Teaching and Learning Issues in the Disciplines

An HEA Funded Project

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Part one – outcomes of focus groups

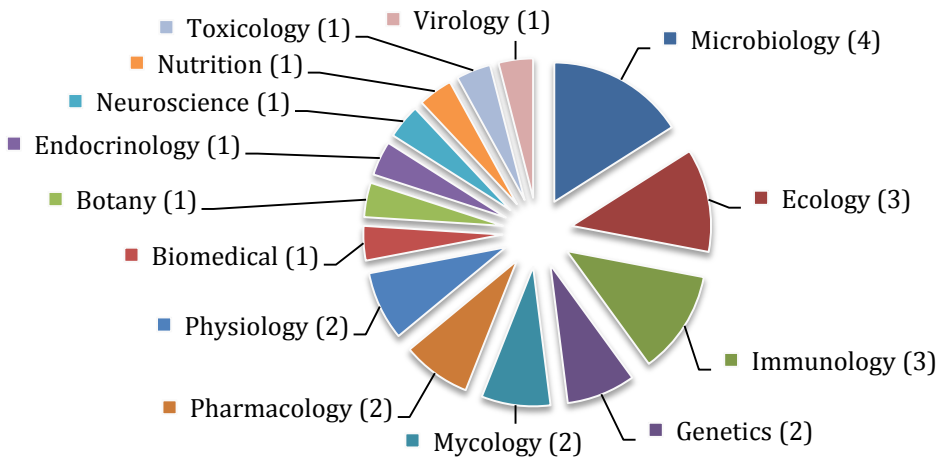
Introduction

The Royal Society of Biology (RSB) recruited 28 active teaching academics from bioscience departments within 21 Universities across the UK. These were divided into three focus groups which were held in London; one on Tuesday 22nd June and two on Wednesday 23rd June.

The composition of each focus group was as follows:

Focus Group 1		Focus Group 2		Focus Group 3	
Associate Professor/Dean	2	Director of Learning and Teaching	1	Head/Director	1
Senior Lecturer	3	Professor	1	Professor	1
Senior Teaching Fellow	1	Senior Lecturer	3	Senior Lecturer	4
Teaching Fellow	1	Teaching Fellow	1	Lecturer	4
Lecturer	2	Lecturer	3		

The composition of participant teaching fields was as follows:



Focus Group Outcomes

Six questions set by the HEA were asked of focus group participants and the responses collated.

1. What are the key resources you use in your own teaching?

There was no great sense that lecturers felt they couldn't access the scientific information and resources needed to deliver their courses. Whilst the resources used varied between discipline, lecturer and institution, generally the information was available in a usable format.

The following frequently used resources were taken from written submissions and discussions had during the focus groups:

COURSE TEXTS

Course texts, particularly those with additional online/downloadable content, such as diagrams and 3D visualisations (which are important for many bioscience disciplines e.g. anatomy, physiology), were frequently mentioned. In a digital age, textbooks are still seen as integral to education as evidenced in 'Why textbooks count' (Oates, 2014) which talks about primary and secondary education but many of the arguments also apply to tertiary. Textbooks mentioned included:

- Janeways (Immunobiology) ~£50 – includes free web resources such as diagrams
- Raven (General Biology textbook) ~£140
- Cunningham (Environmental Science) ~£140
- McGraw Hill (General Biology textbook) ~£60
- Purves 5th Ed (Neuroscience) ~£50
- Campbell (Biology) (~£120 for 10th ed)
- Kendrick (The Fifth Kingdom - Mycology) ~£20
- Moore (Essential Fungal Genetics) ~£90
- Wiley-Blackwell, Johnson 7th Ed (Essential Reproduction) ~£40
- Blackwell, Waites (Industrial Microbiology) ~£40
- Pierce (Genetics: A Conceptual Approach) ~£50

The use of textbooks is common practice and was broadly welcomed as it allows consistency across a cohort and generally provides a lecture / module structure and materials for the lecturer to work from. Some lecturers who have written books will use these to support their teaching, which will be free to the lecturer but still be a cost to the institution and students. It was noted that with McGraw Hill, lecturers use it as their recommended textbook and the university purchases it for their library, which results in the publisher offering free online access to all students on the course. This can make it cost effective and reduce the financial burden on students.

However, limitations arise with the licensing models that different publishers have. For example, single use online access codes mean that students can't access online resources when they purchase secondhand books, or the codes expire after a year. These online elements will be more extensive, interactive and up to date than the textbook itself and so puts students who can't afford a new edition at a disadvantage. This is especially true with resources for the biosciences which due to constant advancements in the field require frequent updates. It was also noted that some lecturers said they try not to recommend too many textbooks, some recommending just one, as they are wary of the £9000 tuition fees and don't want to add further financial burden to students.

ONLINE RESOURCES

Increasingly, online resources are being used, which can complement or in some cases form the basis of teaching and learning. Examples include:

- **Journal articles** and **primary papers** are useful for giving students an understanding of current research, developing analytical skills and becoming familiar with the writing style and format of publications. These are more suited to final year undergraduates and MSc students. These are accessed through **Ovid**, **Pubmed** and **ScienceDirect** via institutional login/Shibboleth, which is free to students.
- Various **websites**, i.e. charities, non-governmental organisations (NGOs) etc. are used for reliable information gathering e.g. fact sheets & policy documents:
    - Human Fertilisation and Embryology Authority (HFEA)
    - Food and Agriculture Organization of the United Nations (UN-FAO)
    - American Society for Reproductive Medicine (ASRM)
    - Cochrane reviews
    - National Institute of Health Care Excellence (NICE)
    - European Society for Human Reproduction and Embryology (ESHRE)
    - Centres for Disease Control and Prevention
    - Institute of Biomedical Science (IBMS)
    - American Society for Microbiology MicrobeLibrary – free image bank for teaching materials
- **InvivoStat** – free download from the British Association for Psychopharmacology website is useful for laboratory work and data analysis
- Free video streaming websites like **YouTube** is used for media that can visualise and explain complex biological models or stream relevant clips from nature/science documentaries
    - *"I try to include at least one or two 3D animation video clips from websites to visualise the unseen science that students learn"*
- Free information and news websites such as **Wikipedia** and the **BBC** used in research and context setting for teaching
- **Social media** like **Twitter, groups on Facebook** or **LinkedIn** are used for sharing best practice with other lecturers – this is apparently more popular in the USA

- In-house **Effective Learning Services** using **LearnHigher** resources to promote generic and academic skills – essay writing, revision, report writing, time management etc.
- Genetics Education Networking for Innovation and Excellence (GENIE) is a HEFCE funded Centre for Excellence in Teaching and Learning (CETL) and incorporates a Virtual Genetics Education Centre

The ability to share resources online with students who are already engaged with this technology is positive. It also allows the lecturer to access up-to-date content without waiting for printed publication. .

Conversely, this increasing 'trust' that students have of what they see online, without checking validity or robustness, can be detrimental to learning. There was one example of a lecturer checking and amending Wikipedia pages to ensure they were correct before presenting lectures surrounding particular topics. In addition, staff and students require training on copyright as online materials are so easily accessible it becomes easy to unknowingly fall foul of copyright law.

