

Does it work?
Evaluating STEM initiatives –
Case Studies



Evaluating STEM initiatives – Case Studies

What are these Case Studies for?

All providers and funders of STEM initiatives, projects and events will want to know how effective their work is – to get a sense of whether it is on the right track, whether it is meeting its objectives, whether it is cost-effective, and how it may be improved. The most effective evaluation helps STEM providers learn more about what they are doing in that:

- it requires clarity in terms of specific and limited intended outcomes for participants; and a willingness and honesty to review progress against these intentions – and to do this all the time
- it moves providers away from simply assessing “What/how much are we doing?” and towards “In what ways, and by how much, are people better off now as a result of what we are doing, and in the longer term?”
- it is considered at the start of an activity and then happens throughout, so that it formatively affects the work providers do – and is not only carried out summatively and after the event.

Approaches to evaluation are as varied as the intentions, scope and ways of working of the STEM initiatives themselves. Many are carried out internally by the project’s staff, while others could involve an external evaluator, or peer organisations and staff. The Case Studies provided here were written to illustrate different approaches taken to the evaluations of STEM initiatives of different sorts – to suggest a starting point for evaluation where it is missing, and help all providers improve their own practice.

What is the starting point for this document?

In 2009, the Department for Children, Schools and Families (DCSF) produced guidance on the evaluation of STEM initiatives (see ‘References’) which the National STEM Centre disseminated in a brief document entitled *Does it work? Better Evaluation: better STEM*. This booklet is available to download from www.nationalstemcentre.org.uk.

The *Does it work?* document includes a flow chart which is intended as a simple schematic for use when planning to evaluate an initiative. It is not a prescriptive list of what should be in every evaluation process – but rather a series of simple prompts that a provider could consider carrying out when starting out with, or further developing, a STEM initiative. The flow chart is reproduced on page one of this publication.

As such, the flow chart is used as a point of comparison with the Case Studies presented here – even if the evaluative work took place before the chart was published.

Where have the Case Studies come from?

The Case Studies were chosen to represent a limited range of continuing professional development (CPD) and enhancement and enrichment initiatives. Although the scales and types of initiative vary, there are elements which can be applied to all STEM initiatives.

Where the main evaluation documents are publicly available, references for them are provided. Reference may also be made to other documents that are not public, but that were produced in addition to the original evaluation.

The text for each Case Study has been approved by the provider organisation that commissioned the evaluation.

What are the Case Studies?

