Evaluation of the 2008-09 DCSF-funded Specialist Schools and Academies Trust STEM Pathfinder Programme

Executive Summary

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About the study

Earlier in the decade, much research emerged to suggest that the popularity of science, technology, engineering and mathematics (STEM) subjects were in decline (e.g. Roberts, 2002; Stagg et al., 2003). This trend was of particular concern given the importance of the science-based economy in the UK (HM DTI/DfES, 2004). Some of the issues associated with this decline in interest in STEM have been attributed to: young people's negative perceptions and experiences of STEM subjects (e.g. Jenkins and Nelson, 2005); lack of information on, and awareness of, STEM careers (e.g. Cleaves, 2005); shortage of specialist teachers in schools (Moor *et al*., 2006); and school awareness of, and engagement with, STEM interventions (HM DfES/DTI, 2006).

Specialist schools have an important role to play in the STEM agenda, as they are an integral part of the Government's plans to raise standards in secondary education. Currently, STEM is represented in the programme as four separate specialisms: science; technology; engineering; and mathematics and computing. However, there are potential advantages in integrating all of the STEM subjects and delivering STEM integrated activities (i.e. activities that deliver learning outcomes for all STEM subjects).

The STEM pathfinder programme, funded by the Department for Children, Schools and Families (DCSF) and managed by the Specialist Schools and Academies Trust (SSAT), enabled and supported networks of specialist schools to design and deliver integrated STEM activities through a programme of continuing professional development, and provision of resources, consultancy and advice to schools. The driver for the pathfinder was DCSF's interest in whether a STEM specialism could be manageable and advantageous for schools, and the types of activities that schools carried out were those that could potentially form part of a STEM specialism.

The SSAT commissioned the National Foundation for Educational Research to undertake an evaluation of the pathfinder, and to provide:

- findings on the effectiveness of different activities and approaches to delivering STEM, including best practice and challenges
- a clear understanding of the impact of activities on pupils, teachers, the school and partners

- a set of recommendations and learning points that will inform longer-term developments, including a possible STEM specialism.

The methodology for the evaluation comprised:

- qualitative baseline and end-point surveys sent to all 40 pathfinder schools at the start of the programme (October '08) and end of the programme (June '09)
- five school case studies
- collation of secondary data to augment the primary data, including school action plans, interim and final progress reports
- discussing and finalising recommendations and learning points with input from the SSAT STEM team.

School context and activities undertaken

Schools generally had little history of undertaking integrated STEM activities, and what experience there was tended to involve all departments delivering activities that related to a school's specialist subject (e.g. during a suspended timetable week). Where there were such experiences, the pathfinder provided an opportunity to build on them.

Having completed pathfinder activities, teachers have a good understanding of what the term 'STEM' means, and the subjects involved. However, many teachers had only developed their understanding and awareness of STEM through the pathfinder. Specifically, teachers had increased their understanding of the links between subjects, the value of collaborative working across STEM subjects, and their understanding of the wider STEM agenda.

The most common activities carried out by schools were:

- suspended timetable and enrichment activities (e.g. day of practical challenges and activities supported by STEM teachers and mentors from industry)
- using KS3 curriculum modules/planning to engage students with broad STEM learning (e.g. introduction of a robotics module into the KS3 technology curriculum, including building and programming a robot)

- promoting STEM in partner schools (e.g. additional training and outreach provided to primary schools to address areas of identified needs from completion of STEM passports)
- developing innovative links with external partners (e.g. the involvement of the RAF in a STEM event, comprising problem solving and work-related learning activities)
- improving scientific literacy/STEM awareness in the wider population (e.g. widening community knowledge of STEM, including STEM family day for feeder primary schools).

Activities focused predominantly on KS3 and KS4, with some schools targeting a whole year group or a specific group (e.g. underachieving boys) within a year, and other schools doing both across different activities. Schools delivered the majority of what they planned to do successfully. Where they did not manage this, the key reasons included clashes with other activities/exams, and difficulties in engaging partners.

Most schools indicated that they would be taking forward their pathfinder activities, and that they were sustainable. Some were also planning to further develop a STEM focus in their school (e.g. by appointing personnel to lead STEM, further development of pathfinder activities).

Impacts arising from STEM pathfinder activities

STEM pathfinder activities led to a range of outcomes and impacts for pupils, teachers, schools and the wider community:

- impacts for pupils included: increased awareness of the links between STEM subjects; engagement in STEM activities; development of problem solving, independent learning and investigation skills; development of team-working and communication skills; increases in STEM knowledge and understanding; and increased positive attitudes towards STEM subjects, further study and careers
- impacts for teachers included: increased awareness of STEM and the STEM agenda; opportunities to work with colleagues on integrated STEM activities; increased capacity to deliver integrated and enriching STEM activities; increased links with partners; and opportunities for professional development
- impacts for schools included: raised profile of and commitment to STEM in the schools; new strategies for developing STEM in the school; enhanced inter-departmental links within the schools; enhanced teaching and learning across the school; enhanced links with HEIs/FE, industry and

primary school partners; raised profile of the schools in their communities; and enhanced resources and materials

- there were also impacts from STEM activities for parents, partner primary schools, individuals in partner HEIs/FE colleges, businesses and industry and partner organisations (HEIs and industry).

