Institution: University of Leeds

Unit of Assessment: 25

Title of case study: Case Study 4: Contributing to evidence-informed curriculum policy in secondary school science

1. **Summary of the impact** (indicative maximum 100 words)

Over more than two decades research conducted at Leeds has had two interrelated impacts: i) supporting the decision-making process of those responsible for reforming the school science curriculum by providing timely and robust research evidence, for example within the recent DfE National Curriculum Review in England; ii) inspiring follow-on research and development activities funded by professional organisations, whose aim is to inform and influence science education policy and practice.

2. Underpinning research (indicative maximum 500 words)

The University of Leeds has made a distinctive contribution to identifying and evaluating a long-term trend towards a school science curriculum that attempts to address the needs of all school students, not just those likely to continue into post-compulsory science courses.

A research programme has been sustained through a series of research projects since the 1990s, based entirely from the School of Education at the University of Leeds. Core researchers are Professor Edgar Jenkins (1967 – now retired), Professor Jim Donnelly (1984 – now retired), Professor Jim Ryder (Professor of Science Education, 1994 – present), Dr Matt Homer (Research Fellow, 2002 - present) and Dr Indi Banner (Lecturer in Science Education, 2008 – present).

A long-term trend since the 1960s, referred to as a 'humanisation' of the school science curriculum **[1],** is evidenced by two clear strands:

i) the growing role of vocational/applied curricula, and

ii) the teaching of socio-scientific issues and the nature of science.

The first strand, focusing on *the growing role of vocational/applied curricula*, has been led by Professor Donnelly, and funded by the ESRC **[RG1]** and the Nuffield Foundation **[RG2]**. Research evaluated the meaning, impact and significance of Applied Science through examining policy documents, interviews with teachers and students, and through a value added study of the performance of students using the National Pupil Database (NPD) **[2, 3]**.

This research identified two key issues. Firstly, the goals of such vocational/applied curricula have often been under-defined. This has led to a lack of clarity of focus in the enactment and evaluation of such courses. Secondly, University of Leeds research has shown that the provision of vocational/applied curricula alongside more traditional courses offerings has resulted in a stratification of science provision by student attainment, with lower attaining students more likely to be following 'lower status' vocational/applied courses that tend not to provide routes into post-compulsory education.

The second strand focuses on the increasing inclusion of *teaching about socio-scientific issues and the nature of science*. This is a growing trend in school science curricula internationally, often associated with the call for 'scientific literacy' or 'science for citizenship'. Our work has examined how adults use science outside of formal science schooling, showing that science-based insights sit alongside ethical, social and practical issues in shaping people's decisions. This has led to our distinctive critique of the feasibility of the goals of 'scientific literacy' in a school context **[1, 4]**. This research has been underpinned by a series of externally funded projects **[RG3-5]**.

In particular, a three year study from 2008 - 2011, Enactment and Impact of Science Education Reform (EISER) **[RG5]**, funded by the ESRC and the Gatsby Foundation, provided a longitudinal analysis of the impact of increased emphasis on applied science and the teaching of socio-scientific issues. It focused on teachers' experiences of working with the new science curriculum, the impact of these reforms on student achievement, student attitudes towards science education and participation in post-compulsory science courses. Key findings have been elaborated in several publications **[1, 3, 4]**, offering details of how the science curriculum has become much more diverse and stratified, of how the reforms have been received and implemented in schools, and also of the mixed reaction by students, with some indicating a preference for a more traditional science curriculum focusing on canonical science knowledge.

As a result of this, and previous research, the University of Leeds has become known as a centre for excellence for science curriculum reform research and in the use the National Pupil Database. The basis of this reputation was formed by a series of three ESRC funded projects **[RG6-8]** from 1990 – 1999, positioning University of Leeds researchers as leading experts in the field. Research showed the tension between enabling students to engage in investigatory work in the school science classroom and the restrictive realities of school curriculum time, availability of technical resources and broader systemic features of schooling such as external assessment. A distinctive finding has been the identification of the distorting effect of a strong focus on accountability through external assessment. Investigatory work became re-interpreted in schools as a series of routinised exercises undertaken by students to gain maximum marks within summative assessment. This research has been elaborated in **[5]** and **[6]**.