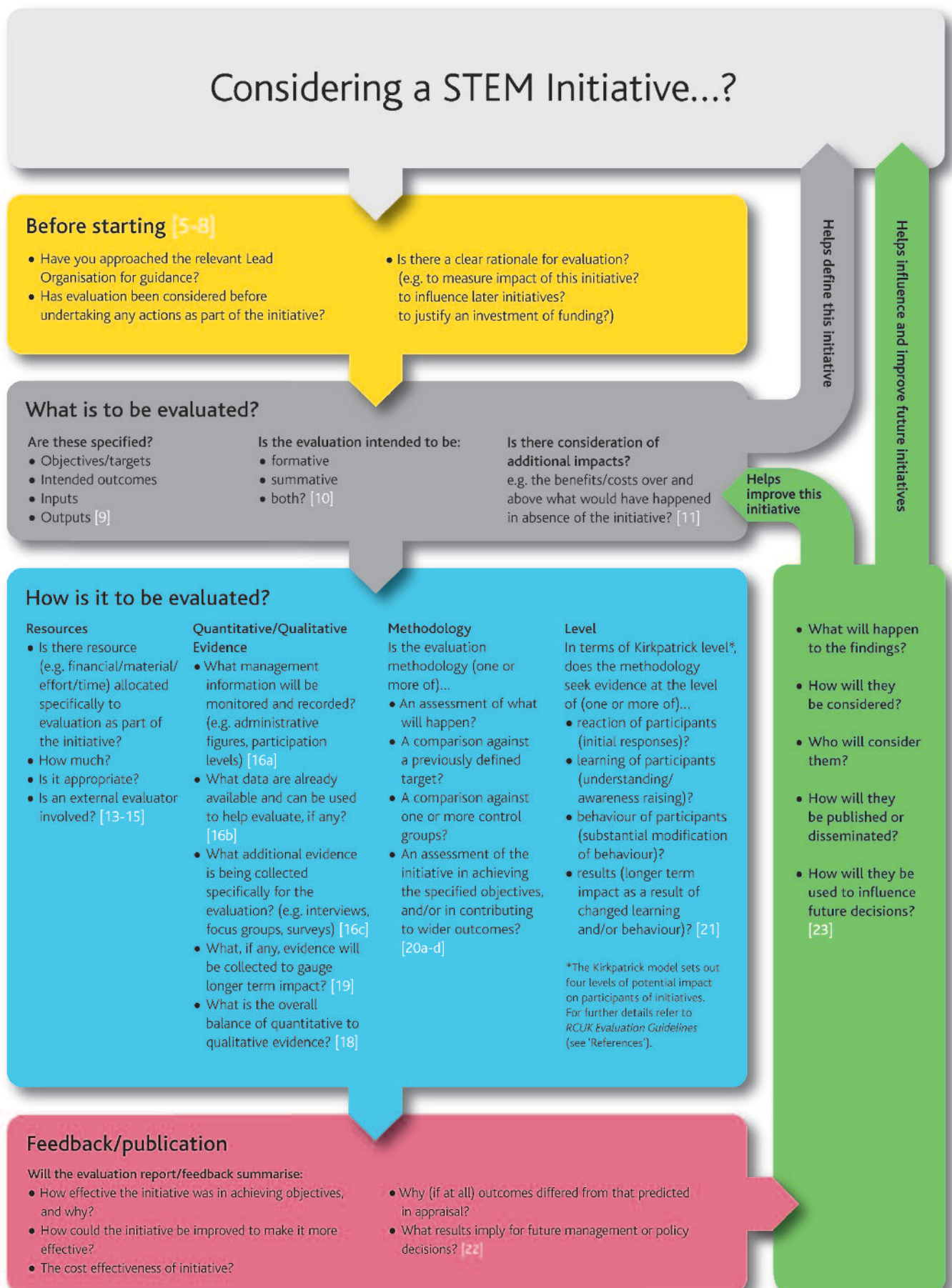
1 FunMaths Roadshow	<i>An enhancement and enrichment project for students</i>
2 Mosaic Magic	<i>An enhancement and enrichment project for students</i>
3 Science Learning Centres courses and events – the CPD “toolkit”	<i>CPD courses and events for teachers and others</i>
4 Chemistry for non-specialists	<i>A CPD programme for teachers</i>
5 CREST Awards	<i>An enhancement and enrichment award scheme for students</i>
6 ASSECs (After-school Science and Engineering Clubs)	<i>An enhancement and enrichment programme for schools</i>

How do I get started?

It is suggested that these Case Studies may be used as follows:

- I. *Familiarise yourself* with the “Does it work?” flow chart prompts.
- II. *Read* the Case Study commentaries with the flow chart prompts in mind. If they are publicly available, it will also help to refer to the actual Case Study evaluation documents themselves to gain greater familiarity.
- III. *Compare* your experience of evaluation of STEM programmes, projects and events with that of the Case Studies.
 - What is different to your evaluative approach?
 - What can you learn to apply and adapt to your work?
- IV. As there is no “one-size-fits-all” approach to evaluation, and no method is perfect, prioritise ways you could improve your approach given the scale of your work.

STEM Evaluation Flow Chart



Case Study

1

Initiative

FunMaths Roadshow

Organisation

Liverpool Mathematical Society

Report details

No report available; and all evaluation activity is carried out internally.

Background to the initiative

The FunMaths Roadshow is a collection of 350 mathematical activities for use with school and college students, and University undergraduates, between the ages of 5 and 20. Led by members of the Liverpool Mathematical Society, the Roadshow is an ongoing attempt to help students experience mathematics in a different way to the classroom. Students apply mathematics to the real world in a non-confrontational and non-competitive setting, encompassing both challenge and enjoyment.

During the programme, participants move around a room tackling a number of activities in any order they choose. Each participant has a customised response sheet to be stamped or initialled by a helper when an activity is successfully completed. In a typical session of 50 – 75 minutes, with students working in pairs, most students will complete a dozen or so activities.

