TIM'S BIRKHEAD'S CASE STUDY

BACKGROUND

Both at school and as an undergraduate I was enthused by handful of exceptional teachers. As an academic my aim has been to inspire undergraduates through my teaching – which in turn is kindled by my experience as a researcher. To achieve my goal of being an inspirational and effective teacher I have used a combination of conventional and unconventional teaching and assessment methods.

It can be difficult to sustain an enthusiasm for effective teaching over 30 years in an environment as dynamic and as vulnerable to fashion and fluctuation as higher education. I have therefore actively sought ways to diversify and enhance the quality of my teaching, mainly though the adoption of new teaching methods but also through outreach. Talking to a wide range of public audiences about the process and excitement of science has helped me to develop a distinctive, and I hope, an effective approach to undergraduate teaching.

My recent innovations (since 2007) in undergraduate teaching include: (i) the use of Facebook to provide a shared communication platform for a particular lecture course, (ii) podcast lecture summaries, and (iii) ten-minute talking-head videos to provide core information that students watch before the lecture slot so that the 'lecture' time can be used for more interactive discussion in which undergraduates explain key concepts and ideas to one another, followed by a mini-quiz. The rationale here is that explaining information to each other - peer instruction - with immediate feedback, is the most effective way of ensuring understanding and retention, and also in generating creative thinking. Encouraging undergraduates to adopt the role of teacher (to their peers) is a particular effective way of learning (Crouch & Mazur 2001).

There is concern in the UK about the decline in the number of students studying science. One reason for this decline is that at school students perceive science to be both dull and difficult, possibly as a consequence of the educational process at school being more like 'filling a bucket' than 'lighting a fire'. Fortunately, academics in universities still have the freedom to combine bucket-filling with fire-lighting and in the process, encourage independent thinking. This has been the essence of my approach to teaching undergraduates since I started as an academic in 1976.

My teaching philosophy has three key elements. The first is to inspire, and motivate undergraduates to learn from, and to be excited by intellectual challenges. Second, is to encourage academic rigour, and third, to provide a broad perspective on what it means to be a scientist.

REASONS FOR INTRODUCING THIS TEACHING METHOD

Case study: APS327 'History and Philosophy of Science' – a third-year course.

This course is mainly about 'doing science' and what it means to be a scientist. I introduced the course (in 2002) to our curriculum because it is the kind of course I would like to have taken as an undergraduate. It would have given me a better understanding of science as a process; the attributes scientists need, and provide a guide to the way scientists should behave. My aim is to provide students with the tools for life-long learning, regardless of the career they later adopt. The course includes some history because with no knowledge of a topic's history, students have no context. It is rare however, for the history of science to be taught as part of a degree in biology, despite the fact that as long ago as 1959 the eminent evolutionary biologist and statistician R. A. Fisher, wrote:

More attention to the History of Science is needed, as much by scientists as by historians, and especially by biologists, and this should mean a deliberate attempt to understand the thoughts of the great masters of the past, to see in what circumstances or intellectual milieu *their ideas were formed, where they took the wrong turning or stopped short on the right track.*

APS327 includes 'lectures' (see below) on the histories of research and ideas about (i) evolution, (ii) sexual selection and (iii) reproduction – all of which link to other Level 3 courses (taught by others). The core of my course however, focuses on philosophical issues: (i) what it takes to be a scientist – what attributes does one need to become a successful scientist? This is taught in an interactive way in which students assess their own attributes. (ii) Ethics in science: how should scientists behave? How do scientists behave? What constitutes scientific misconduct? (iii) Sexism in science: most students have little experience of sexism in science since it is rare at undergraduate or even postgraduate level, so my aim is to increase awareness of the issues: fore-warned is fore-armed. (iv) Communicating science: how is science communicated or miscommunicated by the media? Why it is important for scientists to excel as communicators? I have encouraged good communication in undergraduates, both in terms of their ability both to write clear, unambiguous prose, but also to give effective verbal presentations.

