

Critical Project Development Skills in the History of Science, Technology and Medicine

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Abstract

We have developed a short course using an enquiry-based approach to orient final-year students, some of whom have little or no prior experience, in techniques of archival research, critical source investigation, and the management of an extended writing project in the history of science, technology and medicine. The course supplements, rather than replacing, established arrangements for individual project supervision. A key aim has been to produce straightforward, directed enquiry exercises whose lessons can be built on, in consultation with supervisors, to develop the skills necessary for more open-ended research.

Background

The Centre for the History of Science, Technology and Medicine (CHSTM) provides historical and science-communication teaching to students from disciplinary backgrounds across the Humanities and the Social, Physical and Life Sciences. Since 2004, CHSTM has been part of the Faculty of Life Sciences (FLS), and as such offers a version of the FLS final-year project. This is a major research exercise running across both semesters, counting for 40 credits and generating a dissertation of perhaps 12,000 words. CHSTM staff supervise around 30 projects each year.

In 2007, we developed a course based on Enquiry-Based Learning (EBL) methods, delivered in the first semester, to prepare students for the task of independent research and writing in our discipline area. The course complements established research

supervision arrangements, and the materials developed are intended to be applied elsewhere in CHSTM's teaching profile.

Rationale

In recent years, increasing numbers of final-year undergraduates have opted for non-laboratory-based projects. Recent work by the developers of the FLS Enterprise Project, a parallel non-lab option, has linked this to the finding that some 40% of FLS graduates pursue non-science careers (Henery *et al.* 2007). Study in the History of Science, Technology and Medicine (HSTM), and in Science Communication Studies, offers a useful grounding for a variety of fields (science writing; public policy work; academic research; museums, libraries and archives). It also provides interpretive and expository skills which are directly transferable into most careers and walks of life. CHSTM staff generally find that most students appreciate these skills and value the opportunity provided.

Most students, however, arrive with limited prior experience in the identification, management and critical interpretation of a broad range of sources — all skills which are essential in the writing of CHSTM projects. While some adapt well to unfamiliar tasks, some potentially capable students have struggled in past years to grasp what is required from them. The challenges of addressing students from traditional science backgrounds have been well-explored in HSTM and related areas (Gooday 2007; Cantor 2001). The length, credit value and apparent open-endedness of the final-year project, however, may be particularly daunting to less experienced students, and also demand a focus on time-management and source-handling skills.

We, therefore, sought support from the Centre for Excellence in Enquiry-Based Learning (CEEBL) for a short taught course to systematically address these concerns. The decision to approach CEEBL was based on our realisation that the final-year project was, as it stood, essentially an enquiry in the sense used by EBL practitioners, closely resembling the tasks discussed in some CEEBL case studies with a historical dimension (Hutchings 2006a; Hutchings 2006b) — in particular, in requiring students to contribute to the definition of the enquiry.

Our goal was to develop a series of small, self-contained research exercises. These would at first be closely directed and, by scholarly standards, relatively artificial, designed so that all students could (if they pursued the enquiries systematically) pick up various basic principles of research, planning and critical interpretation without individual assistance. This training would then serve as a basis for investigations tailored to students' own research projects.

Approach

The course was planned around the constraints of a busy core timetable and a centralized assessment structure. We were not permitted, in this first year of operation, to assign assessment credit to the EBL exercises themselves, a position which is currently under review. Assessment is based largely on students' individual written output: a literature report (slightly recast, for 2007-08, as a 'Preparation Report' including plans for accessing primary source material) in the first semester, and a longer dissertation in the second, with a minor element awarded for the student's performance in supervision meetings.

Accordingly, we developed a series of weekly EBL classes based on non-assessed exercises. Each was devoted to one of the major skills to be addressed, chief among which were:

- defining a manageable project;
- critical examination of evidence;
- working in libraries and archives;
- project organisation and time-management;
- writing skills: defining and justifying an argument from documentary evidence.

How the Classes Were Delivered

The proposal initially specified that the materials would be developed electronically through the WebCT system, in consultation with FLS support staff, with a view to online delivery of all or part of the course. The University's commitment to WebCT was,

however, withdrawn around the time the project was accepted: we were advised to wait until summer 2008, when development time would be available for the new Blackboard system. The course was thus run as a weekly contact hour over half of Semester 1. Materials were provided as paper handouts in class, and made available for download via the FLS intranet.