The FunMaths Roadshow has received the support of various organisations during its development, including COPUS and EPSRC under the Partnerships for Public Awareness Scheme.

The evaluation of the activities is carried out by the providers themselves.



Using the flow chart

Before starting

Evaluation is used to gauge the impact of the activities in terms of enjoyment and challenge to the students. The feedback from students and teachers is also used to indicate the level of impact to the EPSRC as funders.

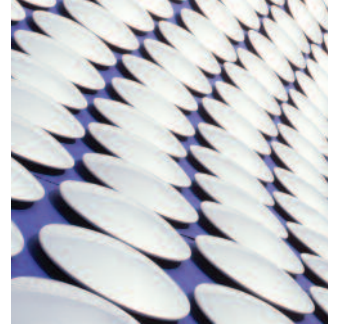
What was evaluated?

The primary objective is to increase the enjoyment and challenge of mathematics, by providing an experience of some elements of what practicing mathematicians do in real-life, including problem solving, insight development, ideas exploration, solution achievement, discussion with colleagues, and outcome interpretation.

While there is no baseline data collected on students, additional impacts of the work are considered in the evaluation in that the teacher questionnaires used after the sessions touch on the developmental effect of the activity on teachers and students.

Formative or summative or both?

One of the main purposes of the evaluation processes that are used is to influence the development of the activities so as to ensure that students continue to engage with them, and ensure they are challenging and enjoyable. The providers analyse the use that particular activities are getting, and subsequently this guides them in development.



How was it evaluated?

Resources

The evaluation of the project is carried out by two to three staff – with resource for evaluation included in the planning and funding of the work.

Evidence and methodology

The evaluation methodology includes:

- **Interaction with participants:** During and after sessions the providers talk with teachers and students to gauge their involvement and level of satisfaction.
- **Student questionnaire:** All participating students are asked to complete a self-evaluation at the end of the session to differentiate their experience of different activities. This self-evaluation is done via a questionnaire where they indicate which activities they have enjoyed and which they have found challenging. The youngest children (early Primary) are asked to stand by the table with the activity they have found most enjoyable, and then most challenging. This gives instant feedback to the providers, and teachers also use the information to guide follow up work.
- **Teacher questionnaire:** Some days or weeks after a session, teachers receive a feedback form. They are asked to respond to statements relating to how the session has helped students in problem-solving, exam preparation, enjoyment, ideas for future lessons, and so on, using a five-point Likert-style scale from 'Strongly Agree' to 'Strongly Disagree'. Teachers are also asked to make additional comments to elaborate on the answers provided.

In this way, quantitative evidence from the evaluation forms (both at and after the sessions) are analysed, while qualitative evidence is considered throughout.

Level of evaluation

The methodology seeks evidence at the levels of:

1. Reaction of participants (teachers and students): This is important, as enjoyment of the activities is a key objective of the work.
2. Learning of students: While this is assessed by teachers and the providers as the sessions take place, the teachers also feed back later on their impressions of the students' developing ability in problem solving, mathematical thinking, and in preparation for exams. Evidence that relates to learning after this point is not collected.
3. Behaviour of teachers: They are asked about ideas provided for future lessons.

Feedback/publication

As this evaluation is carried out internally by the providers there is no formal report produced, although collated evidence is used when accounting to funders.

What happened next?

Evaluation information from the activities and resources across many sessions in a number of schools and colleges is reviewed in order to assess which of the spread of activities have been found to best meet the project objectives, and why. As a result, the activities are regularly updated, amended and adapted, and used in subsequent sessions – and this has happened throughout the project's history.



Case Study

2

Initiative

Mosaic Magic

Organisation

Science Communication Unit, University of the West of England, Bristol

Report details

Bultitude, K., (2007). *Mosaic Magic Summary Report*
www.scu.uwe.ac.uk/files/Mosaic_Magic_Summary_Report.pdf

Background to the initiative

This initiative was a partnership between researchers at the University of the West of England (UWE), a professional artist and a local school. The work was funded by Research Councils UK through a National Science and Engineering Week Award, and managed by the Science Communication Unit at the University of the West of England. The overall aim was to raise students' aspirations and improve their attitudes towards science and engineering through the non-traditional engagement medium of mosaic art.