TECHNOLOGY USE

Technology is being increasingly used during the teaching of courses; this is in part driven by the individual lecturer but can also be mandated from higher management. In general, it appeared to be down to the individual lecturer or department to apply technology in a way that was useful to their circumstances (with varying degrees of success). The following examples were given of where technology has been utilised in HE:

- Largely voluntary recording of all lectures using **Panopto**, **Camtasia** and **Clickview** etc.
- **Virtual Learning Environments** (VLE) e.g. **Blackboard** and **Moodle** – to share lecture information, assess students throughout modules and support communication with discussion boards. Some can also access **WileyPlus** which offers additional learning materials such as animations and practice questions
- **LabTutor** – software that demonstrates effects of medicines on physiology
- **Banner** software for communicating with students
- **Turnitin** for coursework submission and marking purposes
- 'Clicker' technology for in class tests (e.g. **TurningPoint**)
- **Gradebook** for online tests and online marking
- Some examples of **iPads** being provided to a whole cohort
- **Gradebank** has '**comment banks'** for frequently made mistakes, which speeds up giving feedback on student's work

New technologies can in theory make teaching and learning more efficient (where time is a limited resource), more interactive (where students demand high levels of engagement) and 'smarter' allowing lecturers to better identify where students need greater support.

However for the technologies to be used effectively there must be dedicated training for both staff and students using it. There are further limitations of using technology including the issue of having enough digital storage; lectures from previous years are deleted to make room for new resources and lectures. The greater use of video recorded lectures also makes it difficult to update materials as new scientific information comes to light (in comparison with simply updating a PowerPoint slide). Furthermore, entire cohorts using iPads during lectures puts a huge demand on the university wireless network, resulting in slow internet speeds. With new technologies, lecturers also described the expected response time from students to be guided by standard online customer service response times rather than a realistic view on a lecturer's time.

PRACTICAL TOOLS

Increasing student numbers have implications for the more hands-on elements of teaching/learning, which are widely believed to be vital to the biosciences:

- **Field trips** (both day trips and residential for fieldwork purposes) – offers opportunity to provide more innovative, interactive learning
- **Laboratories** for practical classes (supported by paid PhD students / demonstrators) and final year projects
- **Computer laboratories** for data analysis and presentation
- **Virtual laboratory training** with **Labster** – currently being trialled by several HEIs
- **Industrial visits**
- **Work experience / industrial placements** (both local and international)
- **External Professionals** hired as part-time lecturers at additional cost but seen as important for students to meet working biologists

These methods of providing practical experience are very important within the bioscience discipline. They allow students to gain hands-on skills which cannot be learnt didactically and which are routinely requested by employers. The increase in cohort size makes timetabling difficult, putting a pressure on space, time, resources and the staff to student ratio. Finding industrial or summer placements and the logistics of visiting the students while they are away are also increasingly difficult with rising student numbers.

> *"It's next to impossible to deliver those skills via e-learning. You can't learn the practical skills that way. But do they need all the practical skills? If they're not going to do that specific job, can they survive with just some familiarity with how it practically works?"*

PEDAGOGY

Resources for pedagogy were either less available or less well known. Discussions primarily focussed on learning gained through experience / evaluation and buddying up with other lecturers. There was little talk of cross-university sharing (although some interest in

it). Specific resources mentioned were:

- Teaching feedback via Start/Stop/Gap using Linolt
- **Higher Education Academy (HEA) courses** – e.g. 'Enhancing Fieldwork Learning' noted as particularly helpful for preparing to teach field courses
- **Institute for Learning in Higher Education**
- University's own **Education department** – some examples of cross-discipline teaching courses for probationary lecturers and 'buddy systems' allowing for peer-to-peer observations and discussions
- **PedR journal** references, which are free via Institutional subscriptions
- **Learned Societies** such as the Royal Society of Biology and Society of General Microbiology

"I research into pedagogy in Science and Medicine. For example, if the Chemistry lecturers apply a different approach for teaching chemical structures with flip lectures or iPad applications (which were learnt from conferences, seminars and workshops), I try to implement such strategies for teaching Biochemistry or pharmacology in future."

"Networking and sharing ideas with more experienced teachers and professionals of the field is another important aspect of developing my own teaching practices and experimentation."

2. What are the learning and teaching challenges you face in your subject area/discipline?

Against the backdrop of the broader educating vs. pastoral care discussion, there were bioscience-specific challenges identified.

BIOSCIENCES

- Increasing student numbers without increased resources means there is less lab time per student, less lab resources per student and larger lab group sizes (all of which risk a less productive experience for students)

"We have to consider the question of 'what is practical work' nowadays? You can do the data analysis away from practicals but basic lab skills (e.g. microscopy) are needed – it's what students want, it's what employers look for from our students. But most labs need to subsidise final year practicals – typically we only start with between £150 to £600 per student for a 30-45 credit module."

"The average antibody costs £400 and you can't just do an experiment with one antibody. The cost of this with the numbers of students that we have is … tricky. All students want practical experience but biosciences lack the big consultancy money (such as found in engineering) coming in. It's a dilemma in the biosciences to increase student numbers, maintain a good research experience and stay in the black.

"How do you show one big machine to 200 students? Even in small groups (of 10) it's quite boring for them. They each get 10 minutes and they don't really experience the practical – they spend so much time not doing anything, and it's not exciting."

"Technology must surely be able to help with delivering practicals?"

"It's next to impossible to deliver those skills via e-learning. You can't learn the practical skills that way."

"But do they need all the practical skills? If they're not going to do that specific job, can they survive with just some familiarity with how it practically works?"

- Lecturers feel that having to submit course details so far in advance means that they risk having to deliver out of date scientific data when the course is live (e.g. March submissions for October lectures)

"Module descriptions for next academic year went in in February, with reading lists. But I don't want to teach in October what I knew in February – it won't be cutting edge any more. Yet our university marking criteria require that First Class marks need to reflect cutting edge thinking – so we either don't teach what the module description states or we teach it accepting that we're teaching out of date information. Part of the skill has become writing module descriptions that are so vague that you can alter the teaching when the time comes."

- The groups suggested that it's generally unclear how (or why) lecturers should be publishing papers about educational practice within the teaching of the biosciences in higher education. They are not sure where they would publish work, the process behind it, what criteria they would need to meet and whether it would be recognised as important.

"You cannot return a pedagogical paper to the biology panel. So research about pedagogy in biosciences – where does this go? It goes into a two star education journal, which has little impact factor."

"Pedagogical papers shouldn't be submitted to a bioscience panel, they should go to an education panel. But which head of a bioscience department is going to turn a paper from their department over to another?"

"It feels like we have very little understanding of what a paper in this area should be like. Maybe the education departments should be more pro-active – they should seek out pedagogical research papers from the biosciences area?"

"It takes a lot of unlearning of our bioscience paper writing [meaning the styles of academic papers for education journals are different to bioscience journals] *to make it work. I wouldn't want to move out of the biosciences into education just because I want to write papers about improving the teaching of biology…"*

"…but as a lecturer, I never read these publications. We don't read other people's papers about educating in biology. One thing that would be interesting is where can you find or publish education case studies?"