For timetabling reasons, a single weekly class had to accommodate the entire cohort of 30 students. Whole-group discussion was encouraged. Because all assessment was to be carried out on an individual basis, it was not thought advisable to introduce formal groupwork arrangements, though this decision will be revisited in future years.

During the period of the EBL classes, each student also received, as in previous years, several one-to-one meetings with an individual supervisor working in the area of his/her research project. These supervisory relationships continued throughout the writing-up process in Semester 2.

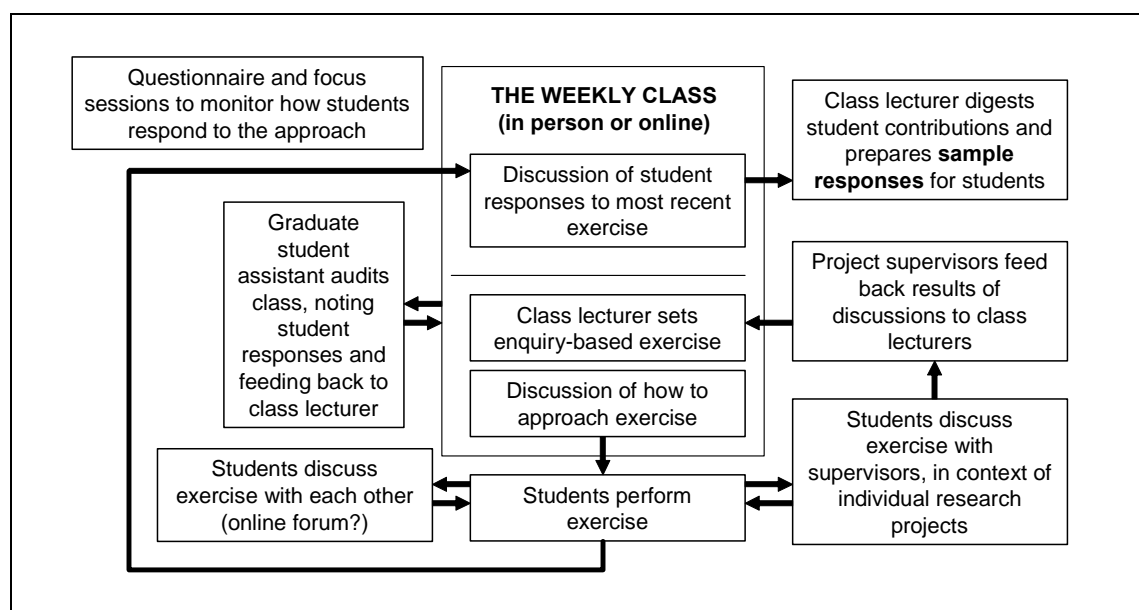


Figure 1 Idealised schematic of the teaching process.

A defining goal was to integrate the new weekly classes with the established supervision arrangements. The intended approach (inevitably, not always adhered to in practice) is set out in Figure 1. In a typical week, the class lecturer would moderate an extended group discussion of the exercise set the previous week, summarise the most significant points raised, and conclude with some orientation for the following week's exercise. Individual project supervisors were informed of the class content and asked to discuss

the results with their students, during the individual meetings, in the context of their more specific research plans.

Though not formally working in groups, students were encouraged to discuss the exercise amongst themselves over the course of the week. Class lecturers were responsible for collecting and digesting students' contributions, responding directly to good suggestions and misconceptions. The classes were also monitored by a graduate student assistant, who produced notes on the students' responses, and sometimes suggested improvements for the benefit of the lecturer. We further intended, at the conclusion of the project supervision process, to take feedback from course evaluation questionnaires and focus sessions.

How the Exercises Worked

The exercises were informed by the planning, researching and writing of actual scholarly research papers, but deliberately avoided various complexities and ambiguities in order to suit an audience of beginner researchers. The aim was generally to produce examples which were obviously 'larger than life', but at the same time carried lessons for 'real' research.