3. References to the research (indicative maximum of six references)

All references can be provided on request, and have been assessed internally as 3* or 4*.

[1] Donnelly, J., & Ryder, J. (2011). The Pursuit of Humanity: Curriculum Change in English School Science. History of Education, 40(3), 291-313. DOI: 10.1080/0046760X.2010.521196

[2] Bell, J., Donnelly, J., Homer, M., & Pell, G. (2009). A value-added study of the impact of science curriculum reform using the National Pupil Database. British Educational Research Journal, 35 (1), 119-135. DOI:10.1080/01411920802041806

[3] Homer, M., Ryder, J. and Donnelly, J. (2013). Sources of differential participation rates in school science: the impact of curriculum reform. British Educational Research Journal, 39 (2), 248-265. DOI: 10.1080/01411926.2011.635783

[4] Ryder, J., & Banner, I. (2011). Multiple aims in the development of a major reform of the national curriculum for science in England. International Journal of Science Education, 33(5), 709-725. DOI: 10.1080/09500693.2010.485282

[5] Donnelly, J., Buchan, A., Jenkins, E. W., Laws, P., & Welford, G. (1996). Investigations by Order (Driffield: Studies in Education).

[6] Donnelly, J., & Jenkins, E. W. (2001). Science Education: Policy, Professionalism and Change (London: Paul Chapman/SAGE).

Relevant Research Grants

[RG1] ESRC 2003-07 Remaking School Science Education Through Application. Jim Donnelly. RES-000-23-0229. £220,000.

[RG2] Nuffield Foundation. March-July, 2009. Applied Science in the 14-19 Science Curriculum. Jim Donnelly. £19,000.

[RG3] Nuffield Foundation 2004-06 Implementation and co-ordination of the evaluation of Twenty First Century Science project. Jim Donnelly. £10,000.

[RG4] Qualifications and Curriculum Authority 2007-08. The Implementation of the 2006 Science Education Reforms at KS4. Jim Donnelly and Jim Ryder. Two separate research studies totalling £60,000.

[RG5] ESRC/Gatsby 2008-11 Enactment and Impact of Science Education Reform (EISER). Jim Ryder and Jim Donnelly. RES-179-25-0004. £386,000.

[RG6] ESRC 1990-92 Policy into Practice: The Internal Assessment of Practical Skills in Science. Jim Donnelly. R000232253. £68,000.
[RG7] ESRC 1993-95 Realizing Policy: AT1 and Science Education in KS3 and KS4. Jim Donnelly. R000233875. £130,000.
[RG8] ESRC 1995-99 Change and Continuity in Secondary Science Teaching. Jim Donnelly. R000236073. £95,000.

4. Details of the impact (indicative maximum 750 words)

Research by the University of Leeds has informed and shaped understanding and the decision-making process of those responsible for reforming the school science curriculum, demonstrating a distinctive contribution to secondary science education policy and practice. Enhancing participation in post-compulsory science has become a major policy goal within the UK, but there has been a clear need for research to inform science curriculum changes so that an appropriate foundation for further science study is provided whilst the school science experience of those students who do not want to pursue post-compulsory science courses is still enhanced.

As an expert in his field, Professor Donnelly was appointed to the committee developing the Royal Society's four 'State of the Nation Reports' (2007 – 2011), which identified and assessed patterns and trends in participation and attainment in science and mathematics. Aimed at influencing future educational policy, Professor Donnelly chaired the subgroup for one of the reports, 'Science and mathematics education for 14-19 year olds', contributing findings from University of Leeds research into applied science **[RG1].** Published in 2008, this report is now referred to extensively in policy debates concerning the school science curriculum. For example, it is widely cited in a review commissioned by the Government in 2010 on science and mathematics secondary education **[A].**

The evaluation of the GCSE Twenty First Century Science **[RG3]** was also central to the call that insights from the development of this qualification should guide the revision of the new GCSEs which were introduced in 2006 (as reported in **[4]**), with ongoing impact through to 2008 and beyond. The Director of the Nuffield Foundation reports that the "*evaluation of the Twenty First Century Science pilots was an important and influential piece of work"*, adding that, "*Jim [Donnelly] was one of the few people in the country with the authority, expertise and independence to have carried out this piece of work"*. **[B]**

