

The Bristol ChemLabS Outreach Use of STEM Ambassadors: A Case Study

An occasional paper for the Bristol ChemLabS' website

Tim Harrison and Dudley Shallcross

School of Chemistry, University of Bristol

Introduction

Bristol ChemLabS is the UK's Centre for Excellence in Teaching and Learning (CETL) and is a project within the School of Chemistry at the University of Bristol. [Harrison T.G., Norman N.C. and Shallcross D.E., (2016). [What can be learned from the Bristol ChemLabS centre for excellence in teaching and learning 10 years on?](#), Education in Chemistry, Royal Society of Chemistry, Volume 53(2), 26-29.]

]The main focus of the CETL was in the refurbishment of the undergraduate teaching labs and the writing of on-line laboratory support with the methodology and lessons learnt subsequently expanded across all the University's practical subjects. [Harrison T.G., Norman N.C. and Wyatt P. (2011). The Dynamic Laboratory Manual: E-Learning Software to Support Practical Chemistry Skills Development, Chemical Education Newsletter, American Chemical Society. CHED Committee on Computers (November). <http://www.ccce.divched.org/P7Fall2011CCCENL>]

A major part of the project involved the expansion of the original school's programme into a major, self-sustaining outreach programme with a current ambition of being seen as world leading in chemistry outreach. A significant part of the outreach programmes relies on well-trained postgraduates as STEM Ambassadors. Participating postgraduate students develop a range of soft skills, experience a potential career in teaching and gain financial support. Such students are invaluable as role models for younger students.

Background

Bristol ChemLabS Outreach engaged with more than 32,500 people in the academic year 2015-16. These numbers include 16,700 in primary school, 14,200 in secondary school and 1,700 members of the wider community. The number of participants is a conservative estimate because accompanying teachers at events are not always recorded. As it is, this total exceeds the typical average yearly numbers of between 25,000 and 30,000 participants in the last 7 years. In total, 254 events were organised and delivered during the year; some other events were organised but were cancelled by external bodies. This amounts to more than one event per school day.

Bristol ChemLabS Outreach has continued to work with and in collaboration with a number of internal and external partners to help deliver outreach programmes. These include established partners, such as the University of Bristol's Widening Participation Office, the Royal Society of Chemistry, The Salters' Institute and the Higher Education Funding Council for England (plus some of its Research Councils), The Primary Science Teaching Trust (PSTT) as well as commercial sponsors such as EDF Energy .

In the latest REF a case study involving outreach on Atmospheric Chemistry and Climate Change received the 4* 'World Leading' category,

Comments from participants are included to demonstrate the impact and value of the activities. These, along with further details of all activities, can be found on the extensive Bristol ChemLabS outreach webpages: <http://www.chemlabs.bris.ac.uk/outreach/>

The STEM Ambassadors Scheme is a nationwide programme to encourage those working in science, technology, engineering, and medicine to work with school students as role models and sources of careers information. This is an invaluable addition to a postgraduate's curriculum vitae as well as an invaluable aid to the promotion of these vital employment areas. STEM Ambassadors can be undergraduate students. Bristol ChemLabS Outreach does not use undergraduates in the outreach role other than those engaged in the Undergraduate Ambassador Scheme (UAS) where final year students work in local schools. [Harrison T. G., Smith, D.M., Shallcross D.E. (2009). Final year School Projects: The Bristol ChemLabS Use of the Undergraduate Ambassador Scheme. *Acta Didactica Napocensia*, 2, (2), 35-40.]

Bristol ChemLabS Outreach works with the regional STEMnet, a UK wide organisation, to train those wanting to participate in the programme. The local STEMnet delivers training courses within the School of Chemistry for groups of chemists several times throughout the year. The STEM training is aimed at supplying up-to-date information about schools and the way they operate to students as well as to notify them of their rights and responsibilities when working with school students. As part of the training process students have to undergo the disclosure barring service checks (police checks) required to work with British school children. Bristol ChemLabS has guided hundreds of postgraduate chemists through that programme over the last 11 years.

We also provide training specific to parts of the outreach programme. Hour-long sessions would be required for those who work with primary students, to rehearse the practicals we run in schools and those working with spectroscopy in a suitcase (a programme for post-16 students run by the Royal Society of Chemistry), and for those delivering lectures or lecture demonstrations. Where possible, new postgraduates would be included as supernumerary bodies at events so that an element of 'on the job training' can take place.