"The way our time is allocated doesn't allow for additional academic training (pedagogy). It's all lectures, prep, face time with students and organisation. We don't get prep time for modules we've taught before"

BIOSCIENCES + OTHER DISCPLINES

- Increasingly, students entering university are not ready to 'learn' in a new style and they would benefit from time spent thinking about why they are there, what they want to get out of it and how they 'learn to learn' (benefits described at length by those establishments with a foundation year).

"My university has decided that the first year at university – the transition from sixth form to university – is so

traumatic that we shouldn't put too much pressure on them. A bit more coursework, less or no exams."

"We're moving towards the first year being about teaching science students 'how to learn' rather than continuing the 'facts learning' that they experience at sixth form. We teach the how to learn and how to find out (and stress test) information for themselves."

"There's an extra element to this too – that students often enter university not really knowing that they're interested in the subject. Why they're interested in the subject and therefore why they should seek out information."

- Students are now widely viewed as paying customers (and view themselves this way) which is leading to greater bureaucracy in order to maintain transparent accountability (e.g. amount of paperwork required to create a new course / shortened feedback timelines).

"Expectations from students are growing exponentially. They're seeing themselves as paying customers. You get an email on a Saturday night from a student and they expect a reply by Sunday morning."

"We have a very strict timeline now to get feedback basically within a 14 day period. Especially when you have a number of modules turning in coursework and exams at the same time – very challenging."

"The amount of paperwork that we're now required to do … the number of policies and documents required to produce a new degree programme is staggering. The logic behind the process makes sense but it's done to excess."

"We're heavily driven by the NSS (National Student Survey) too. If the students don't like it, we change it and tell them we've changed it. Satisfaction is up in the 90s but something else is down and you have to change it."

"This is so important for the university league tables, which consequently drives student numbers…"

- Proliferation of technology options for lecturers means learning lots of new skills which is time-consuming to begin with (e.g. marking takes longer online).

"The progression from acetate to digitised versions on Power Point (PPT), then onto BlackBoard via a Virtual Learning Environment (VLE). None of that saves me time, it takes more time. I have to link to everything I use, each year we have to check the links exists… and there are a lot of people who simply don't know how to do these things. You have to try and fit in the training time."

- Similarly the rapid growth in numbers and subsequent move to technology usage has implications for students – they risk being bombarded with too much information, condensing workloads down restricts their time to reflect and discuss ideas, less face time with tutors / lecturers means more chance to be unengaged from the learning process.

"An issue with flip learning (block learning / bite-size chunks / recorded lectures etc.) is that we may be reducing the amount of time that students have between lectures to source their own material, prepare, think about the subject, make presentations."

- While recording of lectures is becoming the norm, there are practical issues (file storage space) as well as concerns about capturing copyrighted material.

"The problem that we have is the amount of server space that all those recorded lectures require. [Broad consensus that] we're struggling with that – similarly with YouTube films, I have to store them there so I have to make a new YouTube channel. If we moved to online only assessments, the system would fail. To the extent that last year's lectures aren't stored because of capacity."

- There are some concerns that recorded lectures are either, not that 'recordable' as they stand, not translating very well to a remote viewing or require lots of new skills and extra time to be recorded properly for repeat use (front of camera skills, scripting and practice).

"We [have] now moved back away from lecture capture in the large auditoriums because of the poor quality – too far away from the microphone, the slides move too fast etc.. We have to record some of ours (almost professionally) sitting in a room, facing the camera delivering it like a news reporter. It takes lots of extra time, take one, take two … Also, how interesting is this delivery likely to be to students?"

"Clearly lots of resource implication of this in its own right but we'd also need to update these every year when the discipline moves on. Much harder than updating my power point."

3 How do you think the teaching in your subject area is likely to evolve over the next few years?

Again, the view from biosciences sector about the future of educating surrounds the increase in numbers of students having an impact across university departments. There was concern that the increase in numbers could have an adverse effect on the quality of teaching and practical experience that students receive on biosciences courses.

"One of the real challenges has actually been balancing a teaching commitment with increasing numbers of students. So, for example 2 years ago we had 220, this year we have 350. Now there's going to be even more, to the point that we can't even fit them all in one place. So therefore, we have to have more sessions. That requires more staff. Obviously research-intensive staff don't want to teach and those on new contracts are protected anyway, so it kind of falls to those that can teach. And at the same time, we also have our own research careers."

The base assumption for the future of teaching in the biosciences is that there will be more students but no more academic staff. The logical steps from this are to think of ways that management can make this work, so, shorter summer holidays and longer academic days are expected.

"Fundamentally, if you want more students (more money) then we need to have a new model for teaching, practicals and tutorials. We're going to be asked to do 6pm – 10pm lectures because that's when the labs are free."

"But moving teaching out of core teaching hours eats into more of our prep time and also has impact on the students as well. They need time to prepare and think as well as – in many cases – work, to pay for themselves. We already have students coming in tired because they've been working all night."

Increasing student numbers has potential to impact on how courses are run, perhaps pushing towards shorter/more concentrated degree courses, which will incorporate more continuous assessment and fewer exams.

> *"We have a problem fitting students into lecture theatres – the first year intake is so high that we can't really fit them all in. Maybe we need to turn it all on its head – do students want to sit in lectures or do they want more interactive time with staff? Maybe we could do block teaching into more concentrated chunks."*

This contrasts with the view that courses may need to be extended to include a "learning to learn" year, and that students benefit from participation in placement schemes which enhances their employability skills and sees a change in students attitudes towards learning.

> *"Students leaving university are increasingly good with facts but seem less prepared for the world after university. They see the world in bullet points and they struggle to create prose, to construct a protracted argument. But they don't tend to care about this because 'I'll learn what you're going to test me on' doesn't cover this."*

> *"In the second year the focus is all on getting good marks and it's really hard to get students engaged in non-marked work. They're not taking up the opportunity for extra-curricular activities like work experience."*

> *"They're increasingly looking for professional / business skills, which doesn't sit comfortably with a BSc Hons vs. a technical qualification. If you want to be an environmental consultant, you probably need to take a consultancy course post university. Students are looking for some of those skills in their degree."*

> *"Accredited work experience adds an awful lot, experience that brings academic credit. They get out there and do some work experience and come back with a whole different perspective on their education and future. Likewise, the chance to give students some international experience – work experience abroad, and Erasmus exchange – all help to increase their employability."*

> *"This is the way it's heading for all universities. The year out option whether it counts or not. Similarly, we may head towards running Y-shaped courses – so they can head into academia or business."*

Managing the numbers will mean that face time with students may only be via tutorials, with a greater reliance on technology for 'learning' (and the subsequent degrading of the campus experience).

> *"It's strange that OU numbers are declining and yet universities are moving towards more online teaching. They produce incredibly professional materials and still they're not in demand."*

> *"Students want more of a face-to-face experience but nowadays you don't have the campus experience, there's no time to meet up with your friends. Students are just working so much – there's so much continuous assessment."*

Practical experience is a key component across the breadth of bioscience courses. It is important to ensure that all students have an opportunity to access it and that it is of a high standard. Universities are making use of a range of techniques to ensure that the practical experience is not degraded, this has been completed through:

- Use of virtual lab experiences alongside wet labs
- Smaller group teaching and running multiple sessions

- Later lab opening times (to accommodate numbers of students completing practical projects)
- Using PhD students in labs as support teaching and learning

"We get PhD students to help out in the lab, if they're interested."

