BristolChemLabs Report November 2008
from the External Evaluator Dr Stuart Warren (Cambridge)

Background

I spent the week 3rd-7th November at Bristol seeing for myself how the labs in each year 1-3 operated and interviewing members of staff, technical staff, graduate demonstrators and students. I interviewed people at random and had a focus group meeting with eight students from the second year. All interviews (and the focus group) were in the absence of any member of the teaching staff.

This is the first year that students at all three levels have had only the new style lab classes and so they cannot compare them with what went before but only with what they expected. There have naturally been improvements in the years that the first and second year classes have operated. I also saw a group of school children at work in the lab and heard details of the outreach mission.

General Comments

The most obvious point to an outside observer is the purposeful air and committed attitude of the students at all three levels. The labs were full and there was a buzz of expectancy and enthusiasm at each level. The students knew what they were doing and were deeply involved in it. This is a great contrast with my observations at Cambridge. No student at Bristol, when asked what (s)he was doing, replied 'I'm down to here on page 2.' One student in the first year said 'I'm refluxing 2.5 grams of tin with 2.5 grams of iodine in dichloromethane'. On further questioning, without my supplying any information, she improved this to 'I'm oxidising tin to tin(IV) with iodine.' Astonishing!

The DLM (Dynamic Laboratory Manual) is vital to the operation of the labs. Students can find out which experiment they are to do, carry out pre-lab experiments, submit their work, see what marks they have got and retrieve comments on their work from the DLM. They can't check other students' reports. Staff can check on the progress of all students. While I was there, a problem arose with one student who claimed that the work was too difficult. The staff member responsible was able to check that the student had not done practical work, had not attended workshops and had not submitted work and was therefore able to alert the progress officer to the reasons for the problem.

The pre-lab experiments play an exceptionally important role as they require students to carry out the experiment virtually and thereby discover what it is about. This is in part an assessment exercise but its main role is teaching as the students can make disastrous and expensive mistakes on the screen and so avoid them in the lab as well as going into the lab with a proper understanding of what they are to do.

The commitment of the staff at all levels (technical, graduate student demonstrators and academic staff) is total and the results demonstrate how valuable this is. Submission of reports by the students must be completed almost immediately the experiment is finished and feedback to the students follows swiftly. Students routinely discuss experiments and write-ups with demonstrators at all levels: this too is a valuable opportunity for learning.

The classes are run is a strict but fair way that the students appreciate. For example: in the first year, reports must be submitted by midnight on the working day following the experiment and there is a sliding scale of lower marks for late reports. They are warned sternly against plagiarism but the warning is tempered by the observation that 'this does not mean that you cannot discuss your laboratory or other course work with other students.'

The First Year Class

This course contains short experiments in all branches of chemistry and the students do one each week on the afternoon they are allocated. The station and the demonstrator for each experiment remains the same so no student is penalised by having a weak demonstrator all the time. The reports are brief and to the point and the style of the report changes as the term develops. The marks are 20% for the pre-lab work, 60% for the work done in the lab, and 20% for the report.

The demonstrators mark the work and offer comments either on the web or on the reports. Each week the demonstrators are available 15 minutes before the lab starts for any discussion the students want to have about their results. It was suggested to me that this lab was 'over demonstrated'. I'd say it wasn't as the demonstrators were consistently busy but not overwhelmed. There was clearly a relaxed and friendly atmosphere but the student attitude was purposeful throughout. This was the fifth week. The students had settled in and none was standing about waiting to be told what to do. Indeed one demonstrator failed to turn up on time and, when he arrived 20 minutes later, all his students were hard at work.

Comments from staff: 'Last year they were still hard at it at 5.45 but this year they have all gone by 5.' (The lab is supposed to close at 5) This shows clearly how the presentation of the course and the pre-lab work has changed with experience.

Comments from demonstrators: One demonstrator had previous experience elsewhere and felt that the students were more enthusiastic at Bristol and got on with their work well. They felt that they were learning and were happy with the feedback. Another said that he was more flexible in his feedback this year and thought that the class had gone better this year.

Comments from students: One said that it was hard at first but 'now it's great fun' and that she felt she understood what she was doing. Another said that the lab was good and that he had got better with experience. He felt he didn't really understand all the chemistry but he did come to the feedback sessions before the class. Another said the feedback was good but his friends were disappointed at some disorganisation about times. He thought that not enough detailed

instructions were given but that he 'recognised that this was deliberate to encourage independence.'