Teaching methodology

I use lecture slots to deliver unconventional interactive presentations, rather than conventional lectures. Students are encouraged NOT to take notes, but instead to listen and ask questions. I provide comprehensive written summaries of the presentations so students do have a record of the material discussed. While students find not taking notes disconcerting initially, they later comment that they find the experience liberating and greatly enhances their ability to understand: 'Tim made us put down our pens for a whole lecture whilst explaining sexual selection. By doing so, he really focussed us all on what was quite a tricky concept. It was great teaching.' [David Shuker, graduated 1994 now an academic at St Andrews University; comment solicited by ex-HOD Prof. M. Press in 2007]

For part of the assessment of this course, students are provided with a topic, which they research and interpret in a 15 min group presentation some 8 weeks later. They are encouraged to read widely around the topic to prepare their presentation and they then answer questions on that topic in the viva. I provide reading lists, but undergraduates have the freedom to read as much as they like. Assessment for the course is based on the group presentation, performance in a viva, and an open book examination (1.5 hours). The presentations are given at a one-day conference at a non-university conference location. The use of a novel non-university location (and a free lunch) for the conference has a very positive effect on the students' perception (and enjoyment) of the day. Listening to and commenting on each others' presentations is an important part of the course.

Here are three examples of topics:

1. Gowaty et al. (2012 Proc. Natl. Acad. Sci. 109: 11740-5) recently repeated Bateman's (1948) classic, pioneering experiment on sexual selection in fruit flies. In a similar way, ten Cate et al (2009 Anim. Behav. 77: 795-802) repeated some of Tinbergen's (1950) classic experiments on bill-pecking in young gulls. Discuss the value of replicating these experiments and assess the extent to which the Gowaty's and ten Cate's conclusions are useful.

2. In 'The Secret Anarchy of Science' Brooks (2012) almost encourages researchers to be dishonest. Is this ethical?

3. Using Smolin's 'The Trouble with Physics' (2006) as a starting point, discuss the extent to which the study of recent developments in physics can inform us about progress in biological science in general and behavioural ecology in particular.

Teaching rationale

Most undergraduate courses are focused on the accumulation of 'facts'. My course aims to help put factual information into a broader context. Judging from the students' responses, they appreciate this additional dimension because it contributes to their overall level of understanding and interest. Undergraduates also appreciate someone making the effort to do something other than a conventional lecture-based course.

Evidence of success

Objective, empirical evidence for the effectiveness of teaching, whether at school or at university, is notoriously elusive. In my own case I consider four categories of evidence supported by some examples of comments:

(i) RESPONSE OF CURRENT UNDERGRADUATES

I have consistently scored highly (close to 1 on a scale of 5) on all student feedback forms measured in response to 11 questions (about delivery, clarity, timing, enthusiasm etc.). My mean scores for the past 10 years for APS327 have been: 1.47, 1.58, 1.50, 1.47, 1.42, 1.60, 1.91, 1.62, 1.42, and 1.55, where <1.5 is considered outstanding, and 1.6 to 2.5 good etc.

Although these quantitative scores provide some indication of my performance, the written comments are much more revealing and more useful. Here are some examples (each from a different student) (full set available on request):

> An incredibly rewarding module
>
> This course really inspired me to understand and appreciate what science is
>
> A unique experience in my university career
>
> By far the most interesting and thought-provoking module I have done at university
>
> I finished this module feeling more like a scientist than I had in the previous three years at university
>
> I really like how this module pushed me to work in a new way, both in this module and also in other modules. I really like the approach and how active this module requires you to be. Definitely the most challenging module out of all the modules I have taken but so far this is the most rewarding!
>
> The form of it - talks and a lot of reading which we really should have done in the previous years. The history is important in understanding primary literature and we have been missing out on it!
>
> I really hope that the interactive learning idea spreads into other modules because it meant that you were much more alert in the lectures and actively engaged in the subject matter. We were allowed to input our own opinions and have discussions about things making each lecture much more interesting.