The project team worked with Year 8 students using interactive activities around the topics of robotics, forensic science and responses to climate change. From these briefing sessions the students worked with an artist to make drawings of their 'visions of the future' as influenced by science and technology. These drawings became the starting point for the design process, and the students' ideas were directly incorporated into the final artwork design. The students then helped to make a mosaic, each student contributing to the overall artwork which is now on permanent display at the school.

The evaluation was carried out by project team members.



Using the flow chart

Before starting

Evaluation of the project was set up to gauge the success of the project for the three partner organisations involved. Evaluative processes were built into the design of the project at the start – and at all stages from preparation to conclusion. Design of the evaluation was based on the team's previous experience.

What was evaluated?

The overall aim of this project was to raise students' aspirations and improve their attitudes towards science and engineering through the non-traditional engagement medium of mosaic art.

Further specific objectives were included in the project planning and expressed as specific intended outcomes. For example, "To involve approximately 100 students in informal discussions about the future with at least three professional scientists and engineers..."; "To involve approximately 150 students in mosaic workshops"; and so on.

Additional impacts of the work were considered in the evaluation by using post-session questionnaires to explore the developmental effect of the activities on teachers and learners, including follow-up with students after the sessions had ended. However, there was no baseline data presented, or use of a control group.

Formative or summative or both?

Although the report is a summary of the overall outcomes of the project, it is clear that the evaluative activity has taken place throughout the project and not just at the end. Observations made during the preparation of the project appear to influence later actions, and observations made during the sessions lead to 'recommendations' which could be used in later, similar sessions.



How was it evaluated?

Resources

The evaluation was carried out by the project team – with resource for evaluation included in the planning and funding of the work.

Evidence and methodology

The evaluation methodology included:

- Consideration of **outcomes from informal discussions** in the preparation stage: This involved the researchers and other team members, and took place prior to engagement with students.
- **Observations of students** at sessions: Aspects such as how the different elements were received by the students, which materials and logistical/structural aspects that were perceived to encourage the students to remain engaged.
- **Student questionnaires, used immediately after** the sessions: Aspects such as the enjoyment and perceived difficulty of the activities, and any changes in attitude to science as a result of the work.
- **Teacher questionnaires, used immediately after** the sessions: Aspects such as the students' enjoyment and perceived difficulty of the activities, and any changes in attitude to science as a result of the work.
- **Student questionnaires, used three weeks after** the sessions: Similar aspects as considered immediately after, but data collected retrospectively. Levels of engagement were also gauged by asking about willingness to take part again if given the opportunity, and whether the student would recommend such activities to others.

Quantitative evidence was analysed from the questionnaires completed at the sessions and after three weeks, and qualitative evidence was also considered throughout. For example, the questionnaires included open-response questions to encourage explanation of the opinions provided, and specific quotes were recorded from participants during the activities.

Level of evaluation

The methodology was seeking evidence, and was able to draw conclusions, at the levels of:

1. Reaction and learning of all participants (including the team members): Immediate responses were taken during all stages of the work.
2. Potential longer term changes in students: Follow-up questionnaires were used to gauge longer term impact on attitudes and potential changes of behaviour of the students involved, rather than relying on "on the day" responses.

Feedback/publication

Conclusions based on evaluation evidence were summarised in the project report. Recommendations are made throughout the report for improvements to different elements of the project. There is a strong commitment towards developing further similar opportunities in the future by all three of the partner organisations.

Despite the small scale of the project, strenuous efforts were made to publicise to a wider audience, and learn from the evaluation that was conducted, so that others running similar future projects can build on the project's ideas and findings. The report was made publicly available via the UWE website and publicised through various means; for example conferences, psci-com, and UWE Masters teaching. A copy of the report including detailed financial information was submitted to the funder. The full documentation relating to the project, including a timetable, risk assessment and the evaluative proformas, are all included as appendices in the report.

What happened next?

UWE built on the learning from this project to run a similar exercise on the theme of evolution in local schools in 2009/2010. "Evolving Communities" involved UWE scientists working with KS3 students in local schools to develop visual artworks as well as scientific demonstrations, all of which then went on display in a local shopping centre. The students and staff then worked together to deliver the demonstrations and engage visitors to the shopping centre with the artworks. Some of the same team members were involved and the existing evaluation report not only helped to secure funding, in this case from the BBSRC, but also greatly assisted the team when planning the new project.



