

The Conflicts Between Science Research and Teaching in Higher Education: An Academic's Perspective

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Academics are now expected to manage increasingly demanding research, administrative, and teaching obligations. These demands in practice mean that the pressures to balance teaching and research duties render cultivating links between the two activities a less-than-intuitive process. The author describes the difficulties faced by academics in the United Kingdom, students' learning experiences and perceptions of quality higher education, and the ways these issues relate to modern society's expectations of what University education should achieve. The author also considers how these issues are currently received and managed by Universities. To provide good quality higher education to the next generation, government and Universities should work together to address disparities and fill gaps in the research-teaching nexus. The evidence points to an urgent need to confront issues in a way that will benefit students, academics, Universities, and society. A non-exhaustive list of proposals described here aims to reverse the current trends that pull research and teaching apart. Such policies should be implemented, either on a national basis, or by individual Universities and should reflect the educational philosophy and cultural outlook of each institution. Ultimately a positive "nexus" may have potential benefits for both science research and teaching in the United Kingdom.

The term "research-teaching nexus" was first defined by Neumann (1994, p.323) and is termed to mean the relationships and links between discipline-specific research and student teaching and learning. This area encompasses a number of issues that involve benefits as well as conflicts between research and teaching. One issue is time management: balancing quality research and teaching duties by busy academics. Of noted importance are the various influences of staff research on the undergraduate teaching delivered. The term also incorporates the impact of government, institutional, and academic department policies on the form as well as the quality of the relationship between research and teaching. Nexus is also meant to include the importance of institutional or departmental curriculum design to student experiences and learning in higher education. Finally, this nexus includes the relationships between academics, Universities, and students: how these are shaped by and, in return, influence modern market forces and the ever-increasing pressures for measurable output and achievements. In this study, using an academic's perspective, I concentrate on describing the tensions that are felt by science academics in their quest to deliver quality in all aspects of their roles, and I suggest how in the current political and cultural academic climate, research and teaching links can be cultivated.

From the Points of View of All Concerned

Education experts have argued that the relationship between research and teaching should be a positive one. Ramsden (2001, p.4) has said: "I believe that the main

hope for realising a genuinely student-centred undergraduate education lies in re-engineering the teaching-research nexus." However, one size does not fit all, and there are evident disparities amongst different disciplines on how this can be achieved. Research work suggests that natural sciences harbor a more specialised research culture, which may be more difficult to translate and relate to teaching (Rowland, 1996), and therefore making the research-teaching relationship a positive experience for teachers and students may be a challenging endeavour by nature. The last 60 years have seen social, political and cultural changes that have impacted the way higher education is conducted today. These changes have had a fundamental impact on how science research and teaching relate and are conducted in UK Universities. Below, I describe the experiences for all who feel the impact of these changes and can benefit from a fruitful relationship between teaching and research.

Influences by Modern Society and Government Policies

A number of studies clearly point to the demands modern market forces have placed on Universities to train research-minded and research-contributing professionals (Wieman 2004; Garrick and Rhodes, 2000; Zetter, 2002). Indeed, modern society and the new global market-driven economy have much to benefit from Universities: from the production of a skilled workforce, to the discovery of new products and medicines to enhance quality of life, to raised expectations in health and patient care. A number of forces have contributed to the pressures currently felt in

academic life and have defined the path of science research and teaching through the later part of the 20th and into the 21st century. The emerging emphasis on world health issues has prompted widespread government-sponsored programmes and driven the expansion of a large international pharmaceutical industry, with the creation of new jobs demanding a wide range of scientific skills. These forces together with the post-war social and economic prosperity have contributed to a vast expansion of scientific research and demand for better healthcare and treatments for many ailments (Scott, 1998). The demand for skilled professionals has also increased the number of students seeking to gain science-related University qualifications.