(II) RESPONSE OF STUDENTS AFTER THEY HAVE GRADUATED

Undergraduates may enjoy and appreciate a particular course at the time, but I feel that if my teaching has been effective, then what students have gained should have a lasting effect. My main goal is to instill skills that continue to be valuable throughout life. To assess my longer-term effectiveness, I obtained

comments from students that took one or more of my courses more than a decade ago.

David Gosney, Animal & Plant Biology, graduated 1979 (school teacher, wildlife film maker):

> Tim Birkhead was, without a doubt, the best teacher we had during our Animal and Plant Biology course. His lectures were always presented with great clarity making the learning so much easier but they also had moments of wit and humour that made them unusually entertaining. But Tim's greatest impact came in the work he did as a tutor, both formally in tutorials and informally in discussions. We shared a love of birds so I found it fascinating to share with him some of the issues of the time regarding how current research was leading to new understandings of bird behaviour. What was exciting was the way Tim involved us students in those issues, asking us questions, and persuading us to make our own observations in a way that led us to believe that we might be able to make a contribution ourselves. Even if our ideas were naïve he was brilliant at asking questions that encouraged us to think along the same lines but more rigorously.

Geoff Garnett, Zoology, graduated 1986 (Professor of microparasite epidemiology, Imperial College London)

> I believe that his [Tim's] lessons in population ecology provided the foundation for my interest in the population ecology of infectious disease. The training he provided in research methods has stood me in good stead for my academic career. I felt that he was genuinely interested in the development of all the students in my year group, so thank you.

Kevin J. Gaston, Zoology, graduated 1986 (Professor of Biodiversity & Conservation, University of Exeter)

> I was the first member of my family ever to go to university, and my choice of subject was determined more by thoughts of simple monetary gain than interest. Fortunately, I also took a Zoology option in my first year. Tim Birkhead's lectures spoke to the things that I was actually really passionate about, and inspired me to study those. I switched subjects very rapidly, and throughout the rest of my degree benefited from Tim's tremendous enthusiasm, skill, and dedication as a teacher. He helped lay the foundations for my subsequent career, and thus the legacy of Tim's teaching lasts to this day.

Rowan Hooper, Ecology, graduated 1992 (Science Journalist)

I first met Tim Birkhead on a visit to Sheffield as an A level student prospecting various universities. I remember Tim showing us a case of insects and pointing to one and asking if anyone knew what it was. I said it was the peppered moth, and Tim said 'yes, well done, it's *Biston betularia'*. And then he started talking about evolution. It was the first time, I suspect, that many of us had heard a real university lecturer speak. Here was someone with real passion, authority, and with a subject that was endlessly fascinating.

On arriving at Sheffield to read ecology, it was Tim's lectures that really caught the imagination. They took us around the world, and through time, across many orders of animals, all tied together by a burning enthusiasm for the explanatory power of evolution.

I also still remember the lecture where Tim told us about Tinbergen's 'how' and 'why' questions in biology - the intellectual richness that Tim communicated was enthralling.

Three years was not enough for me. I signed up for a PhD, fired up to learn more about this subject that Tim had first shown me. Later I began writing about evolutionary biology for a lay audience, trying to communicate that same sense of wonder that Tim had instilled in us as undergraduates.

Chris Cole Zoology, graduated 1995 (Executive Producer, BBC Natural History Unit)

Every so often places you used to be part of get in touch and ask you to say nice things about them. Normally they hit the recycling bin faster than a tax reminder....but Tim is a truly deserving case. There's no doubt in my mind that he was one of the most inspiring teachers I've had.

There were academics truly at the top of their game, when I was at Sheffield, and there were great teachers – but there weren't many who were both. And I think there was, I'm sure still is, something in the rich texture of Tim's passion for his subject that made him stand out and that helped draw others in.

There's no doubt there's a sharp, curious and enquiring intellect behind that slightly furrowed brow – but there's also a man who loves natural history in the broadest possible sense. I worry that that's becoming increasingly rare in the field of zoology, because I think that as well as helping infect others with enthusiasm for the subject, it also gives one a different perspective that I genuinely believes makes for a better scientist.