Examples of the Outreach Programme and the Parts Played by STEM Ambassadors

The following activities rely on the support of Postgraduate STEM Ambassadors or are delivered through Ambassadors working alone.

Open Laboratories Programme

On most Wednesdays throughout the secondary schools' academic year the Undergraduate teaching laboratories are used to promote Chemistry. Groups of students, typically in Years 10 to 13 spend the morning performing practical work of the sort not easily accommodated in schools. The most popular practicals are caffeine extraction from tea leaves and the synthesis of a solid anaesthetic. [Shallcross D.E., Harrison T.G., Obey T.M., Steve J. Croker S.J. and Nick C. Norman N.C. (2013). Outreach within the Bristol ChemLabS CETL (Centre for Excellence in Teaching and Learning), *Higher Education Studies*, CCSE, 3(1).]

STEM Ambassadors act as demonstrators in supporting the development of the students' practical skills. When time allows the students introduce themselves, giving brief details of their undergraduate course(s), where they are in their PhD programme and brief, but 'school friendly', descriptions of their research, and future plans. Teachers, as well as the students, find the latter of great interest.

Spectroscopy Tours

These are tours of the spectroscopic analytical equipment in the School of Chemistry for school pupils in Year 12 or 13, in groups of 8-10 with a postgraduate guide. Each instrument/spectroscopy type (including a selection from Nuclear Magnetic Resonance, Infrared, Mass Spectrometry, Scanning and Transmission Electron Microscopy, Gas Chromatography and possibly X-ray Crystallography) is presented to the students with a short talk by an academic or postgraduate/postdoctoral researcher with a demonstration and possibly hands-on experience. The students see the instruments in action, while learning about how they work and the application of the technique in analytical chemistry. As Ambassadors also act as tour guides students have opportunities to ask them about what it is like being at university. [Harrison T. G., Shaw, A.J., Shallcross, K.L., Williams, S.J., Shallcross D.E., (2010). School-University partnerships: Lessons learned from 10 years of Spectroscopy for Teachers and Post 16 Students. *New Directions*, 6, 72-76.]

Residential Chemistry Camps

These are residential chemistry camps lasting between 2 and 5 days, where students have an intensive experience of university chemistry, spending each day in a combination of laboratory work, lectures and possibly spectroscopy tours. They typically take place in January, March/April and June/July. The Trinity College Summer School involved time at the University of Bristol and also Trinity College, Dublin over a period of 5 days.

The Ambassadors act as demonstrators and guides. Some double up as 'minders' being present in halls of residence as necessary. Suitably trained and experienced Ambassadors may lead residential schools in place of the School Teacher Fellow (STF). These are usually those writing up their thesis or awaiting vivas and having several years outreach experience. [Harrison T.G., Croker S.J., and Shallcross D.E. (2014). Residential Chemistry Camps for School Students: Why Bother? *New Directions in the Teaching of Physical Sciences, Higher Education Academy*, 10(1), 44-49.]

Demonstration Lectures

The demonstration lectures 'A Pollutant's Tale', 'Gases in the Air', or 'A Chemical Delight', are 'flash/bangs' which involve practical chemistry demonstrations with detailed understanding of the chemistry involved.. 'A Pollutant's Tale' is the more advanced, older brother of 'Gases in the Air'. It involves many of the same practical demonstrations as 'Gases in the Air' but with a focus on Climate Change. 'A Chemical Delight' is a chemical kinetics demonstration lecture.

Postgraduate Chemists with specialised training may take on the delivery of such talks in the place of the School Teacher Fellow (STF). This requires considerable delivery skill, detailed knowledge of the Chemistry involved and of the health and safety considerations. It is usual that the first performances are 'double-teamed' with the usual deliverers before being allowed to perform solo. [Sunassee S.N., Young R.M., Sewry J.D., Harrison T.G., Shallcross D.E. (2012). Creating Climate Change Awareness in South African Schools Through Practical Chemistry Demonstrations, *Acta Didactica Napocensia*, 5(4), 31-48.]

Postgraduate 'Lecturettes'

Lecturettes are short lectures given by current postgraduate students (and sometimes postdoctoral students), on a topic related to their research. A period of Q&A is always scheduled after such talks. These lectures have no demonstration or practical component and usually take place along with one of the demonstration lectures in the afternoon after a morning spent in the laboratories. The talks are developed with support from the STF often with additional tweaks and upgrades as the talks are repeated. Occasionally schools request the Postgraduates to deliver the talks as part of a school's own programme at venues across the UK. It is common for postgraduates to give such talks 20+ times during their PhD.