Responding to the changing economic market forces, consecutive UK governments have outlined policies to expand the student population in all disciplines. This has enhanced social integration and promoted diversity in the student population, changing the culture in student life and experiences in University education, promoting a more market-driven educational system (Johnston, 2004). As this expansion is continuously taking place, great pressures are placed upon Universities to excel in both research and teaching to attract the best talent and to produce graduates with market-relevant knowledge and skills. These pressures are then transferred to academic staff that must produce value for money in both research and teaching for their organisation.

A formalised process of assessing the quality of research conducted in the UK was implemented in 1986, in the form of the Research Assessment Exercise (RAE) ratings system. This was conducted to develop an objective measure to assist the distribution of research funding allocated to Universities by the UK higher education funding bodies. A total of 6 RAE exercises have been conducted so far, jointly by the national funding councils of England (HEFCE), Scotland (SFC), Wales (HEFCW) and the Department for Employment and Learning, Northern Ireland (DEL), with the latest RAE assessment in 2008. RAE ratings represent the recognition that research excellence is pivotal to the financial success of this country and form part of a major initiative by the UK government to invest in science research and promote innovation. The introduction of the Research Assessment Exercise (RAE) ratings (<http://www.rae.ac.uk>) have also rendered science research excellence an important deliverable and a measure of success for Universities in the United Kingdom but they have also intensified the pressure for Universities to enhance research output. This has also increased the drive to engage in translational research: scientific research that can have direct benefits for society or that can be made into a product that improves health or patient care, although

many researchers and clinicians feel that RAE has had deleterious effects on the quality of research conducted (Williams, 1998; Banatvala *et al.*, 2005). Collectively, these policies sparked major changes in the philosophy and culture of University life and have opened fresh debate on what Universities are expected to offer to society (Barnett, 2003). However, one concept everyone agrees on is that these government policies that directly encourage and promote scientific research may inevitably drive research and teaching apart and make the links between the two more difficult to shape.

Changes in Higher Education Culture and Policies

Universities have quickly responded to these forces by adopting a business-like ethic and expanding to meet demands placed by society and government policies (Morley, 2003). As a result, the University environment is one of constant change and one that struggles to balance traditional values of what academic institutions should stand for with new demands for target-driven performance assessments and the merits and perils of financial independence (Lomas, 2006). There have been considerations and calls at policy level to separate research and teaching activities in order to achieve high status in RAE and to enhance revenues. The rise of a number of science research centres, where staff are completely free of teaching obligations and able to concentrate on research, is a reaction to these policies. However, is isolating career researchers from University teaching environments beneficial to science research output, but is it also another way in which research and teaching are now driven further apart (McNay, 1999)? Even for departments committed to teaching, the ways teaching activities are managed do not naturally foster links and references to academic staff research. To achieve career progression, science academics are assessed mainly on the quality of research they conduct relating to RAE and on the revenue they bring in for the division/organisation. Teaching duties are therefore largely regarded by many academics as a “necessary evil,” a drain in terms of time, resources, and effort, without major returns in terms of benefits for the academic. Without a doubt, academics and students are the primary recipients of the consequences of these policies.

From the Academics' Point of View: Demands on Time and Commitments

When questioned directly, most academics agree that student learning should be enhanced through scientific research and in research-rich environments, and they identify acquisition of research skills as an important aspect to student learning experiences (Zamorski, 2000; 2002). However, some studies

demonstrate that under the present changes in University policies, teaching and research are independent of each other, and a need to create circumstances where research and teaching may meet is necessary and beneficial for student learning (Hattie and Marsh, 1996; Marsh and Hattie, 2002). Others argue that those academics who view teaching as an integral part of the wider debate in their discipline and as a natural extension of their scholarship tend to make stronger connections between research and teaching in the way they instruct students to understand and experience research (Prosser et al, 2004, 2005). But how would this be a conceivable possibility, given the increasing demands on academics' time and effort?