> I always felt that within Tim was still a small 8 year old boy with a pair of second hand binoculars round his neck looking at the natural world in wonder – and that's a truly wonderful thing to have. It's because Tim still hangs on to that authentic sense of wonder, and can share it, that he's stayed fresh and engaging as a teacher and at the top of his field as someone who observes, questions and seeks to better understand nature.

(III) RESPONSE OF COLLEAGUES

An effective teacher can also act as a role model for academic colleagues. Academia makes huge demands on people, with most of the rewards (i.e. promotion) coming from grant acquisition and research output. As a result many academics focus on these activities at the expense of teaching. By trying to ensure that I manage to acquire research funding, publish in high profile journals and take a pride in the quality and effectiveness of my teaching, I hope I demonstrate that it is possible to excel at more than one thing, and that teaching is something worth doing well. Indeed, I would argue that excelling at teaching helps one to excel at research and vice versa. Since my department has consistently scored highly in teaching quality assessments, I believe I have been reasonably effective. Some of my colleagues think so too:

Professor Catherine Lessells (Netherlands Institute of Ecology)

> I was a lecturer in the Department of Animal & Plant Sciences from 1984 to 1993. The Department at the time was a small 'old-school' Department with a total of 9 academic staff. Of these, Tim was the only one who stood out as a great teacher who believed that teaching should be done well, rather than merely done. Tim was the person from whom I learnt all aspects of how to teach. In this he was both patient and generous, and is in large measure responsible for the quality of my own teaching.

Professor Malcolm Press (Pro-vice chancellor, University of Birmingham)

> Tim is one of an ever-declining breed: the outstanding academic researcher and teacher. During my six year headship of the Department of Animal and Plant Sciences Tim's teaching was consistently rated at the top level by cohort after cohort of students. The content and style of delivery together combine to ensure that the underlying messages of his teaching remain with students throughout their careers and impact on the ways in which they see the world. Tim's ability to communicate and convey complex information is second to none and his delivery is always inspirational. His communication skills extend to his authorship of a number of science books, which also play a great role in conveying his passion and the importance of the systems that he studies to current and future generations of biologists. Tim's regular column in the *Times*

Higher Education also gave a sense of the challenges that modern university teachers faced and brought to the fore some of the tensions that exist between university teaching and research. Universities get most of their income from teaching and that's what people think we're here to do; however, promotion, reputation and career advancement are generally dominated by research performance. By excelling in both research and education, showing how research can inform teaching, and always advocating the importance of enhancing the student experience, I can think of no more worthy a recipient of this award.

Dr Andrew Beckerman (senior Lecturer, Animal **&** Plant Sciences)

Tim Birkhead has been a professional mentor, advocate and friend in my career at the University of Sheffield, Department of Animal and Plant Sciences. He is an outstanding guide to academic life, providing stimulating, honest and always valuable advice about teaching, research and negotiating the politics of departmental and university life. Importantly, he leads and guides by example, demonstrating an unwavering commitment to acquiring knowledge, packaging it in accessible forms and demanding from students and colleagues, in creative ways, attention to big picture ideas and details.

Looking back on the past few years, I can offer the following story as an example. The APS centenary celebration involved a presentation by current faculty and staff about ongoing research in the department. The target audience was not easy - a mix of former staff, former undergraduate students, spouses and children, the public, the press and administrators from the University. There was a need to impart enthusiasm, importance and impact and as well as big ideas to an audience of wide background knowledge and capacity for digesting science. In short, the day-to-day conversations we might have among ourselves, littered with specialist vocabulary and often without more than a scrap of paper and pencil for visual aid, needed to be drastically modified. Prof. Birkhead was in charge.

As one of the 15 or so staff presenting, Tim set the following challenge. Nobody would have any words on their Powerpoint presentation, and we were allowed only one piece of data. This in a 10 minute presentation. Instead, we were to use emotive, visually stunning, accessible pictures to convey a story - a story that we had to tell with our voices and ideas packaged to wow the audience.

