What are the scientific activities involved in impact? Investigating case studies of scientific practice to inform policy (0214)

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Introduction

Science and technology is a centerpiece of the UK's economic strategy (Sainsbury, 2007) and, in turn, its higher education strategy (Department for Business Innovation and Skills, 2009). As such, science is expected to serve a host of social and economic ends, in addition to the traditional academic job of producing valid findings published in leading journals (Smith, 2001). However, translating scientific findings into social impact is a complex matter (Bozeman, undated); while examples of the impact of scientific research are easy to come by, the path to those impacts is not easy, quick or always predictable from the outset.

This paper identifies the scientific activities that need to be supported, encouraged and afforded by funding, promotion and professional development practices to enable high impact science. Various policy mechanisms, including the Roberts skills training agenda and the research councils' doctoral training centres (EPSRC, 2007) have been created to provide for the practical skills and experience that doctoral students need for increasingly demanding careers. Simultaneously, research funding councils are proposing that grant applications describe how their research is likely to lead to social and economic impacts. The new Research Excellence Framework was originally expected to employ an impact measure that would account for up to 25% of a department's total score. As "impact" measure is proving elusive and problematic, the government is delaying the research excellence framework by a year. (Times Higher Education, 8 July 2010, p. 6).

However, to be most effective, both the professional development agenda and the policy agenda must consider how scientists actually work and the factors that support creativity and innovation at the coal face. In the higher education research community in the UK, research is being carried out under the banner of "academic practice" (http://www.learning.ox.ac.uk/files/AP%20document.pdf), although research in this field has not, to date, focused specifically on scientific practices. Separately, a newly emergent group of interdisciplinary US researchers are engaged in the "Science of Team Science". (http://scienceofteamscience.northwestern.edu/), as a subset of the newly emergent science of science and innovation policy, which aims to "provide a scientifically rigorous and quantitative basis for science policy" http://www.scienceofsciencepolicy.net/Default.aspx. This paper bridges this gap, connecting academic policy and practice in UK higher education and the study of "new" science in the US.

It is well established that the sciences and social sciences are becoming increasingly collaborative (Leahey & Reikowsky, 2008; Goden & Gingras, 2000). The needs and challenges of interdisciplinarity (Rhoten & Parker, 2004; Klein, 1996; Kessell, 2003; Stokols et al 2003) are also also well-documented, as well as the importance of university-industry partnerships (Ailes et al 1997) and the involvement of the public in biomedical research (Board on Health Sciences Policy & Institute of Medicine, 2003).. What else, though, characterizes the "new" science?

Here I examine case examples of biomedical research, originally collected for an evaluation of a large scale research initiative (pseudonym: CBR program) funded by one of the US National

Institutes of Health (NIH). The case examples highlight key aspects of academic practice in modern biomedical sciences -- what the academics *do* that is likely to create scientific impact.

Methods

The CBR program funded 10 regional research centers. Each center involved researchers from multiple institutions and establishment of laboratory and other core research facilities. The grant program created mechanisms that provided greater flexibility in funding projects than typical NIH grants, which prompted the collection of the case studies investigated here. Each center submitted several short case studies (up to 200 words each; N=49) which described specific situations and research innovations that would have been difficult under traditional grant mechanisms. For this study, I analyzed these case examples, using grounded theory, asking "What do (biomedical) scientists *do* to produce innovative, high-impact science?"

Results

Seven key themes emerged from the case studies, which the academics submitting them argued were vital in enabling innovative, high impact science. These themes are listed here as actions. Thus scientists:

1. Collaborate across institutions and disciplines.

2. Coordinate with external stakeholders/partners. To facilitate transfer and translation of research findings, scientists communicate with people have needs or are positioned to use scientific findings.

3. Engage in training and professional development. Hands on training is valuable, as is the opportunity to network with others with complementary interests.

4. Access core facilities. Typically core facilities have steep users' fees. By removing those fees for worthy projects, new researchers can enter the field and science is stimulated through increased access.

5. Leverage funds and manage resources creatively, including combining projects and dividing projects up strategically to make them attractive to various funders.

6. Develop preliminary data using nontraditional methods. New scientific breakthroughs demand exploratory studies before being able to develop hypotheses to test.

7. Act quickly to take advantage of emerging opportunities and respond rapidly to emerging priorities. Scientific priorities may emerge as new discoveries suggest promising paths of inquiry and other projects prove unproductive. New priorities might emerge from immediate public needs, such as public health threats.

In the conference presentation, we will look at selected case examples that illustrate and flesh out these themes.

Discussion

While this research reiterates the importance of collaboration, interdisciplinarity and training identified by others, findings 4-7 above also direct attention to other vital activities involved in high impact science.

Understanding the nature of today's complex scientific practice can inform the development of supportive policies and conditions for high impact science. Such science requires alignment of a number of overlapping systems, including professional development policies, university employment-related policies and funding agency policies. These findings suggest a wide range of skills that might be addressed in doctoral education or ongoing professional development of researchers. Alternatively, new kinds of scientific jobs may emerge to support this type of science, such as advisors on product development. We might consider how promotion and tenure policies can foster and incentivize collaborative work. Finally, this research suggests possibilities for how funding might be distributed. Focusing funding on core facilities to facilitate access or making funds available for early, exploratory work are two examples suggested by these case examples.

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