

**Impact case study (REF3b)**

<p><b>Institution:</b> Oxford Brookes University</p>
<p><b>Unit of Assessment:</b> 25 – Education</p>
<p><b>Title of case study:</b> Developing teachers’ classroom practice to raise pupils’ attainment and engagement in primary school science</p>
<p><b>1. Summary of the impact:</b>            Research by Oxford Brookes University identified that teaching for inclusive challenge in primary science lessons, with an emphasis on classroom discussions, practical work and conceptual challenge, increased pupils’ enthusiasm for science and also their attainment in the subject. Led by Helen Wilson, David Coates and Jenny Mant, research insights have been used to produce evidence-based professional development for primary school teachers. This has been delivered to thousands of teachers, through training events and programmes, through a dedicated website, and through training led by Local Authority advisors who have chosen to disseminate our materials. The impact on the teachers’ practice has been to encourage pupils’ higher order thinking in science lessons through an emphasis on questioning, discussion and practical scientific enquiry. The ultimate impact has therefore been on the learning experiences of school pupils.</p>
<p><b>2. Underpinning research</b>            Inclusive challenge for all in a class, rather than an exclusive approach to provision for able pupils, has been at the foundation of Helen Wilson (Senior lecturer primary science), David Coates (Senior lecturer primary science - left September 2006) and Jenny Mant’s (Senior lecturer secondary science - left September 2010) work in gifted and talented education. In this field, it is common to hear Renzulli (1998) cited who stated that challenging the most able in the classroom on an inclusive basis raises standards for all. However, there was a seeming lack of evidence that Renzulli’s claim proves true. Hence this research was launched to test his hypothesis. The research began in 2002-2004 through the AstraZeneca Science Teaching Trust (AZSTT) funded research project: Conceptual Challenge in Primary Science. The study compared the effect of a continuing professional development (CPD) initiative for teachers of classes of 10–11 year-old children in 16 matched pairs of primary schools: 32 schools in all. The intervention was provided to one in each pair of schools and the main quantitative outcome measure was the percentage of children achieving the highest scores (level 5) in the national science test.            The research was not just focused on attainment but also on pupils’ attitudes to science with appropriate qualitative data collected. Several authors internationally had noted a decline in enthusiasm for science and that this had a resulting impact on subject choices in secondary school and subsequently recruitment for science-based jobs (Sjøberg, et al, 2006). In the UK, Pell and Jarvis (2001) noted that this decline in enthusiasm for science appears to begin towards the end of pupils’ years in primary school.            The research demonstrated that teaching for inclusive challenge in primary science lessons, with an emphasis on classroom discussions, practical work and conceptual challenge increased pupils’ enthusiasm for science and also their attainment in the subject. The research also demonstrated the value of reducing the amount of writing in primary science lessons and organising the pupils’ recording more carefully so that it is better focused.            As a result of this research project, materials were produced to facilitate a dedicated discussion slot in primary science lessons - the Bright Ideas Time. A variety of prompts for the discussions were developed and exemplified in all areas of the primary science curriculum and the evidence showed that all the participating teachers integrated these resources into their lessons. In addition to the science specific findings, the research has also informed our work in gifted and talented education as a whole. The research has deepened our understanding of strategies for challenge that teachers can use in their practice which can be applied generically across all subjects, for example questioning skills, pupils’ higher order thinking and pupil discussion.</p> <p><b>References:</b>            Pell, T., &amp; Jarvis, T. (2001). Developing attitude to science scales for use with children from five to eleven years. <i>International Journal of Science Education</i>, 23(8), 847–862.            Renzulli, J. (1998). <i>A rising tide lifts all ships: Developing the gifts and talents of all students</i>. Retrieved 13 December 2012 from <a href="http://www.gifted.uconn.edu/sem/semart03.html">http://www.gifted.uconn.edu/sem/semart03.html</a>            Sjøberg, S., &amp; Schreiner, C. (2006). How do learners in different cultures relate to science and technology? Results and perspectives from the project ROSE (the Relevance of Science Education). <i>APFSLT: Asia-Pacific Forum on Science Learning and Teaching</i>, 7(1), Foreword.</p>

### 3. References to the research

**Publications:** these are tightly focused on the research undertaken in 2002-04. The range of publications was part of a deliberate strategy to increase the impact of this research on teachers' practice and so it includes articles in practitioners' journals:

1. Mant, J., Wilson, H. & Coates, D. (2007) 'The Effect of Increasing Conceptual Challenge in Primary Science Lessons on Pupils' Achievement and Engagement' in *the International Journal of Science Education* 29(14), 5 November, 2007, pp. 1707-1719.  
DOI:10.1080/09500690701537973
2. Wilson, H., Mant, J. and Coates, D. (2005) Creative Science and Conceptual Challenge at Key Stage 2 in *G&T Update* Issue 22, March 2005  
<http://www.teachingexpertise.com/publications/gifted-talented-update-89>
3. Wilson, H., Mant, J. and Coates, D. (2004) 'There's Nothing More Exciting than Science' in *Primary Science Review*, 83 May/June 2004; pp 20 - 22; Association for Science Education
4. Wilson, H. (2002) 'Bright Ideas Time' in *Primary Science Review* 72 March/April 2002; pp 13 - 15; Association for Science Education.