'Critical Examination of Evidence', for example, was inspired by the observation that many students, trained to rely on textbooks, tend to begin by treating all historical sources as though they were authoritative sources of factual data. Claiming to be presenting a sample case study, the lecturer began to narrate an alleged nineteenth-century taxonomic theory which departed increasingly from common-sense plausibility, culminating in a scheme to rank fauna in purely alphabetical order, and the assertion by one naturalist that the abacus must be a species of bird (evolutionarily descended from the aasvogel).

At this point, with most students showing visible signs of disbelief, the lecturer broke off and asked the class to consider *why* they found the account incredible. He then gave a wholly different and purely truthful narrative of the naturalist's theory, and then asked the students to consider whether — now that he had established himself as an unreliable source — they believed it, and, if not, how they would go about checking it. Finally, the students were handed a list of plausible claims about the naturalist and given

the task of trying to verify them, whilst recording their search techniques and grounds for acceptance.

Consistently false and absurd accounts, of course, are rarely found in the historical record. The point, which was made explicit to the students, is that real-life accounts, which tend to show tendencies which are rather more subtle and difficult to spot (slant, incomplete coverage, limited relevance to the task in hand), can likewise be addressed through careful critical appraisal and cross-checking of sources. The CHSTM Resource Guide, a collection of useful starting-points for research, was introduced to students through the enquiry task in this exercise.

In order to ensure that the exercise was practically possible and pitched at an appropriate level, one of the authors (Sumner) performed it himself and took detailed notes, a process that was repeated for the subsequent exercises. In class, once the students' own responses to the exercise had been discussed, these responses from more experienced researchers would be distributed and compared with the students' own.

Similarly, for 'Defining a Manageable Project', students were asked to assess, in the light of their own timescales and word allocations, a range of carefully selected project descriptions: some were intended to be seen as appropriate, some overly basic, some too ambitious (modelled on real-life PhD projects), some irrelevant, and so on. They were also asked to consider how the more problematic projects could be modified. (This class provoked some useful discussion: some students who departed from the intended answers were particularly persuasive, obliging the lecturer as well as their fellow students to think carefully about underlying assumptions.)

'How to Write' used an actual past project submitted in a previous year, which students were required to 'mark', assessing it against the criteria to be used for their own work. The process was then repeated for an article published in a scholarly journal by a CHSTM colleague. In each case, the students' responses and annotations were compared with those of the course co-ordinator.

Assessment

As noted above, it has not so far been possible to tailor dedicated assessment to the EBL exercise. We have seen very distinct improvements in overall results, however, since the introduction of the new course. Average performance on project work is up more than half a degree class on last year's figures; a breakdown of results (Table 1) shows this as mainly due to fewer results falling into the nominal 2:2 range (50-59) and a larger number of Firsts (70+), including, for the first time, a significant number of high Firsts.

| | 2006-2007 | | | | 2007-2008 | | |
|---------------------------------|-------------|-------------|------------------|--|-------------|-------------|------------------|
| | Sem 1 (25%) | Sem 2 (75%) | Weighted average | | Sem 1 (25%) | Sem 2 (75%) | Weighted average |
| Total number of students | 23 | 24 | 24 | | 27 | 30 | 30 |
| Marks in range | | | | | | | |
| 30-39 | 0 | 0 | 0 | | 1 | 0 | 0 |
| 40-49 | 2 | 1 | 1 | | 1 | 1 | 1 |
| 50-59 | 4 | 6 | 7 | | 4 | 0 | 2 |
| 60-69 | 13 | 12 | 13 | | 11 | 12 | 12 |
| 70-79 | 4 | 5 | 3 | | 7 | 12 | 13 |
| 80-89 | 0 | 0 | 0 | | 3 | 5 | 2 |
| | | | | | | | |
| Mean result | 62 | 63 | 62 | | 65 | 70 | 69 |
| Median | 65 | 64 | 63 | | 65 | 71 | 70 |

Table 1 Breakdown of project assessments before and after introduction of EBL training. (Variations in student totals are due to small numbers of non-FLS students taking alternative Semester 1 assessment outside the Faculty, in combination with the 30-credit CHSTM project in Semester 2: in these cases, the Semester 2 result has been carried into the 'weighted average' column).