For days on end, Tim offered his time and proverbial and real red pen to all of us. We toiled under pressure from him, knowing that on the day, 15 stories about our science would wow the public and past staff and students alike. It took time and effort, but the experience was invaluable. On the day, we all presented like the professionals we were trained to be by Prof. Birkhead. Moreover, to this day, I minimise text in my teaching and academic presentations, preferring

to tell stories using key visual aids to make several key points. Of course, there is always a place for text, but Prof. Birkhead's insistence on using a text free presentation in this instance made me realise that communicating science is a challenge that requires, simultaneously, creative lateral thinking about the audience and material. Invaluable.

Dr Duncan Cameron (Senior Research Fellow and University Royal Society Research Fellow, Animal & Plant Sciences)

Tim Birkhead is truly an inspirational teacher. I have interacted with Tim from both 'sides of the fence' over my career, firstly as an undergraduate student to here in Sheffield, and latterly as a member of academic staff. In both capacities, Tim has been a tremendous inspiration and support for my enthusiasm for biology and for my subsequent career as a professional scientist. During my undergraduate days, my interests was firmly in the plant sciences, however attending Tim's lectures certainly made me re-evaluate my interests, and while I have pursued a career in botany, Tim engendered a passion so all aspects of the biological sciences particularly capturing my interest in the behaviour of animals, and how animals interact with other organisms, particularly plants!

After I left Sheffield to pursue my Ph.D., Tim's mantra that we need to understand how the diversity of organisms interact with each other in communities and ecosystems was still ringing loudly in my ears, shaping my subsequent research, and when I returned to Sheffield as a post doc, I thoroughly enjoyed discussing my science and teaching with Tim over a cup of coffee. When I made the move into an academic position, through NERC and more recently, Royal Society fellowships, Tim was the first to offer his help in supporting my transition into this new role, reading my grants, but most importantly, helping me to become the best teacher that I could be. I was delighted when Tim asked me to join him in preparing the first practical that we deliver to our first year students, where we aim to enthuse our students with some of the most exciting biological case studies that we've all worked with. Tim was masterful in helping me manage my first major teaching exercise, not only in supporting me in terms of the choices I made for the case studies I wanted to use, but giving me practical feedback on my delivery and structure of my teaching. Since then, Tim has become the most valued mentor that any young academic could possibly ask for, always there to give you critical analysis of your teaching (or anything else for that matter) when you ask, but never one to shy away from praising the positives. Tim's inimitable style means it's exceptionally easy to ask for his advice, and having been taught by him, to take his criticisms, appreciating the skill with which he enthuses and excites undergraduate students for 'all things biology'. This couldn't be more evident when I have been involved in outreach activities with Tim, that both of us are

> passionate supporters of, culminating in his truly excellent Christmas lecture at the University of Sheffield. It has also been fantastic to watch him support the new generation of academics, indeed one of my postdocs has received the most fantastic support advice and mentoring from Tim undoubtedly influencing her decision to pursue an academic career her self. From my perspective, having been taught by Tim, and then mentored by him, I cannot possibly think of a more inspirational teacher, colleague, and friend.

(IV) MY INFLUENCE OUTSIDE SHEFFIELD

My paper with Bob Montgomerie on scientific misconduct, published in the newsletter of the International Society for Behavioural Ecology in 2005 was re-published by several other academic societies in their journals– presumably because it was felt to be useful – and elicited a large number of responses. These ranged from thanking us for bringing the issue of scientific misconduct in its various forms to their notice, to suggestions for how the academy might deal with misconduct. Some feedback:

> I wish scientific misconduct had been better covered as a topic in my degree courses
>
> A very brave endeavour
>
> I think that this is a really important topic that needs to be thoroughly addressed and honestly discussed within the scientific community and beyond
>
> You're doing a great thing and there should be more emphasis on doing good science even if it may seem to go against possible career benefits
>
> I like to applaud you both for investing the interest and the time in this topic. I firmly believe that there is much and urgent need to have a much more openly discuss this issue
>
> In my experience, some researchers are convinced about their own integrity while being guilty of misconduct of a kind they would criticize when done by peers.