With an increase in the number of students being awarded First class degrees, the participants felt that there was a need to differentiate between them; they also felt this was a view held by students.

"Those students who are graduating with Firsts and Two-Ones are looking for something that they can have that puts them above their 'competitors' – and there's nothing at present."

4 What gaps can you identify in the current coverage of teaching and learning resources for your subject discipline?

The resource that was the most valuable and lacking was time for lecturers to prepare, be that for teaching lectures, setting up practical activities, developing assessments or marking assessments. Aside from this it was felt across all the focus groups that ensuring that their students had enough experience of practical work and time in the labs to do this was important. Practical work is a vital part of a students' experience on a bioscience course and essential if they wish to continue studying the subject or if they continue in to research. It was seen as a fundamental part of becoming a professional biologist.

Lecturers want their 'customers' to think of themselves as biologists more than just students and hands on experimentation is key to that, as is exposure to practical work experience and those already working as commercial biologists.

"Most of our students don't really have a clue what they're going to do despite everything that we try and do from day one that they enter, by the time that they leave – so I think our employability is somewhere around 60% which is very low, below the average I believe. So …. our biggest problem is to try and address that."

"It's not that our graduates aren't skilled. They're just not aware of what they want to do."

"We're still trying to understand what it is [employability skills] – and we have things called the professional development portfolio where students collect things as they go. They're demonstrating they do other things, so if they have a part-time job, they've set up something – we give them points and some prizes and things like printing credit which are a bit mundane. But other things are [more useful], we'll pay for them to travel to conferences so they're enhancing and improving their career aspirations – but very, very few students engage with it."

"Students who come back from work experience, or time abroad or from meeting actual working biologists – they have a whole new perspective on their studies."

From a resource perspective, it was clear from all focus groups that it is lab space, equipment (antibodies etc.) and technician support that is most in demand. Access to work experience and real life biology in action follows as a close second. There was also a disparity between

universities in the amount allocated for consumables for final year undergraduate projects, which ranged from £150 to £600.

For the lecturer's own development, there is scope to collate and disseminate 'best practice' to help them unpick the challenges they face. That might be guiding them through successful applications of new technology or it could be more general pedagogical support and shared learning. However in practice there seems to be little or no time for this currently.

"I can't find so much support for 'me' to improve my teaching. So helping create power points, documents etc."

"The Higher Education Academy website is quite good and we occasionally have cross-discipline symposia."

"At our university all probationary lecturers have to take a teaching course. Its cross discipline which can be good but can also mean a non-science lecturer is trying to upskill a science lecturer, it doesn't always work."

"We have annual peer review, both new and experienced people reviewing each other. It's also possible to go and watch more experienced lecturers doing their thing, which was the most helpful. We can do that with other science lecturers or even other departments."

"We have departmental staff who work with the educational team so we have liaison and can learn. [Although the general view is that] it's generally under-developed and that we'd benefit on a symposium on teaching best practice, it becomes very technical typically. An educating stream might be good."

5 Thinking back to question 2, what gaps might emerge in the near future, given the projected evolution of teaching and learning in your subject?

The general sense was that the current issues faced by this discipline will become more acute in time. Therefore the resource challenges due to increasing student numbers in the future are as per responses to question 4.

6 Can you think of any other ways in which your PSRB, learned society or the HEA could support and advance learning and teaching in your subject-based practice?

Solutions to problems were sparse throughout the sessions although the groups themselves seemed cathartic for those who took part. Seeing first hand that other lecturers are facing the same challenges as they are gave them renewed energy to tackle the issues they faced. Also, knowing that some establishments are attempting to solidify progression through teaching excellence seemed reassuring.

If we acknowledge that most / all establishments are facing pressure from increased student numbers then some kind of 'coping with the change' materials would be useful. This could be from a pedagogical perspective (e.g. getting PhD students to act as lab support, successful

lecture templates, course material resources etc.) or based on successful applications of new technology in bioscience lecturing (e.g. information on Labster trials, successful lecture recording and sharing etc.)

Guidelines on how to publish pedagogical research in the field of biosciences and the credit that this might bring, could raise the profile of this type of research and give the discipline more momentum than it has at present.

> *"A lot of my colleagues that have been research-active and that have been moved into education are really quite depressed because they don't see a career path anymore."*

> *"I think one of the biggest impacts is the National Student Survey (NSS) because once the NSS came on board, I think vice chancellors recognised, 'hold on a moment, we've got to try and do something', and I think it's up to staff, and I'm more than happy to comment about saying look, how do we as academics do our best to be recognised for what we do?"*

> *"We have our own teaching route outlined, but it's very much the understanding that those staff will not have a subsequent research career. The two things will separate and that's what will happen – and there will be REF-returnable staff and none REF-returnable staff who deliver most of the course."*

The Royal Society of Biology perspective

The majority of overarching issues, if not all, were already identified and are the current focus of our higher education (HE) work at the Royal Society of Biology (RSB). These issues broadly cover the quality of practical work, valuation of teaching (particularly in terms of career progression) and sharing of best practice in bioscience pedagogy. This has therefore reaffirmed that we are focussing on the real needs of HE bioscience teachers, which is a positive outcome of the study.

Based on these focus group outcomes, and discussions that have taken place prior within the RSB's education committees and particularly our Special Interest Group, Heads of University Biosciences (HUBS), the following issues clearly have significant implications for the bioscience discipline.

1. Increasing student numbers

An extra 30,000 student places were made available in 2014-2015 academic year and later this year the cap on student numbers will be removed entirely leaving universities free to recruit as many students to courses as they wish. An increase in student numbers is an issue facing all departments, regardless of discipline, where resources such as time, space, equipment and staff will need to be increased or used more efficiently in response to rising student numbers. However, bioscience departments will be particularly affected by these rapid increases in student cohort size. This is due to necessary 'hands on' practical elements that are inherent to learning about many biological topics and gaining essential skills for employment. These elements are often time-consuming and require expensive equipment, sufficient working space and extensive staff time compared to lecturing. Rising student numbers will therefore put great pressure on these resources, which are already limited.

