Institution: Bath Spa University

Unit of assessment: UoA 25: Education

Title of case study: Improving Science Together

1. Summary of the impact

The Improving Science Together (IST) project developed pupils' enquiry skills, teachers' assessment and curriculum continuity across the primary-secondary transfer in 24 schools. This research had an impact upon public policy through its inclusion on the Department for Children, Schools and Families (DCSF) website as a case study supporting government guidance on primary-secondary transfer. Its impact upon practitioners in the project schools and authorities has been to change their practice in science enquiry assessment and primary-secondary transfer; it has a continuing wider impact on the work of teachers and trainees across the UK and internationally through web-based materials and training.

2. Underpinning research

The IST project (2000-2002) involved research on the key issues science assessment and cross-phase transfer with 20 primary and 4 secondary schools (48 teachers), together with local authority science advisors and advanced skills teachers in Bristol and South Gloucestershire Local Authorities. The key researchers were Professor Dan Davies, Dr Kendra McMahon and Alan Howe, all of whom were employed within the UoA as Senior Lecturers in Education at the time and continue to be core members of the Centre for Research in Early Scientific Learning (CRESL) at Bath Spa University. The project's theoretical perspective was informed by the analysis of science pedagogy in upper primary and lower secondary education undertaken in the ORACLE project (Galton *et al* 1999, 2002), which found a mismatch between pedagogical approaches between the two phases; an issue the IST project sought to address through jointly-planned bridging units. The research questions were as follows:

1. How do primary and secondary teachers' perceptions of how transfer information is used change through the development and implementation of a science bridging unit?

2. How do pupils' perceptions of transfer during the implementation of a science bridging unit compare with those from previous studies?

3. What evidence is there of continuity and progression in science teaching and learning across transfer during the implementation of a science bridging unit?

4. How can primary and secondary teachers improve their formative assessment and focused teaching of scientific enquiry?

Project interventions to improve teachers use of formative assessment in science enquiry and facilitate better pedagogical continuity between primary and secondary science education included:

- workshops and discussions during central cluster meetings to develop primary and secondary teachers' shared understanding of scientific enquiry;
- joint review by primary and secondary teachers of existing pupil transfer data in science and how it could be made more meaningful and accessible;
- joint planning and teaching of science bridging units in the last term of primary and first term of secondary schools, to include transfer of pupil work;
- individual support by project tutors in developing school frameworks and teaching

strategies for improving scientific enquiry;
- incorporation of assessment strategies such as 'floorbooks' (a written record of children's utterances in the form of a 'home-made' book) and 'focused assessment of scientific enquiry' in classroom teaching;
- team teaching between the teacher with responsibility for leading science teaching (science subject leader) and their colleagues.

Data from multiple sources (observation, survey, interview, case study) were triangulated to address the research questions. Findings suggested that, as a result of joint planning and implementation of a bridging unit, there had been an increase in the secondary school teachers' understanding of both the range of the science curriculum covered in primary schools and pupils' levels of attainment in the procedures of scientific enquiry. There was also evidence that assessment information transferred from primary to secondary schools was informing planning and that pupils were experiencing greater continuity in their science education.

The project led to further externally-funded research by the CRESL team in the use of e-portfolios to assess scientific enquiry at primary and secondary level (the *e-scape* project 2007-10) and will continue as a substantial three-year externally-funded project *Teacher Assessment in Primary Science* (TAPS 2013-16), seeking to integrate formative and summative purposes of assessment.

3. References to the research

Davies, D. and McMahon K (2004) A smooth Trajectory: Developing Continuity and Progression between Primary and Secondary Science Education through a Jointly Planned Projectiles Project, *International Journal of Science Education***,** 26 (8), 1009 – 1021 ISSN 0950-0693. DOI: 10.1080/1468181032000158372

McMahon, K. and Davies, D. (2003) Assessment for Enquiry: Supporting Teaching and Learning in Primary Science, *Science Education International*, 14(4): 29-39
These outputs were both submitted to RAE 2008.

Subsequent research by the team in the same field (science assessment at the primary/secondary transition) resulted in the following output, submitted to REF 2014:

Davies, D., Collier, C. and Howe, A. (2012) Assessing Scientific and Technological Enquiry Skills at Age 11 using the e-scape System, *International Journal of Technology and Design Education.* 22: 247-263. DOI 10.1007/s10798-011-9191-3

The IST research was supported by two grants from AstraZeneca Science Teaching Trust:
Grant 1: September 2000 – July 2001, £90,000. Grant holder: Kendra McMahon
Grant 2: September 2001 – July 2002, £60,000. Grant holder: Kendra McMahon

4. Details of the impact

<u>Impact upon Public Policy</u>

The IST project exerted an influence on policy made by the UK government in relation to its guidance to schools on primary-secondary transfer (including the recommendation to schools to make use of bridging units), and upon the Key Stage 3 Strategy for science (including a greater emphasis upon pupil-led enquiry approaches adopted from the primary sector) through the inclusion of project materials on the DCSF website (http://nationalstrategies.standards.dcsf.gov.uk/node/97530 - archived on the change of

government in May 2010).