The research into applied science **[RG1, RG2]** also proved significant in ensuring that the previous government's decision to go ahead with a Science Diploma in schools (subsequently abandoned by the Coalition Government) sought to address key issues of status and scientific content within the aims of the Diploma. The Director of the Nuffield Foundation stated that **[RG2]** "*provided a clear and authoritative picture of what was happening … this affected our own thinking directly but it also had influence at wider policy levels*". **[B]**

In particular, this study **[RG2]** was presented by the Director of the Nuffield Foundation directly to the Qualifications and Curriculum Development Agency (QCDA) STEM curriculum committee in 2009, and was "*received with great interest and changed thinking within QCDA. I can say from experience that few of the discussions of that committee were informed by such clear and reliable data"*… "*the data about uptake of Applied Science at GCSE and Level 3 were new to the people on the committee. They hadn't appreciated the scale of the uptake of AS, the rate of growth."* **[B]**

The route to impact can also be traced through University of Leeds research directly informing and shaping educational policy through, for example, inclusion of research recommendations in the National Curriculum Review (NCR). The outcomes from the EISER research study **[1, 3, 4] [RG5]** formed the basis of a submission of written evidence in May 2011 to the Department for Education NCR. Although lines of impact within educational policy are inherently difficult to evidence directly, the science curriculum reform proposals, published in February 2013, do include the EISER recommendation that the 'science curriculum should include canonical science knowledge, insights into the practices of science, and discussions about science-related issues that impact on society (e.g. climate change)'.

Moreover, as a direct result of this research and subsequent submission, Professor Ryder was invited on 31 May 2011 to join the NCR Science Expert Working Group. The director of the Science NCR team at the DfE states that "*we have engaged with the [EISER] study and taken into account its findings*."**[C].** In a series of private meetings within the DfE (June 2011 – July 2012), Professor Ryder also presented the findings of University of Leeds research to members of the NCR team leading on the content and development of the new national curriculum.

Further impact is demonstrated by how research has informed and shaped research and development activities of professional organisations aiming to influence Government practice and policy. The Head of Education Pre-19 at the Institute of Physics, the leading scientific society working to advance physics education, research and application, references how EISER NPD analysis has resulted in ongoing work:

"*The EISER research, along with other data from the NPD, contributed to the Institute's decision to set up and fund a project to look at the effects of socio-economic conditions on children's likelihood to choose physics at A-level*." **[D]**

The Director of Programmes **[E]** in the Education Team at the Gatsby Charitable Foundation, which aims to strengthen science, engineering and maths education in the UK and inform national policy, states that the "*Science Education team at Leeds University have made a significant and sustained impact on our understanding of the science curriculum in schools. Through a series of investigations and evaluations they have been able to highlight the differences between the science curriculum as intended by policy makers and as experienced by teachers and students*."

Furthermore, "*From a Gatsby perspective their early work on the role of practical work in the science curriculum has been critical in informing our current work in trying to understand how a more benign system of assessment could promote the development of laboratory skills*." (reference to **[RG6**, **RG7]**).

In relation to more recent work led by Professor Ryder, the Director also reports that EISER analysis of the National Pupil Database "*has provided a strong evidence base for the continued push towards triple science at KS4 although with some important caveats around inclusion issues"*. As a result a 'push towards triple science' has become a key policy goal of the Gatsby Charitable Foundation. **[E]**

5. Sources to corroborate the impact (indicative maximum of 10 references)

[A] 'Science and Mathematics Secondary Education for the 21st Century: Report of the Science and Learning Expert Group' (2010), an independent review commissioned by Government http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/wp-content/uploads/2010/02/Science-Learning-Group-Report.pdf.

The document references the *Royal Society, State of the Nation – science and mathematics education, 14-19, 2008* http://royalsociety.org/education/policy/state-of-nation/14-19/

[B] Corroboration letter from Director of Nuffield Foundation (up to Autumn 2012)

[C] Corroboration letter from director of Science and PE team, Curriculum and General Qualifications Reform Group, National Curriculum Review Division, Department for Education

[D] Corroboration letter from Head of Education Pre-19, Institute of Physics

[E] Corroboration letter from Director of Programmes in the Education Team, Gatsby Charitable Foundation