



The many positive impacts of participating in outreach activities on postgraduate students

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Postgraduate students are excellent role models for school students, where their passion and energy play a vital role in engaging younger students...

Abstract

Postgraduate students are excellent role models for school students, where their passion and energy play a vital role in engaging younger students and spreading enthusiasm and excitement about science. However, participating in outreach is not a one way activity for these postgraduate students. Through focus groups we show that the postgraduate students perceive that there are many benefits for themselves. These benefits are identified and discussed. This paper also contrasts the postgraduate with their undergraduate counterpart in terms of their contributions to engagement activities.

Introduction

Roberts and Wassersug¹ analysed data from an annual hands-on science summer school run for high school students between the years 1958 and 1972. Their data indicated that students who were interested in science and had an opportunity to participate in hands-on science research at school were significantly more likely to enter and maintain a career in science compared with students whose first experience did not occur until university. Their study provides quantitative support to the assertions that participating in hands-on science predisposes participants to having a positive attitude to science were made by Russell *et al.*² and Hanauer *et al.*³ Gibson and Chase⁴ showed that attitudes towards science were significantly improved when a hands-on (inquiry based) science program was employed in middle schools. Therefore, there is evidence that hands-on science interventions at school have a long-term impact on school students in terms of their attitude towards science, and there is higher chance that students will go on to science careers. Many studies describe a range of hands-on activities that are effective and their positive impact on students⁵⁻¹². However, a key element of these successful activities is the provider; in these studies they feature either undergraduate students¹³ or postgraduate students as a key component of the provision⁵. In both cases these students are excellent role models for school students; their enthusiasm, energy and the effect this has on enthusing and inspiring students is well documented. There are several schemes in place that facilitate undergraduate student participation in such activities for example, the Undergraduate Ambassador Scheme in the UK^{14,15}. Undergraduate students can use timetabled free time during term-time where that exists, to devote to such schemes and these schemes have been shown to be effective. However, for postgraduate students to engage with these activities they need to take time out from their research and there may be a variety of barriers to this, e.g. resistance to being released by supervisors. In this paper we look at the positive impacts that postgraduate students have on engaging with school students and their teachers and the many benefits they themselves experience during such interactions.

Bristol ChemLabS Outreach has a wide portfolio of activities that engage with primary pupils, secondary students and members of the wider community. Activities include lectures, demonstrations, spectroscopy tours, schools conferences, competitions, domestic and international residential schools and laboratory based workshops. Annually 27,000 to 30,000 people are engaged in the outreach activities which require considerable postgraduate input. There are 260 PhD students in the School of Chemistry, and a large number of these volunteer for STEM Ambassador¹⁵ and internal training to enable them to be involved in outreach activities.

Methodology

In addition to obtaining feedback from school students, teachers and event organisers, feedback from participating postgraduate students has been sought. On two separate occasions (2008 and 2010), all postgraduates involved in outreach were invited to lunch. On the walls of the lunch venue were put A0 sheets containing questions, marker pens

and post-it notes. The students were allowed to populate these areas with whatever feedback they wished to provide and to read previous input and comment upon that. Therefore, the informal input was both individual and collective. The responses of the first focus group were collected and categorized which led to several questions which were asked of the second focus group, as well as providing an opportunity for open feedback. Responses from both groups are reported here.

General observations comparing postgraduates with undergraduate ambassadors

Both undergraduate and postgraduate students have the advantage of youth over academic members of a university department, who are typically aged between 30 and 70 years old. School students generally find it easier to identify with people closer in age and outlook to themselves, so undergraduate and postgraduates can often be excellent role models for them

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Postgraduate students are more likely to be available for whole day events rather than typical science and engineering undergraduates. At Bristol, undergraduates are not allowed to miss lectures, seminars, laboratory time or workshops to participate in outreach, many of which are whole day activities. Unlike most undergraduates, postgraduates have gained teaching experience through the delivery of seminars, workshops, tutoring to small groups and in demonstrating in the university teaching laboratories. Postgraduates do have a richer science background and a more rounded (and possibly higher) level of understanding of their subject. They have their PhD, research to talk about with school students and teachers whereas the undergraduates could be seen as still being in education as they are still being taught. Postgraduates have been through the whole university first degree process whereas undergraduates are still going through it and this added experience is useful when discussing University first degrees with school students. The postgraduates may have also experienced other universities and university types for example campus versus city-based, and many are from other countries. A more subjective observation is that postgraduates tend to be more self-reliant than undergraduates, a feature of the PhD program.

General comments on what University students get out of engaging in outreach?