While I was sitting at a table in the lab making notes, a student came up to me and asked what I was doing. When I explained, he joined in an enthusiastic discussion and was keen that I should realise how excellent the labs and the course were. Unsolicited testimonial?

Second Year Class

The demonstrators ask 'in lab questions' of the students. They have a list of five questions for each experiment but are encouraged to ask their own. Generally if the experiment is outside the demonstrators immediate expertise (s)he will use the suggested questions. This is part of the in-lab assessment. Several students in the focus group (see below) praised the positive effect these questions have on their understanding of the experiments.

Comments from Technical Staff: The students are making good progress this year compared to last year's second year group. Presumably this reflects the training they got in the first year course.

Comments from Staff Demonstrator: One demonstrator had experience of the O***** course as a demonstrator and was very enthusiastic about the Bristol course. In his previous university he had asked not to be paid for demonstrating as the organisation was so poor. At Bristol there was no more than a few minor problems of instructions not understood.

Comments from Demonstrator: The experiments are well designed for learning. He picked out the analysis of cigarette smoke by IR as it explores a scientific technique from first principles.

Comments by Students (See also report on Focus Group). A Chinese student whose English was not great said that she liked the course and found it much easier than level 1 as she had previously done no lab work. Another student particularly liked the in-lab questions as they had helped him to know what he was doing

Second year Focus Group *My comments in italics.*

I had lunch with a group of eight second year students who, after a little prompting, talked freely about what was good and bad. They needed prompting so I asked them some questions:

Did you feel there has been a connection between lectures and labs? More so this year than last. Last year's lab was mainly about getting up to speed and some of the experiments seemed pointless.

How do you feel that the labs help you with your understanding of chemistry as a whole? The report writing helped and the DLM was excellent. Last year they could just 'look at the script' but this year there was 'no hope' unless they understood what was going on. *There followed a rush of comments on these lines:* Having questions in the lab that put you on the spot is good. Most of the demonstrators are really good if you're not sure about something. But some of them have poor English. The first week was not so good as the demonstrators didn't appear to

have had a 'dry run.' The academics are 'lovely' but there are only a few of them. There are problems with timing and you might have to miss lunch as 'half of the mark is the yield'. *This is a misconception that could be rectified.*

How did you feel about the assessment? They were really useful, especially as the staff give real help. One felt that the questions were 'really hard' last year and she couldn't find the answers in textbooks or online so she had to ask and felt she was marked down for 'not knowing'.

Nobody has mentioned the pre-labs so far. They had got harder this year, with only one attempt allowed. They make us think a lot more. One said they took five minutes last year but this year the first one had taken her two and a half hours. The animations were really good and help understanding. They felt they had seen the equipment before. One suggested actual demonstrations might be better than 'photographs.'

Was the main feedback the returned and marked reports? Yes because the lab work is marked only as a percentage on the Web with no comments and it can be frustrating not being able to find out why they got a low mark. (*Ask?*) Personal tutor helped 'loads.' The demonstrators were a bit variable but all reports annotated and marked by staff were 'very good'.

For the first time, marks allocated to reports increased during the year. Was this helpful? Two said it was good as it took the pressure off early reports but it didn't seem to have made much of an impact. There was some disgruntlement over the lack of guidance for the first report. The wrong template had been supplied and the Report Guidance Lecture' was given the day before the report had to be handed in. They were given a link to a DLM page that didn't have enough info.

How do you feel the balance is between the course's aims and practice? 'Pretty good'. One said that the labs were even better than they'd expected and it was amazing how much skill they had gained in one year. *I prompted them about the confidence I had observed in the lab.* They immediately said this was due to the pre-labs and the instructions in the books kept in the assigned cupboards.

What do you think of the technical staff? Some are amazing, particularly Steve Croker, who also knows the theory and Tom Podesta - when you can get hold of him - one said he had 'saved her experiment'. Some on the other hand are grumpy, sarcastic and mean.

Any final comments? They felt more involved this year, Last year there were only three hours a week and even this year's six hours were not really enough. (*Incredible! Asking for more!*)

Experiments are more relaxed this year so you can take a break while 'something is developing.' Three practical subjects are great as they could make a more informed decision on what they really want to do. Workshops this year useful, especially Organic. One wished there were more as three-weekly interval is a bit long especially if there is no tutorial in the meantime. [This sounds like a comment about the first year tutorial cycle because second year workshops do not have three week intervals.]