For seven years I wrote a regular (every 4-6 weeks) column in *The Times Higher Education* (originally THES, now THE). My original remit was to write about research, but I quickly realized that my articles were more effective when I wrote about teaching and its relationship with research and other aspects of academic life. My objective was to emphasise the value of good teaching, and the necessity of maintaining academic standards while identifying the problems that academics faced in trying to juggle their complex lives, and suggesting approaches and solutions that would benefit both their undergraduates and

academics. Some examples of articles I have written in the THE and elsewhere are listed on the final page.

This is what Ann Mroz, Editor, Times Higher Education, (2008-2012) wrote:

> It was Tim Birkhead's reputation for research into bird behaviour and reproduction that led to his being given a column in Times Higher Education. But it was his support for teaching, flying in the face of a research-driven agenda, that set him apart from any other columnist.
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> A passionate advocate for improving undergraduate teaching, he did so with no romantic notions. "I am sympathetic to the idea of students having more contact time and better teaching: God knows, many of them need it," he wrote.
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> And the readership lapped up his words.
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> When as editor I wanted scholars to write about their "passion for teaching" Professor Birkhead was an obvious candidate. And he did not let me down. "Being an effective teacher is largely about being motivated and caring whether you do a good job or not," he wrote, and "effective teaching is about empathy".
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> While empathetic in his teaching, in his writing he was forthright, to the delight of the academic community. "Contrary to what students may think, coming to university is not like turning up at the barbers, paying for a haircut and sitting there passively while someone else does all the work. Rather, it is -- or should be -- more like turning up to an appointment with a personal trainer, where you are told how to get fit but have to do the work."
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> [Tim] was a beacon of common sense, [and] one reader wrote:. "I suggest that the decision-makers in higher education would do well to make the connection between Tim Birkhead's article on shaking up the "dreadful inertia" in teaching and the piece on academics breaking out of the academy because of that inertia and its effects. If Birkhead's suggestions about teaching graduates how to think were followed, we would have good academics fighting to get back in!"

REFLECTIONS

Many years ago a colleague told me how at an interview for an academic position at Harvard, he was asked what he would like to be remembered for. Taken aback, he made a flippant reply – and didn't get the job. I've often wondered what I would have said. With the benefit of having had some time to consider, my answer is this.

Although I love research, I'd really like to be remembered for making undergraduates think. For making them think about why they are at university; what it means to be a student and what it means to be a scientist. The discussion of two themes that I have found particularly effective are those of 'ignorance' (how we acquire knowledge) and 'scientific misconduct' (how scientists should behave). Together these provide an extremely accessible route into the day-to-day practice of science, for both the general public and undergraduates.

Being a successful researcher is not a nine-to-five job; one constantly thinks about how to resolve particular problems or to test hypotheses. I suspect that some people – academics and non-academics alike - imagine that being an effective teacher IS a nine-to-five job. It isn't. For me, how I improve or increase a student's interest in a topic and how I can help them recognise and develop the suite of traits needed to be a success is something that I think about much of the time. I take a lot of wildlife photographs and do so with a view to using them in teaching. Similarly, all the reading I do about science as a process is accompanied by imagining ways that I can better inspire, enthuse and educate undergraduates – for life.

And the future? For pupils in England, it looks as though A levels are about to change (again). Whether this change will better prepare pupils for university – as it is supposed to do - remains to be seen. Regardless, the transition from school to university remains a major challenge. Ten or more years of being 'taught for the test' certainly prepares pupils only poorly for university, although many universities try hard to make that transition as easy as possible – possibly too easy. I see my next challenge as devising a style of teaching at Level 1 (first year students) that increasingly allows students to see the liberating, and stimulating effect of a different style of education.

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