The former Qualifications and Curriculum Authority (QCA) Science Officer, interviewed in 2013, reported that 'the examples of science bridging units provided by the IST project and its overall approach to primary-secondary transfer constituted best practice that the QCA wished to promote to schools.'

Impacts upon Practitioners and Professional Services

The IST project led to the development of resources to enhance professional practice. These included an online CPD unit for primary teachers on the AstraZeneca Science Teaching Trust (AZSTT) website on the use of 'floorbooks' (see above) as a formative assessment strategy in science (www.azteachscience.co.uk/resources/cpd/floorbooks.aspx); and a set of online materials on the AZSTT website to support primary teachers in planning for focussed assessment of scientific enquiry (www.azteachscience.co.uk/resources/materials/scientific-inquiry-sc1.aspx)

Use of these resources by teachers in the UK and internationally to change their practice significantly increased the reach of the project. Download data from the AZSTT website monitored over a 12 month period indicates that the 'floorbooks' CPD unit was downloaded 741 times between Feb 2009 and Jan 2010. This included 'hits' from around the world, of which the most came from Netherlands and Australia. A teacher in Barnsley who had downloaded and used the materials, interviewed in 2012 said: 'I have enjoyed using floorbooks this year and will continue to use them with future classes… it is preferable to tests and far easier to manage than hoping you obtain enough detail by observing the children.' Usage data on the 'Focused assessment of Scientific Enquiry' materials on the AZSTT website, indicates that these materials received 13,527 visits during the year from Feb 2009 to Jan 2010. This included 'hits' from around the World, of which the most came from USA, Australia, UAE, India, Malaysia and Nigeria. One Advanced Skills Teacher (AST) in Durham who had downloaded and used the materials, interviewed in 2012, said: 'They are a great way of demonstrating progression and development of skills. As an AST I recommend that schools do one per half term and keep a spreadsheet of children's levels, this can then be used via best fit to assign a level for SC1 at the end of the year.' A 2012 survey of 500 schools awarded the Primary Science Quality Mark reported that 40 of them (8%) were using these materials from the AZSTT website to support their assessment of science. Through the publication of an article based on the IST project in *Primary Science Review,* the main science magazine aimed at primary teachers which has a readership of around 4,000, the research had potentially wider impact on professional practice.

A further indicator of reach of impact is provided by the use of research outcomes and resources from the IST project in CPD courses run by the National Science Learning Centre (NSLC) at the University of York, and subsequent impact upon teachers attending those courses. A primary CPD provider for NSLC, interviewed in 2012 said: '… if I'm doing an assessment course, floorbooks are a natural part of that as they offer teachers a holistic approach to collecting evidence from the children's initial thinking and initial questioning to having answered the questions and then reflecting back on the work they have done… they're brilliant… a lot of the teachers I have worked with and have introduced floor books to, have gone off and used them very successfully and incorporated them into their practice… hundreds, maybe thousands. I come across people who have emailed me, or I have met again who say they have been using them.'

The most significant impact upon changes in practice for a specific group relates to the teacher participants in the IST project. A survey of teachers in the original project schools undertaken in 2012 indicated that eight of the original 20 primary schools were still using approaches influenced by the IST project, 10 years on. Involvement in the project has also positively impacted upon the careers of participant teachers; eight were still working in the same schools

– often now in senior positions – whilst a further 10 had moved school to take on management responsibilities, including one headship, one deputy headship and one academic at the University of Bristol who said 'Involvement in the IST project helped establish my research credentials when I applied for an academic post'.

The IST research has had a widespread impact upon professional training of primary school teachers in England, through the publication of textbook for primary teachers and PGCE trainees using material derived from the project: Howe, A., Davies, D., McMahon, K., Towler L., Collier, C. and Scott, T. (2005, 2009) *Science 5-11: A Guide for Teachers,* London: Routledge. According to data from Routledge publishers, the first edition of this book sold 3,931 copies and sales of the second edition currently stand at 2,124. The publisher confirms that it has been adopted as a core text for Primary PGCE courses at Cambridge, Birmingham, Greenwich, Leicester and the Institute of Education, London, together training over 1,000 pre-service teachers per year.

5. Sources to corroborate the impact

The following independent sources could be consulted:

1. A researcher at the University of Bristol can corroborate impact relating to:
    a. an Internal report on the Impact of the IST project, including interviews with teachers who had downloaded and were using the above resources;
    b. interviews with teacher participants in the IST project; and
    c. an interview with CPD provider for National Science Learning Centre, Rosemary Feasey. All undertaken in 2012.
2. The Associate Director, Science Learning Centre East of England can corroborate impact evidenced by Analysis of Primary Science Quality Mark (PSQM) database.
3. *Primary Science* readership figures can be provided by the ASE Journals Co-ordinator.
4. Routledge marketing data for *Science 5-11,* available from Commissioning Editor (David Fulton Books), Taylor and Francis.
5. Interview with former QCA Science Officer. Impact on public policy.
6. Data on AZSTT website page visits and downloads for the two online resources emerging from the project, available from http://www.azteachscience.co.uk/the-trust/contact-us.aspx.