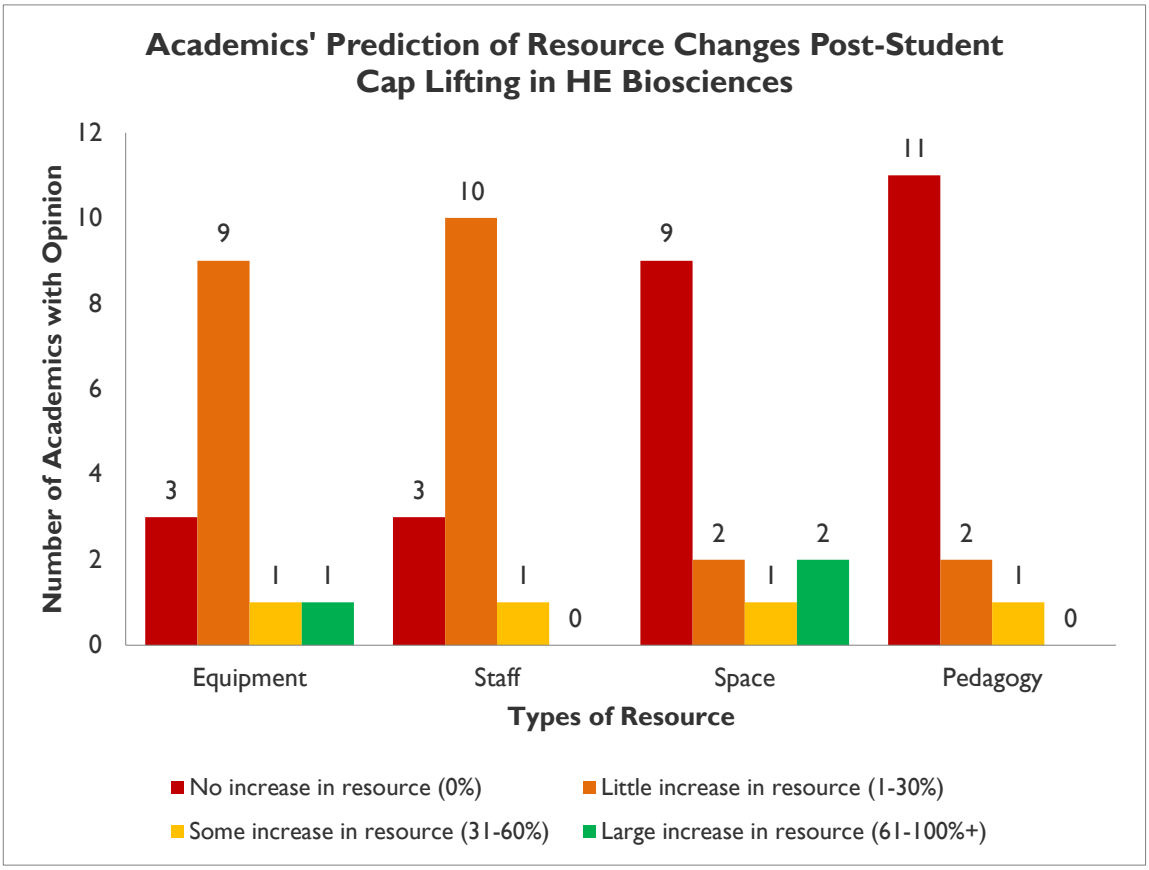
PRACTICAL WORK

The skills learnt through practical work are recognised as invaluable to the UK's scientific workforce and therefore the advancement of our technologies and economy, as set out in the Government's '***Bioscience and Health Technology Annual Report 2014***'. The Association of the British Pharmaceutical Industry (ABPI) published '***Skills needs for biomedical research***' in 2008 outlining how employers did not feel that bioscience graduates had the right level of skills required for employment, in particular applied skills rather than knowledge. Numerous bioscience skills were also deemed as vulnerable in the '***Vulnerable skills and capabilities report***', published by the Biotechnology and Biological Sciences Research Council (BBSRC) and Medical Research Council (MRC) in 2015, which was supported by the RSB. The practical elements of bioscience degrees are therefore widely viewed as important and something in need of improvement.

The RSB, HEA and the Biochemical Society undertook research into the quality of practical work, which lead to the publication of a 2014 report ***'Audit of Practical Work undertaken by Undergraduate Bioscience Students across the UK Higher Education Sector'***. It found that an average bioscience degree involves a total of ~500 hours of practical, laboratory-based work over three years, which excludes field work. University teachers described the quantity and quality of the provision as '***adequate or better***' across the sector but noted several barriers to practical work:

- *Increasing student numbers*
- *Inadequate preparation from school*
- *Limited resources (funding, laboratory space, equipment, staffing)*
- *Maintaining the research project (reliance on cross-subsidy from research funding; limiting number and diversity of host research labs; conflicting demands of, and rewards for, teaching and research in an academic career*

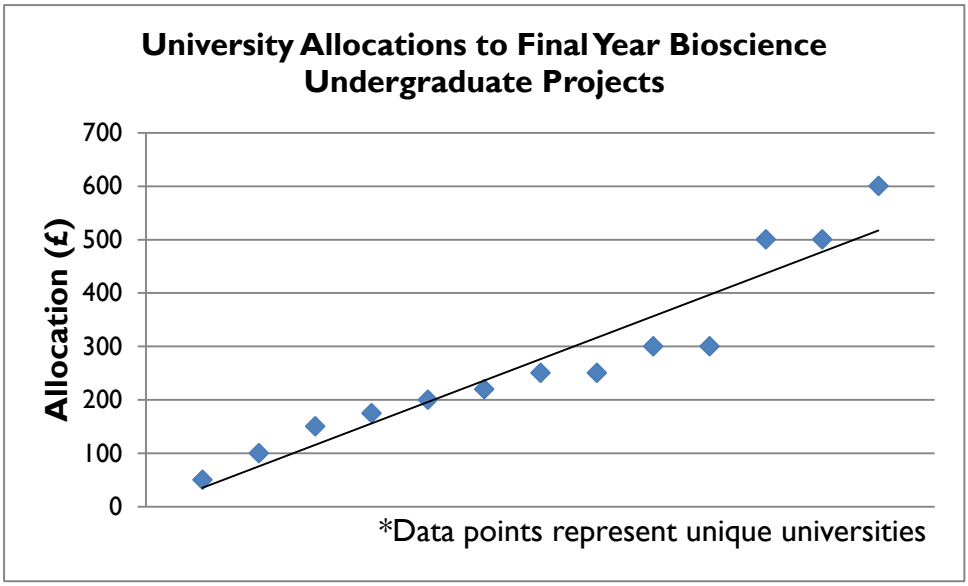
When this research was conducted throughout 2013 and 2014, a cap was in place to limit the number of students a university could recruit. . Our focus group reported that with the relaxation of the cap they have seen anything from a 25% increase to a doubling in bioscience degree cohort size with little to no increase in resource provision. We followed up the focus group discussions to ask specifically which resources were being increased in response to any rise in student numbers due to the student cap lifting. The results are as follows:



Generally there were some increases in equipment (e.g. purchasing more laboratory equipment/consumables, library books) and staff (e.g. hiring additional lecturers, demonstrators) – although one respondent stated a 30% decrease in staff and another mentioned lecturer redundancies made by their institution. In most cases, there was no increase seen in teaching space or pedagogical resources (e.g. funding to go to appropriate conferences, support mechanisms for sharing best practice), though there were some exceptions of a university constructing a new science department whilst another had added more general lecture space, along with two others expanding their laboratories.

Focus group participants felt the increase in student recruitment was, perhaps unsurprisingly, profit-driven. The commercialisation of the UK's higher education is a concern when profit becomes a greater priority than the quality of education provided. Though it must be noted that one participant stated they brought in £300,000pa from their MSc course alone, but this was not taken into account as it is with research grants.