Some improvement was to be expected from the fact that 2007-08 sees the first final-year cohort on the new Biology with Science and Society programme, who take CHSTM projects by default, and who tend to have more experience and aptitude in the field than their peers. As there were only four such students this year, however, we may assume that the institution of the EBL course also had a significant effect.

Anecdotal evidence suggests that this effect was as much on supervisors as on students. Through the introduction of the EBL course and its associated documentation,

supervisors found they had a clearer sense of the particular skills being promoted, and the best way to guide the students in responding to assessment requirements. This is borne out by the observation that the greatest gains are seen in Semester 2 (i.e., in the months following the taught course itself).

Evaluation

In terms of formal gathering of student feedback, our evaluation was, unfortunately, ineffective. We were unwise in relying on the centrally-supplied University course evaluation questionnaire: as it turned out, the anonymous mechanism provided no way to differentiate our students' responses from those of students taking laboratory projects under the same unit code. We intend to make independent provision for questionnaire feedback in coming years.

Two focus group sessions were announced but no students were willing to attend, probably because the sessions were scheduled at a week's notice late in the semester. Two students did, however, respond with email accounts of their experience. Both were very positive, one writing as follows:

I had never done a history module before and preferred the idea of writing up a historical report... Expected it to be a little boring and easy. This wasn't the case... supervisors were very helpful... we are given a topic and encouraged to go in any direction we feel [appropriate]... I advise people to take this if they like to work in their own time.

The staff who acted as supervisors was overwhelmingly positive about the development, several commenting along the lines that the project was 'what they had been waiting for', giving students a clearer sense of the generalities of the research task which they could build on in individual research cases.

Our graduate student monitor's notes indicate that the students were initially reluctant to contribute in class, but settled into the arrangement as the course progressed. One technique which quickly proved effective was to open the class by asking students to write down, on small pieces of paper, answers to relevant questions (for instance: 'What's going to be the most important source of evidence for your project?'). The lecturer would then sort through the pile, reading out occasional answers to give a

sense of the overall response, and solicit discussion on the answers which were similar or interestingly different.

During the course, discussion with both students and supervisors was invaluable in making clear to us what kinds of guidance the students specifically sought, leading us to develop additional materials in several areas. These were not necessarily extensions to the EBL course; in the case of writing style and citation practice, we found it more productive to distribute a general guidance handout, which the supervisors could discuss individually with students in the context of their work.

The limited online support possible through the FLS intranet was, on the whole, satisfactory. Links to external online resources were provided through a version of the CHSTM Resource Guide distributed as a PDF document, a basic approach which proved effective and reliable. The only desirable feature we found ourselves missing was the possibility of an online discussion forum: most students worked on their tasks individually.

Our most significant problem concerned student attendance. Though we were assigned a vacant slot in the FLS master timetable, some students repeatedly skipped classes, while others explained persistent serious lateness as due to over-running practical sessions. One embarrassment was a library skills class organised by a JRUL colleague: no students arrived for the advertised start time and the class had to be rescheduled. This is perhaps an argument for systematic online provision, allowing the students to work in their own time; it also suggests that some assessed credit should be assigned to the exercises to ensure the less motivated students do not simply ignore them.

Further Development

This project is funded to September 2008, and is still ongoing at the time of writing. Our immediate priority is to make the course materials available through the Blackboard electronic courseware system, which offers new opportunities to develop assessment exercises and discussion between students, skills training coordinators and research supervisors online.

Although the final-year project is a particularly extensive and demanding research exercise, the skills it promotes are widely applicable across CHSTM's teaching portfolio. Colleagues have expressed interest in applying the approach and materials developed for the EBL course (in reworked form) to the shorter research projects used on many 20-credit undergraduate courses; to core research training on the Biology with Science and Society programme; and to elements of MSc teaching. In addition, the CHSTM Resource Guide, which will feature more heavily in subsequent versions of the course, is currently being reworked in consultation with JRUL colleagues.

The need which originally informed this project — communicating historical research skills to students with non-humanities backgrounds — is one which is shared by several similar units in the UK; we expect to disseminate the results of our work through the relevant HEA subject centre and informal contacts. We are already in discussion with colleagues in the Science Studies Unit, University of Edinburgh, who are considering using a version of the EBL materials with their own students.

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