Both postgraduate and undergraduate students have the opportunity to develop their communication skills⁵ during outreach but the starting point is more likely to be advanced in the case of postgraduates as many already have teaching experience as part of their PhD. training. Communication skills, as part of a 'soft skills' set, are highly desired by prospective employers and further enhances the case for participation¹⁶. A specific element of communication skills that is particularly relevant to postgraduates is the ability to explain their research at a number of levels. Several postgraduates have remarked that it is a challenge to explain what they are researching to a primary school student. However, they found training exercises extremely useful when discussing their research with a wide variety of non-specialists and those with little science background. Indeed, one even had the chance to describe their research to a senior MP and was told that they had explained things most clearly!

Feedback from postgraduates and their discussion

What do you think the school students get from outreach activities?

Role modeling^{9,10}

Several postgraduates commented on their use as role models: *'It's good that the students meet young people who do science so they don't just think that only old bearded men are scientists.'* Further it is still common to receive feedback on gender role models such as: *'Feedback from one primary school said the children were amazed to see "girl scientists"! I think this is (outreach) a very positive influence on young people (in) breaking down gender stereotypes from a young age.'*

Practical experiences that students cannot get at school^{5,9,10}

Several commented on the practical activities undertaken during outreach. *'Students get the chance to carry out experiments they may not have been able to do at school and also the chance to work in state-of-the-art labs.'* *'They (the school students) get exposed to aspects of science that aren't covered on the national curriculum. They see real scientists at work.'* *'(They get) the opportunity to do experiments using equipment that they probably don't have at school and spend time doing experiments which they might not have time to do at school.'* *'For Primary school students they learn lots of science theory but don't normally get to put it into practice. The workshops give them the chance to do this.'*

Students' own personal development (skills)^{5,10}

Through being involved in university-led chemistry outreach the postgraduates stated that school students gain greater confidence in their own abilities, improved their communication, team working, practical skills and learnt to deal with unusual situations. Several comments on the potential for students to consider their future careers, or at least see what a chemistry degree would be like, were made: *'Chance (for school students) to ask questions about what a degree in chemistry is like.'*

What is the difference in teachers' interactions with postgraduates compared with undergraduates?

It has been observed for more than a decade⁹ that chemistry teachers enjoy conversing with postgraduates about their research. Indeed, postgraduates have been used to deliver Continuing Professional Development (CPD) to teachers especially in the areas of spectroscopy/spectrometry and electron microscopy. Teachers often value the chance to learn about the very latest research or developments in different fields. They often comment that they feel 'outside' the scientific community and, despite their intrinsic interest, have few opportunities or little time to update their science knowledge. Postgraduates also deliver short lectures to teachers when they are removed from their students during competitions. Topics have included extremophiles, the chemistry of chocolate and silicone polymers. This allows teachers to gain insight into current research. Teachers also question the postgraduates about their experiences of being a student at Bristol or further afield if they read their first degree elsewhere. Whilst undergraduate chemists can answer the last question on their experience of studying at Bristol they cannot be used to deliver all the other areas as they lack suitable experience or expertise.

What do postgraduates get from Outreach Activities?

The expected responses of 'Respite from research!', 'It's great fun' and 'Getting paid' were recorded as well as a range of comments concerning science communication, development of skills and enhancement of confidence. The following are some representative responses: 'Practice at communicating science to different target audiences at different levels', 'An opportunity to learn how to share knowledge with people with a completely different level of knowledge of the subject.' and, from a Chinese student 'A good chance to communicate with kids and practice speaking English.'

Surprisingly comments such as 'The opportunity to watch some entertaining lectures,' 'Know that you don't want to be a school teacher' and 'Working with young children and sharing the enthusiasm I have for science' were also recorded. The social aspects were also presented including: 'The chance to meet people in Bristol who are not students.' and 'meeting other postgraduates.' The latter is something that is often ignored, but for postgraduates to flourish, particularly those in small research groups, having a wider group of friends and colleagues is helpful. In terms of research, it has been observed that postgraduates studying seemingly disparate areas have found common ground that has aided both projects. For example, one postgraduate routinely used a particular analysis technique and in conversation with another postgraduate was able to share that technique and its benefits. The result was that the recipient then started using this analysis to great effect.

Justification as to personal involvement in outreach was given by one postgraduate: 'A friend of mine told me recently he can still remember the day his school had an outreach (or similar programme) visit. I like to think I made a difference and will be remembered by the children. He's now a chemist by the way!'

What do you think schools get out of Outreach activities?
Comments were spread between those with experience of primary schools versus secondary schools.

Primary schools

Postgraduates felt that 'schools can provide a wider educational experience that doesn't have to stick to the national curriculum'. Also A: 'Help in the classroom, teaching support for a topic that they may not be their specialist subject', 'reach more kids with science, make science more accessible and enjoyable and (carry out more) diverse activities'.