As mentioned above, academics' career prospects are now largely dependent on the quality of their research activities as a source of funding/income for Universities. With the introduction of the RAE ratings system, it has become the main task of academic staff to conduct research that leads to strong publication output in reputable journals, leading to generation of external funding in the form of grants as well as intellectual property as an additional source of revenue. The RAE has also introduced a more business-like approach to conducting research in academic environments and has burdened academics with management, organisational and administrative responsibilities, but has also introduced a stronger political culture within the scientific community. These pressures leave little time for the University lecturer to devote to planning and implementing links between research activities in order to enhance students' deep knowledge and produce highly trained, research-led graduates. Anecdotal evidence to the pressures felt by UK academics was communicated to me at a recent discussion with three King's College London academics. For some time now, United States-based scientific journals have difficulties convincing UK-based academics to review research manuscripts submitted for publication, a sign of how overwhelmed academics are by their commitments and the pressures to achieve for the next RAE rating round. Thus, under the intense scrutiny of government-driven University and departmental targets, academics are abandoning any activities they consider less vital for their career progression. Amongst my colleagues in science and medicine academics, all consider teaching as an important aspect of their academic role and experience, but inevitably they feel forced to allocate teaching a second priority to their research as they struggle to meet increasing demands.

Research and Teaching Links: Students' Perceptions and Academic Culture

Students consider excellence in research an important factor in their decision to choose a University for undergraduate studies. Many perceive that studying in research-rich environments adds value to teaching and greatly benefits the quality of their learning (Neumann, 1994; Zamorski, 2002; Jenkins 2004; Hunter et al., 2007). However, despite student perceptions, a concrete link between research quality and student learning experience has not been established to date (Seymour et al., 2004; Trigwell, in press, quoted in Jenkins and Healey, 2007). Students see themselves as recipients of research-acquired knowledge rather than participants in University research (Zamorski, 2002; Brew, 2006). One therefore wonders how the student experiences of learning can benefit from academic research and how students can become active participants rather than recipients. This link is particularly poor in undergraduate education.

Another parameter is the introduction of University fees, arguably turning students into consumers or customers with the power to drive policy and change, which in turn may contribute to a more plastid curriculum to meet demands and needs of the changing future workforce (Sharrock, 2000; Johnston, 2004). Tuition fees also bring demands on students' time. Many now need to continue working while studying to ease the financial impact on their families and this has inevitable repercussions on the way they choose to learn and engage with their courses: students inevitably make strategic selection of what they need to learn to attain their degrees. Under these conditions, deep learning and research-based knowledge acquisition becomes a commodity. However, now more than ever, and certainly in scientific disciplines, our University students are expected to acquire research-led knowledge and develop the ability to analyse and conduct research as an integral part of their academic and professional development (Garrick and Rhodes, 2000; Scott, 2002; Zetter 2002).

Therefore, the challenge in science education is to strive to develop research-based teaching as Wieman describes (2004, pp. 8-9): "A meaningful science education involved transforming the way in which students think by promoting a progression from 'novice' to 'expert' in both their attitudes and their approaches to the discipline and problem solving in that discipline. Today's educator should aim not simply to produce more scientists, but rather to get all students to learn to think about science like a scientist. Similarly,

the goal of education in general is to get students to think like experts more broadly.” In today’s knowledge-driven society, these can only be truly accomplished if teachers can introduce research-led, research-oriented, research-based, and research-tutored teaching in undergraduate science curricula (Scott, 2002; Griffiths, 2004; Healey, 2005). But could this be realistically accomplished by overworked academics facing their own pressures on time, knowledge acquisition, achievements, and expectations?