Evidence for the rigour of the research is shown by the fact that the research paper above (Mant et al, 2007) has been cited by Slaven et al (2012) as one of the 17 studies that met the inclusion criteria for their systematic review of research on the achievement outcomes of all types of approaches to teaching science in elementary schools. They noted that 'the most important finding of the present review is a very limited number of rigorous experimental evaluations of elementary science programs. After an exhaustive search involving examination of 327 published and unpublished articles that purported to evaluate science approaches in elementary schools since 1980, only 17 studies met the review standards'. (Slaven, R., Lake, C., Hanley, P. and Thurston, A. (2012) *Effective Programs for Elementary Science: A Best-Evidence Synthesis* Best Evidence Encyclopaedia) [http://www.bestevidence.org.uk/assets/elem\\_science\\_June\\_2012.pdf](http://www.bestevidence.org.uk/assets/elem_science_June_2012.pdf)

Through our links with Stanger University, Norway, a science educationalist there, Bjorn Haland, has had an article published in the Norwegian journal for science teachers, "Naturfag", which describes our research based approach to science teaching:

Haland, B. (2011) *Time for good ideas - Bright Ideas Time* in *Naturfag* 2/11  
<http://www.naturfagsenteret.no/binfil/download2.php?tid=1798756>

#### Key research grants awarded:

1. Grant title: Conceptual Challenge in Primary Science for Able/Gifted Year 6 Pupils  
Sponsor: The AstraZeneca Science Teaching Trust  
Period of the grant: September 2002 – July 2004  
Grant was awarded to: Helen Wilson, Jenny Mant, David Coates (Oxford Brookes University)  
Value of the grant: £140,000
2. Grant title: Challenge in Primary Science  
Sponsor: London Gifted and Talented  
Period of the grant: September 2006 – July 2008  
Grant was awarded to: Helen Wilson, Jenny Mant (Oxford Brookes University)  
Value of the grant: £49,000
3. Grant title: Thinking, Doing and Talking Science  
Sponsor: The Education Endowment Fund  
Period of the grant: January 2013 – July 2015  
Grant was awarded to: Helen Wilson (Oxford Brookes University) and Bridget Holligan (Science Oxford)  
Value of the grant: £271,000 <http://educationendowmentfoundation.org.uk/projects/science-oxford>

### 4. Details of the impact

The impact of the research undertaken falls into the following main categories:

- Resources produced for use by teachers, nationally and internationally
- Continuing professional development delivered to practising teachers, nationally and internationally
- Consultancy requested by governmental departments, nationally and internationally
- Presentations at national and international conferences for practising teachers
- Education Endowment funding for a further research project and the PSTT hub

#### Resources produced:

The findings of the AstraZeneca Science Teaching Trust (AZSTT) research project have been

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widely disseminated each year since 2004 and, in order to have a maximum impact on the pedagogy of practising teachers, dedicated resources have been developed. These include an online Continuing Professional Development Unit (CPDU) for teachers, which was funded by the AstraZeneca Science Teaching Trust in 2009 and is available on their open website. This is called Bright Ideas in Primary Science and can be found at: <http://www.pstt.org.uk/ext/cpd/bright-ideas/index.html>

The AZSTT collect data about the usage of the Continuing Professional Development Units on their website and this CPDU was the most frequently viewed of the 29 available between February 2009 and January 2012, with 7,647 viewings recorded. The next most popular CPDU had 4,650 viewings recorded in the same time frame. The website was redeveloped in January 2012 and between then and September 2013 the CPDU was the second most frequently viewed with 4,901 visits recorded. In total, the number of page views from February 2009 to September 2013 for this CPDU is 12,547.

At our instigation, the AZSTT also funded us in 2006 to write a booklet, 'Creativity and Excitement in Primary Science'. All 4,000 of the original print run have been distributed and the demand was such that another 1,000 were produced in 2009. These continue to be requested and they have gone to teachers, students, Local Authority advisors, to National Strategy consultants and to international contacts. Hence this booklet is also available on the Norwegian website for science teachers: naturfagsenteret <http://www.naturfaq.no/binfil/download.php?tid=1786575>

The findings from the research project have been used by the Science Advisor for Somerset Local Authority who wrote: "I was introduced to the Creativity and Excitement project at the Annual National ASE conference (January 2007). I was immediately very excited by the project and worked with our science Advanced Skills Teacher to implement the project at her school, the project proved to have a very positive impact on year 6 science SATS results. Together, we wrote a 1 day course based on the Creativity and Excitement materials which we have run on numerous occasions since then. The project thus has been cascaded into many Somerset schools. It has been the focus of at least 2 teachers' dissertations for their MA and formed the basis of part of our training for our Foundation Degree and School Centred Initial Teacher Training students. The project is still as relevant and exciting as it was when I first heard about it in 2007."