Third year Class

A new feature this year, in response to criticism last year, was an explanation of the style of instructions given this year in comparison with those at level 1. An example (ferrocene) was provided of the two styles of instruction. Other features new to the students include: terser instructions, an element of choice among the experiments available, and extensive use of NMR and MS. The most impressive thing to me was the adult attitude of the students to making a step forward into significantly more advanced work, They were not put out by the difficulty and were confident because of the well planned development. One student said he had found the course very difficult to start with but expected a similar growth in understanding and competence to what he had experience at level 2. Another student was not quite so sure but was clearly enjoying herself and was 'hoping' rather than confident that she'd be at home with 'the more professional environment'.

The students have to complete a COSHH form before they can start an experiment, and bring it to a member of staff for discussion and signature. One student did this while I was talking to Nick who told him that he had completed the form for the wrong experiment. The student accepted this gracefully with no complaint. Adult attitude.

Comments by Staff: Impressed by mature way the students approach the more difficult style of experiment. He didn't like the way they resort to Wikipedia. He liked the range of experiments and the provision of challenges that the students can solve.

Comment by Demonstrator: He had demonstrated in all three years and found the students, after a week of uncertainly, to be much more focused and enthusiastic than in levels 1 and 2. My comment: the demonstrators are very active, going round and talking to the students and not just sitting and waiting for questions.

My Impressions: All the students did an introductory experiment (carboxylation of an aryl Grignard reagent) and prompt feedback by Tom Podesta is serious and helpful. After this they have a choice within quite a wide range of experiments. They are not restricted to a particular day but sign in and out when they work. The big advantage of this year's course is the involvement of all (staff, technical staff, demonstrators and students) in the choice, the experimental work and the feedback. Feedback seemed to be prompt and helpful. I should have preferred to see more feedback by staff face-to-face with the students. It could be a problem that staff who demonstrate in year 3 do not necessarily mark the work.

Hardware

The labs are of course superbly equipped. The students are aware that this is so and several praised the design and equipment and clearly understood that this was not usual in British Universities. Things that stand out are the modern style of the exceptionally well designed furniture, adequate provision of diamond IR machines so that useful information can be got quickly even in the first year, and enough fume cupboards for all.

Outreach

I was in the lab with a group of KS4 (14-16 year old) schoolchildren who were isolating caffeine from tea. They were obviously enjoying the experience and were quite excited by the adventure of working in a 'real lab'. I spent a morning with Tim Harrison hearing about the outreach programme. The full scope of this programme was the most surprising revelation of my week in Bristol. Everything they do is over-subscribed. More details are available on CheMneT and the ChemLabs web site.

Outreach in Schools. An A-level version of the DLM is used for visits to schools and is sold to schools for their own use. Some 30,000 school children each year benefit either from a school visit of from a visit to Bristol. The main area is SW England but other areas are increasingly being involved. The Jersey science festival involved 6,000 children on the island during a week's visit with graduate students doing the teaching. In the last year visits have been made to schools in a Paris slum and a South African township as well as Calcutta, Singapore, Brunei and the island of Malta where 90% of the A-level students were involved in 5 days. These activities have led to a roughly 50% increase in pupils taking chemistry A-level in schools affected as well as a similar increase in applicants to read chemistry at Bristol.

The other side to the impact on schools is the impact on Ph.D. students who may find their vocation in teaching. In addition to visits, there are graduate students linked to national training schemes and working in schools. Some 240 such students have gone into teaching on the Sceince and Engineering Ambassadors (SEAs) Programme in the three years this scheme has been running.

Teacher Training: Science up-date courses take place in Bristol in the vacations. The teachers are not trained in 'how to teach' - they don't want that - but in new developments in the science subjects they teach. An example is the spectroscopy courses run at Bristol for 50 teachers at a time. Course materials are prepared at Bristol for use in schools or for training teachers.

Outreach in Other Universities. This has already started but the main impact will come from the imminent free release of DLM for all chemistry departments in Britain.

The Future

Possible problems when the CETL money runs out (April 2010):

Keeping enthusiasm among staff, technical staff and demonstrators when all is not new.

Essential that the academic staff continue to interact directly with the students.

Important that the course continues to evolve.

Maintaining the level of equipment: there is some hope that the pharmaceutical industry will help to fund the purchase of new equipment and provision for this is built into the plan.

It is very encouraging that the students at all levels this year are full of enthusiasm even though they never saw the 'old' system.

Stuart Warren, Cambridge, November 2008.