Drawing Links Between Academic Research and Teaching: A Personal Perspective

My experience in University education has highlighted the great tensions and disparities in the messages of policymakers and institutions to academic staff. In response to the implementation of the RAE rating system, academic divisions regard research output as their main aim. Coate et al. (2001) report that departmental managers considered research and teaching to be synergistic in theory, but found it easier to manage these as separate activities. This separation and also the inability to foster links between teaching and research are true in my experience and has been acknowledged and debated (Elton, 2001; Henkel, 2004). Furthermore, it has been shown that staff engaged in teaching are undervalued and in some cases marginalized, compared with those concentrating on research (Lucas, 2006). In my experience, I have also found this to be the case. Despite the emphasis on research output, and in contrast to the general perceptions of teaching being inferior to research as a scholarly activity, lecturers with heavy research loads, demanding management responsibilities, and punishing schedules writing grant and research papers are obliged to undertake teaching duties as part of their roles. Asked directly, most science and medicine academics consider teaching to be a rewarding experience they wish to conduct effectively. Science and medicine teaching can be conducted in many forms, including negotiated teaching formats and in the form of apprenticeships, and is pivotal to University science education and at the heart of science and medicine academics.

Unlike many of my fellow academics, my main duties are in academic research, and thus my contribution to teaching in University is not compulsory. To this effect, I have been in the privileged position to a) select subjects that I have a keen interest in, b) choose topics of biology and immunology where I have conducted research, and c) define areas to incorporate in my teaching which I wish to explore in my own research. Therefore, I find that my research interests, experiences, and knowledge largely inform the content and style of my teaching practice. As a

researcher, I implement a variety of tools to promote enquiry-based student learning, and I believe that this is an important aspect of bridging scientific research with teaching.

Despite the obvious challenges I face as a researcher, lab supervisor, and working mother, to allocate time to the limited teaching duties I have agreed to undertake, I appreciate that I, more than my colleagues, am able to dedicate reasonable time and thought to preparing my teaching duties. I am also more likely to agree to conduct teaching-related activities in and out of the laboratory environment, including meeting students for questions and help and conducting small group tutorials prior to exams and assignments. Thus, I have the flexibility and opportunity to draw links between what I do in the lab and what I teach my students both in and out of the classroom.

I also reflect on another observation drawn from my personal experience of fostering research and teaching links to enhance student learning. This stems from teaching undergraduate students in a negotiated teaching format, so they can develop research skills and research-led thinking, by undertaking lab research projects based on my own and my close colleagues’ scientific research work. This experience has been much more challenging than I had originally anticipated. I think major factors here are a) the complexity of scientific disciplines, b) the requirement for specialised training in experimental skills and equipment handling, but also c) the cognitive processes required to develop experimental and research-led thinking. These issues point to the concrete need for the design of appropriate and rather simple projects with clear achievable aims that inevitably have little benefit for the teacher. Also, due consideration should be given to the impact lengthy training has on time management for the lab supervisor/teacher, making this aspect of student learning a time-consuming endeavour for the research-led teacher.

Despite my belief that research and teaching can be entwined and my resolve to promote the research-teaching nexus in my own practice, working in academic environments strongly highlights the tensions arising from the co-existence of teaching and research. I thus believe that to achieve a positive teaching-research nexus in higher education, such links should be promoted in a form that benefits all stakeholders, including academic staff.

What Can Be Done to Make Things Easier?

Despite academics’ best intentions, many feel that few opportunities to link their research and their teaching exist, and indeed there is an ongoing debate whether these activities have become uncorrelated in modern academic life (Marsh and Hattie, 2002).

However, since science research-based learning forms an integral part of student learning, the notion of separating research and teaching in scientific disciplines contradicts our aim to train the next generation of highly skilled scientists. Indeed, most science researchers are incredibly committed to improve teaching and would welcome opportunities to better integrate the two disciplines. Thus, the foundations as well as the enthusiasm and willingness are in place to make the research-teaching nexus a reality. Here, I suggest some key changes in departmental, institutional, and/or government policies (Jenkins & Zetter, 2003), which can potentially increase the opportunities where academics can implement these links. The outcomes may be beneficial for both teacher and student experiences and will go a long way to redefine the roles Universities play in society in educating the new generation of science professionals.