**Continuing professional development (UK):**

The government funded organisation, London Gifted and Talented (LGT), commissioned the design and delivery of a course, 'Challenge in Primary Science, in 2007-8. This consisted of six sessions – two face-to-face, four online and in school, spread over the year and 35 teachers participated. The project was evaluated for impact by LGT.

Two 4 day training courses were requested by the South London Organisation of Gifted and Talented (SLOGAT) and were carried out in 2008-09 and 2009-10 with 60 teachers participating. The Lewisham Local Authority Gifted and Talented Advisor, wrote: "Lewisham teachers working on these courses found them stimulating and engaging. The ideas and approaches were taken back into schools and shared widely. Pupils' approach to science became more enthusiastic and teachers reported that the pupils' skills, knowledge, understanding and depth of thought improved across the ability range."

As well as the above outputs, the following projects have also been delivered:

Wilson is a consultant with the National Science Learning Centre (NSLC) at York University, annually (2006-13) running a four day residential course for primary teachers, with at least 200 teachers participating. The link tutor stated: "The evidence is clear that Helen has been able to make a real difference to what teachers do in the classroom. Many of the comments and ratings show that Helen's invaluable advice, guidance and instruction has made a real impact on teachers' practice and, in turn, on their pupils' learning and experience of science."

**Continuing professional development (International):**

Wilson was invited to Vilnius, Lithuania (November 2011), to give an INSET for Lithuanian teachers and university education lecturers, entitled: 'Using Questioning techniques and Higher Order Thinking Skills to enhance science teaching and learning'. She was invited to a day's INSET in Malaga (March 2008) and Barcelona (September 2008) in British International schools focussing on provision for the Gifted and Talented.

**Consultancy for the UK government:**

In 2008, Wilson was a consultant for Department for Children, Schools and Family on the

development of science specific materials for the nationally used Gifted and Talented Classroom Quality Standards:

<http://webarchive.nationalarchives.gov.uk/20110809101133/http://nsonline.org.uk/node/246326>

She was also invited by the National Strategies to write the e-module: Primary Science which forms part of the blended learning package for the national training of Leading Teachers of the Gifted & Talented:

<http://webarchive.nationalarchives.gov.uk/20110809101133/http://nsonline.org.uk/node/175139>

**International consultancy and conference presentation:**

Invited by the Finnish Board of Education, Wilson delivered a keynote (Teaching for Challenge) at the first national conference focused on gifted and talented education for head teachers and educationalists in Helsinki, Finland 15-16 April 2009. Furthermore, she was invited to deliver a lecture (Teaching for Challenge) at the University of Helsinki Department of Teacher Education on 17 April 2009.

**Conference presentations (UK):**

Wilson gave the keynote address (Creativity and Excitement in Primary Science) at the Annual Primary Science Conference Somerset for 100 teachers on 9 July 2010, and, gave a presentation (Gifted & Talented and Science - National Developments) at the conference for Oxfordshire head of secondary school science departments for 30 teachers on 7 November 2008. Also, she gave a presentation (Creativity & Excitement in Primary Science) at the Oxfordshire Primary Science Conference for 80 teachers on 18 March 2008.

**Education Endowment Fund (EEF) project**

A key indicator of the impact of the original research is that the EEF has accepted a recent bid to study the impact of inclusive challenge in primary science lessons in more depth and on a larger scale. The Education Endowment Fund support projects which are evidence based and the findings of the AstraZeneca Science Teaching Trust were instrumental in the successful bid.

**The Primary Science Teaching Trust (PSTT) Science Education Hub**

The PSTT (formerly the AstraZeneca Science Teaching Trust) have granted Wilson and colleagues £150,000 to develop a science education hub at Oxford Brookes University over at least three years, beginning in October 2013. A key aim is to further cascade the findings of the research so that they are embedded in teachers' practice.

**5. Sources to corroborate the impact**

1. **Corroborative contact 1:** The Director of the AstraZeneca Science Teaching Trust  
The 2002-04 research project was monitored by the AZSTT, as is the on-going use of the related Continuing professional Development Unit on their website. Also interim and final reports were produced by us for the AZSTT's monitoring and evaluation purposes (2002 – 2004).
2. **Corroborating contact 2 -** A participating teacher from the original AstraZeneca Science Teaching Trust project Charlton Primary School, Wantage:
3. **Corroborating contact 3-** previously a director of London Gifted and Talented
4. **Corroborating contact 4 –** Professional Development Leader CIEC Promoting Science and link tutor for the National Science Learning Centre York and co-deliverer of the Extending Gifted and More Able Children in Primary Science courses
5. A participating teacher in the course at the National Science Learning Centre York – contact details available from Oxford Bookes University upon request
6. **Corroborating contact 5 –** previously a science advisor for Somerset Local Authority, now FD and SCITT programme Manager Somerset LA
7. South London Organisation of Gifted and Talented – formerly Lewisham Local Authority Gifted and Talented Advisor. Contact details available from Oxford Bookes University upon request
8. Finnish educational author and consultant. contact details available from Oxford Bookes University upon request