Evening Lectures and Schools' Conferences

Schools' Conferences and lectures take place a few times a year, and involve talks by scientists from the University of Bristol (as well as other institutions) on their research, aimed particularly at secondary school students. They take place in the early evening or late afternoon. There may also be demonstration lectures by the STF along with visiting academics. They may be sponsored by learned societies or the University of Bristol Alumni.

Research Activities and Special Events These activity types refer to non-routine activities taking place at the university. This would be any practical activity or lecture event which is not run by Bristol ChemLabS as part of their usual offerings for schools, but is led by a research group or academic working with a school as part of a special project or grant, as has happened through Royal Society Partnership grants for example, which allowed for research partnerships between academics and schools. A recent example would be an afternoon schools workshop on Antimicrobial research (<http://www.bristol.ac.uk/news/2016/december/schools-conference-amr.html>)

Practical Competitions

These include Top of the Bench, sponsored by The Royal Society of Chemistry, The Royal Society of Chemistry Analytical Competition and Salters' Festival Competitions. Here STEM Ambassadors act as Judges assessing team work, safety and correct use of equipment. They also mark the answer scripts and present the prizes.

Practical Workshops in Primary Schools

Practical Workshops taking place in a school for primary school pupils are generally considered unusual, but a primary circus of practical experiments are provided weekly by Bristol ChemLabS. These are occasionally supplemented by fragrance/perfume chemistry workshops. A chemistry workshops involve a team of 3 or 4 STEM Ambassadors usually along with a member of the Outreach team. 3 or 4 workstations are set up in a school classroom with 4 experiments set up-each run by a postgraduate. . The circus last two hours and usually 2 such workshops are run per day for pupils in Years 5 and 6. Such workshops may involve an overnight stay or a very early start as they can occur anywhere between Kent and Cornwall. [Shallcross, D.E., Harrison, T.G., (2007). Why bother taking University led Chemistry Outreach into Primary Schools? Bristol ChemLabS experience. New Directions 3, 41-44.]

Spectroscopy in a Suitcase

Spectroscopy in a Suitcase involves a mobile kit of Infrared and UV-vis spectroscopy instrumentation with a value of over £25 K and activities delivered by postgraduate students for senior students at their own school. The visits are free due to sponsorship by the Royal Society of Chemistry. After suitable training these visits to schools across the SW of England are entirely delivered by STEM Ambassadors with the help of the Outreach Administrator.

Advantages for STEM Ambassadors in Outreach Participation

The postgraduate STEM Ambassadors involved in outreach activities gain from their experiences. They have opportunity to develop their soft skills so much in demand by both industry and potential future academic employment. They gain invaluable communication skills in that they have to explain their work to school students using appropriate language and explanation. This is considerably different to speaking with their peers at an academic conference, poster presentation or group meetings. They also they also have opportunity to demonstrate organisational and timekeeping skills as well as to demonstrate the skills they have learnt through their practical chemistry experience. Within a Postgraduate chemistry body as big as that at Bristol ChemLabS some postgraduates working in outreach may meet each other for the first time and discuss their research with each other. On several occasions such social contacts have led to changes in research direction. [Harrison, T.G., Hanford, K.L., Cheesman, B.T., Kaur, G., Franklin, S.D., Laurain, A.M.C., Medley, M.I., Rivett, A.C., Sellou, L., Shallcross, K. L., Shaw, K.E., Williams, S.J., Shallcross, D.E., (2011). The many positive impacts of participating in outreach activities on postgraduate students. *New Directions in the Teaching of Physical Sciences*, Higher Education Academy UK Physical Sciences Centre, 7, 13–18.]

Some postgraduate chemists, who are already junior lecturers in their own countries' universities, are reporting that they are coming to the University of Bristol, not only to learn and gain from pursuing a PhD, but also to learn outreach so that they can adapt it for their own institutions on their return.

Bristol ChemLabS Outreach pays its postgraduates to demonstrate or lecture to school groups and others. Such financial recompense is invaluable to those postgraduates whose funding may have come to an end whilst they are still writing up. It should be noted that students working for the STEM Ambassador organisation do so in a voluntary capacity so do not get paid.

Tim Harrison Bristol ChemLabS School Teacher fellow and Outreach Director

Dudley Shallcross, Former Bristol ChemLabS Outreach Director

School of Chemistry, University of Bristol

t.g.harrison@bristol.ac.uk d.e.shallcross@bristol.ac.uk