Suggestion 1: Aligning Staff Research Interests with Teaching Activities

The least painful policy change would be implementation of changes in teaching management at departmental, divisional, or institutional level, depending on the size of the organisation. Changes would comprise allocation of teaching duty according to staff area of research interest and would require simple good management skills. Minimal investment in resources would be necessary to achieve this. Prior to organisation of the curriculum, consultation with academic staff would assist managers or course organisers to allocate teaching duties according to individual research and teaching interests. As an example, I use here my interest in Cancer Immunity and Immunotherapy, a rapidly expanding area of science research in which I have been involved for a number of years. I would welcome to teach a topic in this field at any level. This would have benefits for my students' learning experiences as well as for my own professional development as a researcher: a) it would serve as a further incentive to constantly update my knowledge on current developments; b) my teaching would be informed directly from my laboratory research; c) drawing from my own research experiences, I can implement research-led, research-oriented and research-tutored learning; and d) the experience would help direct my research strategies (Elliot, 1991). Despite my enquiries, at present I am not aware of a manager or organiser to whom I would address enquiries. I believe students would benefit from academics' specialist research knowledge, experience, interest, and passion for their chosen area of research, and that this could be facilitated by a more formalised recognition of the "research-teaching nexus" within the curriculum.

Suggestion 2: Teaching Assessment Exercise Ratings

The second policy change I suggest is implementation and enforcement of Teaching Assessment Exercise ratings at national and institutional levels. This should be used as an incentive and a tool to motivate academics to excel in their teaching, but also importantly, to reward and celebrate quality of teaching as a vital contribution to academic experience and life and one that benefits students, academics, Universities, and society. Academics would be more willing and certainly motivated to link their research interests and activities to their teaching, knowing that this effort would be rewarded and would benefit their academic career progression. Despite the obvious benefits in driving teaching excellence and in placing teaching together with research at the centre stage of University education, potential disadvantages could be envisaged. There exists the danger that a teaching ratings system, by rendering teaching a target-driven endeavour, may serve to render University teaching more prescriptive, discouraging academics from implementing new teaching strategies and tools, and thus become less reflective in their teaching methods and style.

A desire to reward outstanding teaching exists and has led to the implementation of a number of incentives for individual academics and Universities that are aimed to reward teaching excellence. Policy makers in Australia have recognised the importance of strengthening the research-teaching nexus as an imperative for the future of University education. This has resulted in a long-standing tradition of rewarding excellence and innovation in University teaching through initiatives such as the Learning and Teaching Performance Fund and the Australian Awards for University Teaching (AAUT) (Carrick Institute, 2005; Nelson, 2002, 2003). These awards bring not only prestige, but also direct and indirect funding for the recipient academic staff and affiliated University, although there is an on-going debate whether these policies have served to enhance research teaching links in Australian Universities (Halse et al, 2007). In the United Kingdom, on a national scale, the Higher Education Academy's National Teaching Fellowship Scheme, is a programme designed to enhance awareness of the importance of teaching quality both at academic and national levels, please see: (<http://www.heacademy.ac.uk/ourwork/professional/ntfs>). Individual Universities have also launched similar schemes. King's College London has set up the Awards for Excellence in Teaching, funded by the Higher Education Funding Council for England (HEFCE), which calls on undergraduate and postgraduate students to nominate a member of teaching staff for an annual

award; please see: (<http://www.kcl.ac.uk/about/structure/admin/acareg/qaaa/teaching.html>). One of the criteria for nomination is that the candidate academic is active in research, as research-led teaching is named as one of the strategic goals of King's College London, and therefore the College looks for opportunities to encourage and reward a positive nexus between teaching and research. In the 2006/07 Academic Year, there were 15 award recipients at King's College London. Such policies, together with a nationally implemented Teaching Assessment Exercise ratings system for academic departments and Universities, may gradually bridge the present divide between research-based academics and teaching academics. Finally, these strategies may help to reinstate the importance of teaching as a fundamental activity integral to higher education.