Whilst some of the impacts could arguably also be achieved through individual STEM subject activities, some impacts that were realised by pupils and teachers were specific to integrated STEM activities. The added-value of integrated STEM activities on pupils includes:

- awareness of the links between STEM subjects (e.g. maths skills and knowledge relevant to science, technology and engineering)
- ability and opportunities to transfer learning between subjects and reinforce learning
- awareness of the relevance of STEM subjects to a broader spectrum of careers
- a sense of the interdisciplinary nature of many STEM careers and applications of STEM subjects.

On teachers, the added-value of integrated STEM activities include:

- awareness of the links between STEM subjects and of the wider STEM agenda
- awareness of the value (for pupils) of highlighting the links between STEM subjects
- capacity, skills and confidence to highlight the broader context of their subject and how it relates to other subjects and disciplines.

In addition to the impacts identified during the pathfinder year, schools anticipated that there would be a further range of positive impacts if they were able to develop, refine and embed the STEM pathfinder activities in the curriculum and culture of their schools in the longer term.

Lessons learnt from undertaking STEM pathfinder activities

The evidence suggests that there are some key characteristics of successful STEM activities:

- successful STEM activities occurred where those organizing them were supported by senior leadership teams; where there was an individual or

group responsible for overseeing STEM activities; and where there had been sufficient time for teachers to meet and plan collaboratively

- activities were also successful when they were delivered by enthusiastic teachers who were willing to try something new, and when partners external to the school (principally from industry) were involved
- common elements to successful activities included: having a clear focus; a 'real-life context; a competitive element for students; some freedom for students to experiment and think for themselves; practical and interactive aspects to the activities; and a good balance between all STEM subjects.

The major challenges faced by teachers were finding time to meet together and plan activities, timetabling activities, and getting other staff involved in the activities. Schools used different approaches to overcome these challenges, including: finding time by meeting after school, using STEM training days to plan, and creating a funded STEM post to coordinate planning; using cross-curricular days and delivering activities in the summer term to overcome timetabling issues; and targeting specific staff or organising joint STEM CPD to get other colleagues involved.

Schools' views of a STEM Specialism

Schools were positive about the idea of a STEM specialism, with most who gave an opinion saying that they would consider taking on a STEM specialism, and the remainder saying that they would 'possibly' consider it. For those who would possibly consider taking on a STEM specialism, the issues that would determine their decision included the perceived additionality such a specialism would offer over current specialisms; the resources made available for the specialism; the views of school stakeholders; and the potential impact on other subject areas.

In practice, schools felt that a STEM specialism would need to engage all pupils in the school, involve increased collaboration between departments (e.g. joint planning, team teaching), entail the delivery of some of the curriculum through a STEM focus, include activities similar to those undertaken for the pathfinder, and involve some changes to school organization to facilitate STEM activities (e.g. creation of a STEM faculty, appointment of STEM coordinator).

Overall, there was no clear consensus concerning whether STEM could or should be a first or second specialism. No schools stated that it should *only* be a first or a second specialism. However, it was clear that schools saw it as an opportunity to build on work carried out as part of an individual STEM subject specialism. It was felt that a STEM specialism would be most effectively carried out by schools that hold a specialism in an individual STEM subject, have senior leadership team support, and also strong leadership across all the STEM subjects.

Schools also suggested that there would need to be some key elements in place to sustain a STEM specialism successfully. These included: ongoing time for teachers to meet; funding to develop activities and embed STEM further in the school; continuing support from senior leadership; and ongoing benefits for pupils.

Recommendations

In light of the evidence from schools, the recommendations highlighted below can be made about the pathfinder and any future STEM specialism.

It is worth noting that DCSF is currently developing revised guidance for the specialist system, particularly in relation to the second specialisms available to high performing schools. Whilst schools framed their responses in relation to the system at the time of the pathfinder, it is hoped that the recommendations below which relate to a STEM specialism would apply to any amended system.

1. SSAT should widely share the learning and evaluation findings with stakeholder organisations in science, technology, engineering and mathematics so that programmes designed to support uptake and interest in STEM subjects are informed by the pathfinder schools' experience and learning.
2. SSAT should draw together the leading practice, learning and resources developed as part of the pathfinder and make it widely available to all schools, as well as encouraging pathfinder schools to share their ideas, learning and resources with other schools.
3. SSAT/DCSF should pursue the idea of a STEM specialism.
4. In order to take on and successfully deliver a STEM specialism, schools should fulfil certain criteria relating to their STEM experience, capacity to

collaborate, strength of leadership, and the clarity of their plans for developing the specialism.

5. In order to sustain a STEM specialism, schools should focus on several key areas relating to the involvement of staff and outside agencies, joint planning and delivery of the curriculum, and development of a STEM ethos.

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