Currently, there is no benchmarking of the amount of funding allocated to consumables for undergraduate final year projects. We surveyed participants after this became apparent during the focus groups and found a wide range, from £50 to £600, giving an average of ~£275 (n=13). The range was fairly evenly spread as shown in the graph below:



It was widely felt that money allocated to final year projects were a small fraction of the actual laboratory and equipment costs, which are largely funded by research grants/internal funds. It also doesn't include 'dry' projects that are purely analytical or educational which are often given no monetary allocation. It begs the question that if all bioscience students are paying the same tuition fees, why some students receive up to 12 times more allocation than others to complete their final year project. This may be explained with assumptions that researchers will always use some of their grant funding to 'top up' the amount but we cannot be sure in every case and it may be useful to investigate.

Practical work within the biosciences is particularly vulnerable to a rapid increase in student numbers as they are often conducted in smaller groups compared to lectures; requiring more interaction between instructor and student. There is also a higher cost and limited availability associated with dedicated laboratory space and high-tech scientific equipment. The issue is exacerbated by the necessity for bioscience graduates to possess these practical skills for later employment, it is not something that can simply be removed from the curriculum.

The topic of virtual learning was discussed where some universities are trialling software provided by Labster. This uses virtual laboratory simulations to teach a wide variety of topics from ecology and evolution to mitosis and photosynthesis. It is important that these do not replace practical work but act as a pre-laboratory session to improve engagement in subsequent practical work.

With pressures on resources already being of concern when student numbers were capped, it means the quality and quantity of practical work is in an increasingly vulnerable position as a result of sharply rising student numbers. Universities will have to invest in increasing their capacity in terms of laboratory space, equipment and staff to uphold current standards and prevent the erosion of vital practical experience within bioscience degrees.

INDUSTRIAL PLACEMENTS

Focus group participants frequently mentioned that students returning from industrial placements had undergone a pronounced, positive change. They were more mature and confident and, as well as obtaining scientific skills and knowledge, had also improved their 'soft' skills and professionalism. It was noted how important it was that students experience working life and transition from seeing themselves as a student to feeling they are a biologist. This is already something we are aware of and promote through the Society's Advanced Degree Accreditation programme, which requires graduates to have undertaken significant research experience (usually a minimum of 80 credits), outside the normal learning environment.

Whilst placements were not seen as resource intensive once they are started, lecturers find it increasingly difficult to secure them for students. This is especially true for shorter term placements where the host feels 'short changed' given that they train the student, only to lose them shortly after when they return to university. With increasing cohort sizes, it becomes more difficult to find placements for all students who have a year in industry incorporated in their degree. This is a great shame when there is general agreement that all bioscience undergraduates should undertake placements, whether incorporated as credited modules undertaking voluntary work or a year in industry.

2. Valuation of teaching and pedagogy

Given its importance in educating and inspiring the next generation of biologists, the valuation of teaching biosciences in higher education is not as strong as it should be. In 2013, the Royal Society of Biology worked alongside the Academy of Medical Sciences, The Physiological Society and the Heads of University Biosciences (HUBS) to review the status and valuation of teaching in higher education**.** This led to the publishing of the report '*Improving the status and valuation of teaching in the careers of UK academics*'.

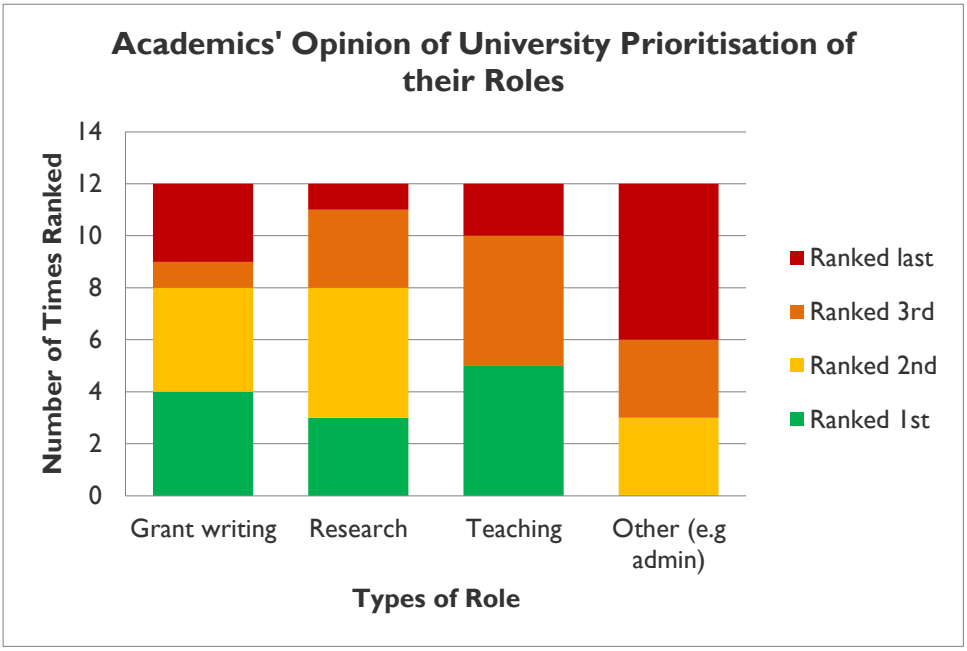
The findings of the focus groups echo this report with research taking precedence over teaching and there being a lack of knowledge/support for lecturers to undertake and publish pedagogical research. These are issues that are showing signs of improvement in some institutions but still requires continued efforts to ensure progress is made throughout the wider HE landscape.

TEACHING VS RESEARCH

The scarcity of gaining professorships through teaching in comparison to those via research was noted many times during focus group discussions. Only one or two examples of

teaching professorships were given from participant's knowledge of their own institution and others. This exemplifies the 'glass ceiling' experienced by bioscience academics that focus on teaching, which is well known to the RSB.

Focus group feedback indicated there is an overwhelming emphasis on research from senior management because it is seen to bring in large amounts of funding through grants and lead to high impact publications, which in turn maintain reputation via the Research Excellence Framework (REF). It was not infrequent to hear examples where 'research active' academics (individuals who conduct research and teach) were told if they do not publish X amount of 4* papers and bring in X amount of grants, their contract would be changed to pure teaching. This seemed to give an impression that a pure teaching role was considered as lesser than pure research or a mix between the two. One participant summarised this pressure between teaching and research: "*Between teaching, tutoring, and student supervision, I find it difficult to find time for research and grant writing. At the same time, the university expects me to have a healthy grant portfolio and write papers that can be submitted for the next REF*". We followed up the focus groups with a data gathering exercise to assess how they perceive their job roles to be ranked by their institution. The results obtained are below:



The data shows that grant writing and research are ranked 1st and 2nd two thirds of the time whilst teaching is ranked 3rd and last almost two thirds of the time. This may illustrate the pressures from senior management on academics to secure grants and undertake research, which push teaching into a lower priority bracket where it should be at least equal given that universities were built on learning and education. However, we also see that teaching is ranked 1st on five occasions. This may allude to a polarisation that was discussed during focus groups. We heard that the HE bioscience landscape could change in future with some institutions focussing purely on research whilst others offer only teaching. A focus on teaching, student satisfaction and employability is perhaps seen more in non-Russell Group institutions that may need to compete for students more, especially now that Russel Group universities with established reputations are able to recruit more students with the lifting of the student cap.