Suggestion 3: Flexible Allocation of Research and Teaching Responsibilities

The separation of teaching only and research only staff is generally regarded as another policy that pulls apart research and teaching activities. A more flexible approach to the allocation of teaching and research responsibilities would entail agreement of percentages of time that each academic spends on each activity for an arranged time interval. This system is already in effect in some European Universities (e.g., Belgium, the Netherlands, Scandinavia). Practically speaking, from implementing this policy, two key features have emerged. One is the emphasis on individuality of academic job descriptions resulting in a unique evaluation system that measures academic excellence as a function of a combination of achievements in research, teaching, public dissemination of knowledge and innovations, as well as links with industry and professional practice. The other is the potential to highlight the interests and aptitudes of individual staff and academic groups (de Weert, 2004). The Dutch educational system has pioneered this approach, and the practical application of this instructs that such processes require fostering but also adaptation to suit different academic disciplines (de Weert, 2001). From the European University experience to date, it seems clear that in order to promote the research-teaching nexus, individual academic staff competencies and performance in each area should also be reflected in the appraisal and career advancement process, which should award equal importance to achievements in teaching and research within an organisation.

Suggestion 4: Freedom to Shape Academic Curricula

Another suggestion addresses the core difficulties faced by academics in bringing their research interests

into their teaching. Researchers who are familiar with the most up-to-date developments in their discipline should be allowed to suggest and shape University curricula: a process should be implemented by which all staff have an input on what are the best topics to include in undergraduate and postgraduate subjects. This is already happening to an extent at a departmental level, but to be truly effective, it should be University policy to identify the links between research and the teaching activities provided to students. Such a centralised policy should truly reflect the quality and diversity of research within an organisation and translate it to student teaching and learning. This would be another way students stand to benefit from a research-rich academic environment.

Suggestion 5: Allocation of Teaching Duties to Junior Research Staff

This suggestion comes from a tested model used in US Universities for a number of years. This involves junior members of staff, such as PhD students and postdoctoral researchers, taking over some teaching duties as part of their work contracts. Such a policy would have a number of benefits. Sharing teaching responsibilities with junior staff would free lecturers' time from the more basic subjects and provide valuable knowledge and teaching experience for aspiring young academics. It would also provide an opportunity for the young teachers to interact with students and use this interaction to link their teaching to their research experiences, use their teaching experiences to inform their own research and help appreciate the research-teaching nexus early in their careers. As Elsen et al. (2007) propose, the policies should aim to deliver "research intensive education" and this aspiration is highly relevant in scientific disciplines. Furthermore, this policy can also encourage and nurture a nexus-favourable culture in higher education. Universities in the United States already benefit from fostering a favourable science research and teaching environment, where academics consider linking teaching and research as part of their wider role and contribution to University life and society.

Suggestion 6: Influence of National Benchmarking Guidelines on Undergraduate Curricula and Research-based Teaching

Universities follow national guidelines for setting undergraduate and graduate benchmarks and programme specifications. These guidelines help shape academic curricula in the UK. The Quality Assurance Agency for Higher Education, established in 1997, is an independent body subsidized by UK higher education funding organisations, Universities, and colleges that

works to define and safeguard academic standards (<http://www.qaa.ac.uk>). The role of QAA involves exercising constant quality assurance, but also promoting continuous improvements in the management and quality of higher education. The benchmarking guidelines set by the QAA are followed by UK Universities. Is it then reasonable to envisage that these have the potential to shape and influence the nexus between research and teaching?

