IOP Institute of Physics

Team Science

Institute of Physics response to a discussion paper from the Academy of Medical Sciences

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25 January 2013

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Dr Rachel Quinn
Director of Medical Science Policy
The Academy of Medical Sciences
41 Portland Place
London W1B 1QH

IOP Institute of Physics

Dear Rachel,

Team Science: a discussion paper

The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 45,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

The Institute welcomes the opportunity to respond to the Academy of Medical Sciences' discussion paper.

We agree with many of the points raised in the discussion paper, but are of the view that the examples of interdisciplinary or transdisciplinary presented are very much focused around the medical sciences disciplines and it is not obvious what the intention is to involve, for instance, the physical sciences. In addition, we are not convinced by the statement that 'transdisciplinary teams are uncommon in academia' and offer some insights on this in subsequent paragraphs; it is probably the case that the interdisciplinary research is the more common term for such research in the UK.

The issues raised in the discussion paper certainly should apply to disciplines outside of the biomedical sciences as cutting-edge research nearly always ends up as an interdisciplinary effort since new theories and technologies often have applications and consequences far beyond the boundaries of individual disciplines. The following quote by the Nobel Laureate, Harold Varmus, former director of the National Institutes of Health, in an article discussing the interdependence of the physical and medical sciences sums this up perfectly:

"*Medical advances may seem like wizardry. But pull back the curtain, and sitting at the lever is a high-energy physicist, a combinational chemist or an engineer. Magnetic resonance imaging is an excellent example. Perhaps the last century's greatest advance in diagnosis, MRI is the product of atomic, nuclear and high-energy physics, quantum chemistry, computer science, cryogenics, solid state physics and applied medicine*."

Physicists have always been willing to collaborate with colleagues in other disciplines, and it is clear that physics, in the future, will continue to make vital contributions to the major problems of our age, such as improving the quality of life of ageing populations.

Many of the current demands on scientists and engineers are highly interdisciplinary. Problems ranging from climate change to drug delivery require increasingly flexible approaches. Physicists have much to contribute to multidisciplinary teams addressing such problems. For example, the fields of medical physics and biophysics have strengthened greatly in recent decades, with new physics-based technologies applied to medical diagnosis, therapy and problems in fundamental biology.

For some areas of physics, involving more fundamental research, such as particle physics, collaborations with other disciplines, while strong, tend to be either using state of the art engineering and computing to build apparatus to undertake experiments, or spin-outs of the instrumentation. One of the areas to benefit most from the different technologies developed for particle physics has been medicine. For example, in this field, linear accelerators are used to administer radiation therapy in hospitals, while positron emission tomography (PET) offers a powerful diagnostic tool.

Indeed, there are very few important challenges facing us that neatly fit into a single discipline; conversely an interdisciplinary environment can be enormously enriching for the fundamental roots of a subject like physics. For instance, a paper published in Science[1] involved three industrial authors and four academics addressing the molecular design of new materials' processing; physics was the 'glue' discipline but chemistry, chemical engineering and mathematics were all essential in a highly interdisciplinary programme of research activity.

In order to encourage more interdisciplinary research and for teams from different environments to work well together there is a need to have mutual understanding and a clear set of common goals/timescales. Any mechanism to support such teams needs to recognise this (which may help remove difficulties in universities/industry working together successfully).

Language is also a real potential barrier, and discipline-hopping programmes and grants can be of real benefit in encouraging teams to develop. Jointly funded studentships can be of benefit in developing a team, but the mechanisms for finding such funding on a one-off basis are now few and far between.

In addition, there is also a need to appreciate the impact that successive RAE/REF exercises have had on interdisciplinarity, as they tend to reinforce disciplinary boundaries. Research that is excellent overall may be seen as weak in one of the disciplines and the way that the RAE/REF is split into discrete disciplines encourages academics and universities to act conservatively and to focus on research activity pertaining to the core areas of a particular discipline in order to guarantee a higher ranking and safeguard precious QR funding. This effect that has led to, for instance, university physics departments preferring to engage in pure physics research over areas that lend themselves to application; such areas are consequently more useful for interdisciplinary activity.

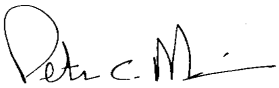
[1] Linking Models of Polymerization and Dynamics to Predict Branched Polymer Structure and Flow. Daniel J. Read, *et al*. *Science* **333**, 1871-1874 (2011).

Another major barrier to interdisciplinary activity is funding. It is rare for an interdisciplinary collaboration to be excellent in all the disciplines involved. As already hinted, the underpinning nature of physics often means that its application in other areas involves building upon advances made, i.e. it is developmental rather than leading-edge. Currently, while recognising the problem, the research councils do not have a satisfactory means of resolving it and, all too often, in a very competitive environment, peer review tends to downgrade interdisciplinary work in comparison with physics work at the leading edge. Interdisciplinarity is hindered when applications pass through two or more separate funding council review systems, and are therefore subject to ‘double jeopardy’. The way out of this longstanding problem would appear to be a change in the peer review system and, in particular, a need to fund good science, interdisciplinary or not, without an artificial split between disciplines being introduced at the review stage.

Finally, despite the obvious merits in encouraging interdisciplinary research, one must not overlook the intrinsic value of individual disciplines – scientists cannot be expected to be experts in all fields and, while there will always be bridging scientists, the vast majority, quite rightly, will be educated and trained within a discipline.

If you need any further information on the points raised, please do not hesitate to contact me.

Yours sincerely,



Professor Peter Main
Director, Education and Science

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