A polarised situation poses a worrying disconnect between research and teaching communities, which should be closely tied. With the biosciences being a constantly changing subject, students need to be taught the very latest in research and a close link with research conducted within their institution is conducive to this. Likewise it is important that research is effectively disseminated for it to make an impact and be built upon; therefore access to the next generation of scientists (the students) is important for continuation of research. The likelihood of a completely polarised situation is unknown but there does seem to be a divide between Russell Group universities prioritising research whilst others prioritise teaching and student satisfaction.

It is also evident that the promotion pathway for teaching focused academics in many universities is less clear, if at all stated, in comparison to promotion pathways via research. Some institutions have documents that demonstrate the criteria required for promotion through teaching, which will naturally have substantial differences to research, whilst others have yet to implement them. The Society would like to see better integration of teaching-specific criteria in promotion documents across all universities.

PEDAGOGY

Lecturers frequently tell us they are not allocated sufficient time to undertake pedagogical research, especially during the period leading up to the REF. For example, REF themed conferences are given precedence over others with teaching themes. There was also a lack of awareness of pedagogical journals and grants available to fund research in this area. UK pedagogical research is significantly underfunded in comparison to other countries such as the USA and there may be a risk of the UK falling behind. There needs to be increased funding in the UK HE sector or a mechanism put in place to allow a 'pedagogy pipeline' linking us to the USA so we can benefit from its research.

Current and Future Work

This section will be used to discuss what the Society is currently undertaking to address the issues raised, how we can maximise the effectiveness of these activities in future and what further work would be beneficial to teaching and learning in the HE biosciences.

1. Practical Work and Placements

DEGREE ACCREDITATION

The Society's Degree Accreditation Programme aims to recognise academic excellence in the biosciences and drive up standards of learning and teaching. The programme consists of two types; '**Advanced Accreditation'** and the more recently launched '**Accreditation'**.

'Advanced Accreditation' requires evidence that graduates meet defined sets of learning outcomes, including gaining substantial research experience, outside the normal learning environment. This research element aims to augment and develop the practical skills and competencies necessary for employment. The success of this initiative has led to the Advanced Accreditation of 179 degree programmes from 22 UK universities over the last three years.

Following a successful pilot of '**Accreditation**', it was officially launched this year and focuses on employability and more general higher level skills acquired through studying the biosciences to Honours level. The criteria require evidence that graduates from accredited programmes meet defined sets of learning outcomes, including subject knowledge, technical ability and transferable 'soft' skills. It also includes a 'developing creativity and innovation' criterion which addresses issues academics have raised, of which is exemplified in this quote from a focus group participant:

> *"My biggest concern is the move towards HE becoming a certification based, narrow, professional education for job training rather than open ended learning with broader goals of developing 'big thinkers' and philosophies of life that lead to disruptive and novel contributions to society."*

The Society will continue to roll its accreditation programmes out, promoting the importance of practical work, industrial experience and 'soft' skills.

AUDIT OF PRACTICAL WORK

The *'Audit of Practical Work undertaken by Undergraduate Bioscience Students across the UK Higher Education Sector'* was produced before the student cap was lifted. It would be useful to conduct a follow-up audit in 2018, allowing institutions an adjustment period to the increased student intake before re-examining whether there has been any significant decrease in quality or quantity of practical work, and what the implications of this may be. The previous Audit sample size was 16 universities, which only takes into account roughly 11% of UK universities that offer bioscience degrees. Given the worrying implications of rising student numbers for practical work, it is of greater importance to undertake a more comprehensive audit with a larger representative sample. We should also expand it to explore the use of virtual learning to ensure it compliments rather than replaces practical work. As before, a partnership between learned societies and the HEA could best achieve

this.

FINAL YEAR PROJECT FUNDING

We noted no consistency in monetary allocation for final year undergraduate projects across institutions, which ranged from £50-£600. It would be useful for the Society to undertake a benchmarking exercise to investigate this further, either with the above follow-up audit or sooner, separately, which the HEA could support.

INDUSTRIAL PLACEMENTS

Students with industrial experience are highly regarded by both academics (as shown in the focus groups) and employers (in our own experience and previously mentioned reports). The Society already promotes the benefits of industrial placements through our Advanced Degree Accreditation programme and by working with our Employer Advisory Group we are identifying barriers and discussing solutions to the difficulty of finding and allocating students on placement years. To meet the demand of increasing bioscience undergraduate students, it would be useful to explore methods of further strengthening university links with industry. These industries would need to represent the full breadth of bioscience degree disciplines in order to increase placement opportunities for all students. One way of accomplishing this could be a database of employers, including Small and Medium Enterprises (SMEs), which can be searchable by application deadline, degree programme, locality and perhaps eligibility criteria (e.g. A-level results). There has been some effort to do this with public and private money spent (e.g. Cogent and RateMyPlacement etc.), yet these don't seem to be comprehensive, focussing on broad bioscience placements at large, national/international companies rather than particular bioscience disciplines or local SMEs. A fully comprehensive database would require seed funding to enable the initial infrastructure and a subscription fee paid by universities to use it, which would fund a staff member to maintain it. This would be a significant project that the Society does not currently have the resources for.

2. Increasing Value of Teaching and Supporting Pedagogy

The RSB recognises the need to increase the value of teaching and better support pedagogical activities. Our current work looks to address these areas in a variety of ways, building upon the findings of last year's report, '*Improving the status and valuation of teaching in the careers of UK academics*'. However, it is apparent that our various methods of support are not being as widely taken up as we would like. This is in part because some activities are in their early stages or are going through redevelopment, but there may also be a lack of awareness of them.

HE BIOSCIENCE TEACHER OF THE YEAR AWARD (HE BTOY)

The HE BTOY Award was originally managed by the HEA Centre for Bioscience and following its closure in 2011, was taken on by the Society. It seeks to identify the UK's leading bioscience higher education teachers, recognising the invaluable role they play in inspiring and educating the next generation of biologists. Funded by Oxford University Press (OUP) and HUBS, the winner receives the Ed Wood Memorial Prize of £1,000 to spend as they wish; one year's subscription to an Oxford University Press (OUP) journal of their choice; and one year's free Membership of the Royal Society of Biology.

We believe the Award contributes to addressing many of the issues raised within the focus groups. For example:

- It raises the **value of teachers**, both within the finalists' institutions, throughout the HE landscape and also to the wider public where it receives press coverage.
- It forms a reputable accolade that can meet **criteria for promotion**, demonstrating national excellence in teaching for promotion through a teaching route.
- It contributes to the **sharing of best practice** within pedagogy through the production of case studies and where finalists present their work at the HUBS Spring Meeting, attended by up to 50 Heads of university bioscience departments.

Awareness of the Award was unfortunately low within the focus groups and in response to this and the issues raised we will work to:

- **increase awareness** of the award amongst lecturers, students, the press and the wider public
- incorporate the Award into our **promotion toolkit** for teaching
- **disseminate the case studies** more widely amongst the HE teaching community to strengthen the sharing of best practice

HEADS OF UNIVERSITY BIOSCIENCES (HUBS)

HUBS is a Special Interest Group of the Society that is open to heads of departments and subject leads. It aims to address the particular challenges of managing biological and life science HE departments. HUBS runs two meetings for members a year: a winter meeting focusing on HE policy issues and research; and a residential meeting in spring, with more extended talks and debates about matters relevant to teaching in the biosciences. A full list of past meeting topics and reports is available [http://www.rsb.org.uk/education/hubs/hubs-reports].