According to the QAA guidelines, Biomolecular Science and Bioscience degree graduates should have attained a range of skills by graduation. These include intellectual, research and biomedical laboratory practice skills, together with other “soft” skills including communication, information technology, numeracy and data analysis, and interpersonal and teamwork attributes. The graduates should also be aware of moral and ethical issues raised within their discipline, consider views that differ to their own, and be capable of critically assessing and engaging in intellectual argument. The graduates should also be familiar with health and safety policies, good laboratory practice, risk and COSHH assessments, and the importance of quality control and quality assurance (<http://www.qaa.ac.uk/academicinfrastructure/benchmark/honours/biosciences.asp>). All these skills can be best learned and cultivated in a research-led teaching environment.

The QAA guidelines normally translate into a range of Programme Specifications set by individual Universities, and as such they can influence and shape undergraduate science curricula. My experience of undergraduate curricula in the UK suggests not only a strong link with the QAA benchmarking, but also a strong indication that, nationally and regionally, we aim to produce research-thinking professionals out of undergraduate science education. University science programme specifications incorporate training undergraduates to attain a range of skills and knowledge that will then help them progress in different employment environments, including postgraduate research study, laboratory-based and office-based employment in biotechnology and pharmaceutical industries, scientific writing, and entry to dentistry and medicine. As science subjects are strongly research-driven, attainment of research-led thinking is crucial for the whole range of professional development avenues. Therefore, linking research and teaching will benefit all students regardless of their career aspirations.

It is indisputable that research-based teaching is crucial in post-graduate science education. But from the QAA guidelines and undergraduate Programme Specifications, it is now becoming clear that, because of the nature and level of our graduate skill base required, research-led thinking should now be integral to the undergraduate learning experience. This applies

whether a graduate decides to pursue a career in research or in a science-related discipline or environment. Superior graduate skills in science can be best cultivated in research-led, research-rich learning environments; it therefore follows that undergraduate curricula should reflect national guidelines to consider the “nexus” an important tool in the training of the ultimate deliverable: producing the next generation of research-thinking professionals at all levels. I therefore submit that national benchmarking guidelines should be a medium used nationally to directly promote and encourage research-led teaching and thus may have a direct and positive influence on the “nexus” and consequently on the quality of science professionals. Should national benchmarking guidelines further emphasize the importance of research-led teaching? It certainly has the potential to enhance science education and redirect thinking in academic research and teaching culture.

Conclusions

To “think like a scientist” forms such an integral part of science student learning, it is almost inconceivable that science research and teaching may not be entwined in University education. To succeed in their promise to provide good quality higher education to the next generation, government, and Universities should work together to address disparities and fill gaps in research-teaching nexus. The evidence points to an urgent need to confront issues in a way that will benefit students, academics, Universities, and society. Policymakers in the United Kingdom may learn from the experiences of European, Australian, and North American Universities and locally implemented policies and initiatives designed to promote science research and teaching links. Drawing from the results of these, it seems that linking our science research and teaching may be a crucial aspect of our contribution to society as academics and scientists; however, the relationship between the two is clearly vastly complex and there is no simple solution. One could therefore suggest that rather than rely on an individual strategy to encourage this complex relationship between teaching and research in science education, the key to enhancing the research and teaching nexus may lie in the simultaneous implementation of complementary policies that may have synergistic effects.

In this paper, I have put forward a non-exhaustive list of proposals to reverse the current trends that pull research and teaching apart in the United Kingdom. I believe that policies and guidelines should be applied, possibly on a national basis, or by individual Universities in accordance with institutional missions and culture. Such policies and set guidelines should reflect the educational philosophy and cultural outlook

of each institution. One way of evaluating some of these strategies would be to implement a number of pilot projects that evaluate the potential success of each suggestion over a defined period of time. The outcomes of such an exploratory journey would provide worthy insights and instruct on efficacy and suitability for implementation on a larger, possibly national, scale. In many disciplines, but certainly in science, a positive “nexus” between teaching and research may not be intuitive in today’s market-driven climate, but it could be cultivated and can have enormous benefits for us all.

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