the vacations, although this was not compulsory. In a significant number of cases the results of their research were published in the major journals. Some of the experiments that led to the discovery of C_{60} were carried out by a CT student.

The projects and supervision worked best, but not exclusively, within the larger research groups and the AFRC units attached to chemistry. A number of projects were natural developments of existing research, and hence, help with the experimental techniques was available from within these groups. The students gained experience of laboratory methods that were not constrained by the limitations of the equipment in the teaching laboratories or by the need to complete an experiment within the 4- 5 hours of a laboratory session. They developed a critical awareness of the chemical literature and the important transferable skills of teamwork, presentation and communication. They became part of the postgraduate research community. However, it was also the case that some found that this commitment to their research project placed too great a demand on them and their time and, for some, it limited their wider, social, undergraduate experience. They reverted, without penalty, to the conventional undergraduate course. It was a matter of their individual personality and students reacted in different ways to the atmosphere of a research laboratory.

Evaluation

It is difficult to assess objectively how many students who succeeded, did so entirely because of the motivation that the programme generated or because they already had some of the inherent qualities that flourished in this environment. Nevertheless, the excitement of research was undoubtedly highly motivating. Although their perspective of chemistry on graduating differed from that of the conventional undergraduate, being perhaps narrower, it was certainly deeper. Their confidence in their knowledge of chemistry and their independence in working was stronger and their transferable skills of communication were more developed. A number of students not only went on to carry out doctoral research, but eventually to occupy senior positions in both academia and industry, and this might be measure of the success of the programme.

The end of an experiment

Following the prosecution of the University by the Health and Safety Executive as a result of an accident to a post-graduate student, the CT undergraduate degree came under scrutiny. The university solicitors and the registrar expressed the opinion that, were the university to be prosecuted under the HSE Act following an accident to a CT student, then there would be no effective defence unless 100% faculty supervision of the student had been provided. By the very nature of the degree and the other commitments of chemistry faculty, this was not practicable. It should be pointed out that there was no serious accident to a CT student over the 20 years of the programme. With considerable disappointment, the Chemistry Subject Group had to bow to the inevitable and on January 17th 1989 agreed with reluctance that the CT degree should be suspended. The students on the course were allowed to complete.

The academic climate today is very different from that of thirty years ago and it is perhaps worth considering some of the problems that the programme would now have to face. Firstly, the programme is expensive not just in terms of materials, but also because at Sussex spectroscopy costs are now charged to individual budgets and each student occupies the equivalent of a research student's space. The consequent space charges would therefore have to be borne by the department. As with research projects, the educational value of obtaining a spectrum would have to be weighed against its cost. The degree programme was also very expensive in faculty time and now the potentially supportive research groups are much smaller and there is very little technical

support. How do you rein in a project that is becoming expensive because of a student's enthusiasm without at the same time destroying that enthusiasm? Secondly, observation of the first year laboratories suggests that many more undergraduates are coming to university with very limited experimental experience and with a greater fear of chemicals than was the case thirty years ago. Thirdly, most students now undertake paid part-time employment to reduce their level of debt. This work, which is often physically tiring, is not compatible with a research-based degree that has to be completed in a defined period. The cost to a student could be high. Finally, the University administration would have problems in awarding credits to two separate cohorts of students taking the same lecture course, one on a pass-only basis with marks making no contribution to the degree, and the other with marks awarded on a contributory basis. Courses are supposed to have the same number of credits and assessment patterns for all students taking them. If a CT student decided to revert to the conventional programme, to intermit or exercise a right to transfer to another university, how is a part of the research programme to be credit-weighted? Moreover, if course-work examinations have been taken on a pass-fail basis, how can the marks then be used in a conventional degree pattern or shown on a transcript? The administration would also raise problems of progression and on the assignment of a level to a research project extending over three academic years, let alone the calculation of the all important student-staff ratios. It does not take much imagination to realise that a central administration would have a bureaucratic field day with this programme. In these days, when it is necessary to have a university-wide structural uniformity of degrees, there is a danger that unique, subject-based innovations that do not conform to the conventional pattern will be stifled.

Future possibilities

However where there is a will, there is a way. It may be possible whilst maintaining a course-work element, to build some of the features of the CT degree into years three and four of an M.Chem. programme. It would require not only an economical and appropriately translucent use of the language of administrators to complete the university paperwork and fend off criticism, but also a careful integration of laboratories and offices so that the HSE objections over supervision can be met. Those of us who were involved with the CT degree remain convinced of its value, in enhancing a student's experience of chemistry, in developing transferable skills and above all in motivation.

Envoi

Colin Eaborn died on the 22nd February 2004, whilst this article was in preparation and I would like to dedicate it to his memory as the father of Sussex chemistry. I also wish to thank a number of colleagues who have helped me in the preparation of the article.

References

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