HUBS has recently planned to offer grants of £1000 to host and deliver workshops on learning and teaching in the biosciences. This will supplement the two annual meetings with a maximum of 3 workshops per year. This is seen to cater to a need left by the closure of the HEA's Centre for Biosciences and its associated activities. These were considered to be very valuable by the bioscience community, as exemplified by the feedback from focus group discussions at one of the final HEA-supported meetings. The HUBS workshop series therefore aims to:

- enable institutions to **disseminate findings** from research or evaluation studies, or evidence-informed policy and/or practice
- facilitate the **sharing of policy, practice and evidence**, across institutions
- promote critical discussion in relation to **enhancing the quality of the student learning experience** in the biosciences

Support from the HEA would allow HUBS to increase the scope and sustainability of this project.

CHARTERED SCIENCE TEACHER (CSCITEACH)

The Society was recently awarded a licence by the Science Council to offer Chartered Science Teacher Status (CSciTeach). This is a chartered designation that recognises the unique combination of skills, knowledge, understanding and expertise required by individuals involved in the specific practice and advancement of science teaching and learning. This registration is available to teachers at primary, secondary and tertiary level and is based on evidence of positive impact amongst students, colleagues and the wider teaching community. It supports innovation, encouraging research within education and the development of research based practice. Practical work is also recognised within pedagogic content knowledge and as a tool for enhancing student learning, as well as being an integral scientific process.

The Society's Continuing Professional Development (CPD) programme is the mechanism through which Chartered Science Teachers can annually demonstrate their credibility and distinction to enable retention of their title. It highlights best practice, allows teacher to reflect upon their own teaching and can be used as a portfolio to assist with promotion via a teaching pathway.

The Society would be interested in discussing with the HEA how CSciTeach competencies map with HEA Fellowship.

TEACHING PROMOTION TOOLKIT

The Society has begun work on developing a 'teaching promotion toolkit' to outline competencies and criteria used to achieve more senior roles through teaching. This is in direct response to the undervaluation of teachers and a lack of teacher-focussed promotion pathways provided by universities in comparison to research pathways (though there are exceptions and we are seeing gradual improvement in this area).

We have established a focus group to look at the development of this document which will support progression through a teaching pathway specific to the biosciences, noting important aspects such as the teaching of practical work. We hope that by collaborating with academics, we will create a toolkit that raises awareness of its need and encourage its uptake by universities yet to create their own. This could be an opportunity for the HEA to provide funding to contribute to costs associated with holding the focus group, such as room hire, catering and travel expenses or the design and publication of the finished document to better disseminate it to universities across the UK.

We also hope this toolkit will help to unite the work the Society does by better directing higher education teachers towards our support mechanisms, such as the BTOY Award, CSciTeach and associated CPD programme, training opportunities and other teaching resources.

HE TEACHING WEBSITE

The Society website includes a HE Teaching Microsite that accommodates Open Education Resources (OER) for the biosciences, which was seed funded by the HEA and JISC in 2012. The site aims to support teaching practical biology in HE, and the resources featured include peer-reviewed lab and field work protocols, data handling exercises, videos of techniques and multimedia alternatives to wet lab work.

We are looking to reinvigorate the OER database with new resources, review its current resources and add additional content to the wider HE Teaching Microsite such as HE BTOY case studies and once complete, the 'teaching promotion toolkit'. We will then look to relaunch it to increase engagement from HE bioscience teachers and better meet the needs raised in this report.

PEDAGOGICAL RESEARCH

There is a huge need for increased funding availability for pedagogical research, which currently the Society is not in a position to provide. However, we can do more to address a lack of awareness of where funding can currently be obtained, and how and where academics can publish pedagogical research. The development of a periodically updated guide could accomplish this, which would detail:

- **current funders** of bioscience pedagogical research (e.g. Wellcome Trust)
- **best practice** in conducting and writing up bioscience pedagogical research, perhaps including interviews with researchers and/or case studies
- **current knowledge gaps** in how to teach bioscience topics and themes
- **current bioscience pedagogical journals** (e.g. *HEA Bioscience Education, Journal of Biological Education, British Educational Research Journal, FEMS Microbiology Letters* education section etc.)
- **how to disseminate research** beyond journal publication

The Society would require funding and partnerships with other learned societies to undertake research for this project and then for subsequent updating and publishing of the guide.

We also continue to receive feedback regarding the higher quantity, quality and status of pedagogical research in the USA. It would therefore be useful to investigate why this is, whether we can replicate it in the UK or whether resources should be invested in creating a **'pedagogical pipeline'** allowing research conducted in the USA to be effectively disseminated in the UK HE bioscience landscape.

We also received feedback to:

- provide funding for teaching-focussed staff to attend pedagogical conferences (currently the Society is not in a position to do this, though we do offer limited travel grants for members)
- develop a teaching forum for members to exchange ideas and get advice on good teaching practice (we have an online TalkBiology forum but it has been difficult to build sufficient momentum for it to be regularly used)

3. Policy Work

The Society provides Government and other policy makers, including funders of biological education and research with independent evidence-based opinion, representative of the widest range of bioscience disciplines. For policy items focussing on HE, we often consult with HUBS to produce statements and consultation responses. These can be found on our website.

BIOSCIENCES AND BIOMEDICAL SCIENCES BENCHMARK STATEMENTS

The Society has worked with the HEA on the redevelopment of the biosciences benchmark and the biomedical sciences benchmark, bringing in expertise from our membership to support the production of the documents. The Society is currently collating the feedback from the wider membership to respond to the current QAA consultation.

TEACHING EXCELLENCE FRAMEWORK (TEF)

We are currently mindful of the recently announced Teaching Excellence Framework (TEF). The measuring of teaching quality is difficult but it may prove a useful exercise, paralleling the REF to raise the profile and value of teaching in balance with research. We will be responding to the Higher Education Funding Council for England (HEFCE) consultation and further government consultations relating to it in autumn.

BIOSCIENCE DISCIPLINE VISABILITY PRE-UNIVERSITY

During the focus group, some lecturers expressed that their discipline was particularly niche so that students weren't aware of it before coming to university. For example, an immunologist stated students learn about white blood cells during A levels but because it isn't referred to as immunology, they aren't able to distinguish it as a discipline. If used correctly within textbooks, the classroom and the national curriculum, students would be able to know the branch of bioscience they are interested in/excel at, and look for the appropriate courses at university. This may help to increase the uptake of bioscience degrees and encourage students to be more focussed. Some may argue that it is too early to differentiate but the vast majority of universities offer broad first year topics to all bioscience degree programmes and allow students to switch programme in second year when units become more differentiated.

PRACTICAL WORK IN A LEVELS

Recent change in A level practical endorsement means the Society will be looking at its impacts and developing documents to support teachers through the changes. This is important given that lecturers commented on students being inadequately prepared for practical work in HE.

Finally, the quote below optimises the feeling of all focus group participants:

"I think studies like this are immensely helpful in highlighting to a more public domain what we in the Universities have to cope with"