Secondary Schools

Students that are 'hopefully more inspired and interested in chemistry' who have had the 'opportunity to use more advanced kit (UV spectroscopy, infra-red etc) to back up what they're taught at A level, GCSE's, and see it happening, not just in a book!'

Schools in General

Teachers get: 'expertise in an area of chemistry perhaps not known to them', and 'get to see things maybe even they haven't heard of/seen such as ferrofluids. This can lead to new ideas in the classroom for practicals.' Outreach is also seen as an opportunity to 'Give teachers a break' and to 'refresh their knowledge'.

Commenting on the numerous photographs taken for websites and newsletters it was perceived that: 'Schools become more popular and parents are attracted to these schools'.

What sort of additional activities do you think we could offer as Outreach?

A large number of responses were connected with providing careers advice to youngsters or involvement in some form of a student tutoring scheme. Some suggested expanding outreach to adults/ the general public and in promoting chemistry through competition 'In Ireland we have "Young Scientist of the Year" competition. Is there something like that here?' Competitive activities such as the Royal Society of Chemistry's 'Top of the Bench' and Analytical Competition' were and are already being held. Additionally it was suggested that Bristol ChemLabS gave help with after-school science clubs. One student looked at this question in an entirely different way requesting that Bristol ChemLabS Outreach provided resources on 'How to get involved in jobs which would involve outreach/public engagement.'

What are the less positive aspects of doing Outreach Activities?

The expected comments regarding commitments and attitudes of supervisors were present: 'I would love to get involved more but can't afford the time', 'I think outreach activities are rewarding for both Postgrads and pupils but they are not necessarily supported by all academic supervisors' and 'Some supervisors do not recognize the value of outreach activities'. Proposals to reduce the time-commitment and avoid supervisor conflict included having some outreach at weekends. It may well be the case that with Impact Factors associated with research grants becoming ever more important, supervisors may be less reluctant to allow their students to engage in science communication^{17,18}.

Other negatives commented on were 'early starting hours' when schools need an 8:45 am start and are 2 hours drive away, when students 'misbehave or don't listen' and 'sore throats!'

Other Comments Made

The progression and recognition of science communicators/outreach workers was brought up on more than one occasion: 'Perhaps there should be a structure award for participants in Outreach – bronze, silver gold etc. Currently outreach isn't part of our assessment, although it takes up research time and is not necessarily valued by supervisors. An award would indicate valuable skills.'

One postgraduate also made a request for 'small amounts of cash for development/ implementation of novel projects.'

Concern was expressed that only the most able school students are given the opportunity to engage in outreach: one postgraduate commented 'I would discourage just taking the 'best' students academically for special treatment from Outreach. Often the 'best' academic students are the best crammers and not the best scientists. The mid-range students can do science too!' Much of Bristol ChemLabS outreach is decided by the teachers who organise the visits. For those visiting the School of Chemistry for laboratory work, the only request made by Bristol ChemLabS is that the students should be bright enough to successfully go on to the next stage of chemistry. Other postgraduate comments considered 'that it is important for pupils from less privileged schools to be exposed to the university experience and encouraged to apply to scientific subjects in particular'. Here too, Bristol ChemLabS Outreach engages with the full spectrum of schools and their students.

The enjoyment for all involved was also commented upon: 'It's fun for the kids and for the postgraduates (if sometimes quite hard work) and often fun for the teachers.'

What additional training could we offer to Postgraduates?

The few comments here were in terms of behavior management: 'Crowd control' and amusingly 'How to control yourself when the children don't pay attention.' Requests for training for practical activities have already been addressed. New postgraduate outreach workers who wish it are given a workshop on the primary experiments used. Those new to the main teaching laboratory experiments are brought in as super-numery demonstrators so they can get on-the-job training before they are tasked with full demonstrator duties.

Summary and Conclusions

In general, postgraduate students offer a superior mix of skills compared with undergraduates, from a range of observations made during the Bristol ChemLabS Outreach program. Practical considerations, such as their availability for whole day events, their experience in teaching, their more complete knowledge of the subject as a whole and their specific knowledge about their research, give them a distinct advantage over undergraduates. In particular, the interaction between postgraduates and teachers is much stronger than with their undergraduate counterparts, where considerable updating for teachers in the research field of the postgraduate is a common feature.

In terms of the benefits to postgraduates there are many beyond the usually reported communication skills, career benefits and confidence building⁵. Many report direct or indirect benefits to their research (e.g. having to really understand a topic that has helped their research or interactions with people outside their normal research arena including more postgraduates). Others value the opportunity to break out from research groups to make new friends, something that cannot be valued highly enough when postgraduates need support during their PhD.

A common benefit noted by postgraduates is simply providing a different activity to their PhD. All postgraduates need to be re-energised and refreshed from time-to-time and engaging with school students, their teachers and the general public gives this cohort a much needed buzz about themselves and science.

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