Case Study

3

Initiative

National Network of Science Learning Centres “Impact Toolkit” for teacher CPD provision

Organisation

National Network of Science Learning Centres

Report details

This case study describes an “Impact Toolkit” which is available to participants on Science Learning Centre training events, courses and other forms of CPD.

Results from using Impact Toolkits relating to many CPD courses have been used to compile:

Professional Development in science education – Making a difference
National Network of Science Learning Centres, Report on impact
2008 – 2009

(National Science Learning Centre, University of York, York, YO10 5DD)
www.slcs.ac.uk/research

Background to the initiative

The Science Learning Centre initiative is funded jointly by the Department for Education (DfE) and the Wellcome Trust. The National Network of ten Science Learning Centres (SLCs) provides short and longer-term professional development for teachers of science, including technicians and teaching assistants, in all phases of education. The main aims are to improve the quality of science education and to bring contemporary science into the classroom. The National Centre operates residential programmes for the UK; the nine Regional Centres across England run programmes of varying length and nature.

Developed by the Network, the Impact Toolkit is used in many of the CPD opportunities provided by the Science Learning Centres for participants to record the progress of their professional development.



Using the flow chart

Before starting

Individual CPD courses or events are evaluated to ensure that the Centres are:

- Identifying both development needs and appropriate learning outcomes when planning CPD provision in order to ensure educator and school/college needs are met.
- Considering and planning for the potential impacts of CPD activities, by developing simple and practicable action plans for implementation in schools or colleges.
- Monitoring and reviewing the extent to which these impacts have been realised in order to identify achievement, see where further support may be helpful, and guide future interventions.

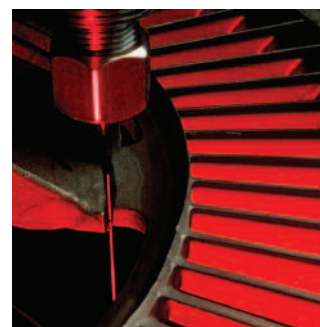
What was evaluated?

Each CPD course or event indicates intended outcomes for participants on all correspondence, websites and at the CPD courses themselves.

It is these outcomes against which participants are asked to evaluate alongside their own identified intended outcomes, for themselves, and their students, colleagues and schools.

Formative or summative or both?

The evaluation is intended to be both summative (in that the course tutors and SLCs are receiving feedback and information on the influence of the course on the participant) as well as formative (in that the participant provides information to the course tutor on their intended outcomes, which allows the tutor to respond to their needs during the course).



How was it evaluated?

Resources

The evaluations are based around pro-formas to be completed before, during and after the courses, and are treated as part of the course provision process. Apart from this, no additional resource is allocated to evaluation of each course, other than the participants’ and tutors’ time taken in the process, and the review of the pro-formas by the Science Learning Centres.

Evidence and methodology

There are three stages to evaluation of the courses and events.

- Participants’ **initial expectations** of the professional development using an “Intended Learning Outcomes” document.

This is to help ensure that participants and their line managers are clear on the outcomes of any provision, as well as being able to influence them at the outset. Participants are asked to complete this document prior to the course. The contents of the forms are then discussed in the course introduction, to help ensure that the participants’ specific needs and expectations are met.

- Participants **action plan** during collaborative sessions using a “Learning and Evaluation Tool” document.

This is to encourage participants to capture and prioritise key learning points, and to begin action planning for any change in their practice. Two versions of the form have been produced to suit the participants – one following a tabular format and the other a more graphic format. During the course and after each session participants are encouraged to reflect on what they have learnt or found useful from the session as bullet point notes. At the end of the course, participants, either individually or with a partner if possible, review the listed learning points in the context of their

Intended Learning Outcomes, and with support from the course tutor develop simple action plans to convert learning into action in their schools and colleges.

- Participants **review the impact** of the professional development to produce a reflective record of the outcomes of the participants’ action plan using an “Impact of your Professional Development” document.

This is used by participants and their line managers to review the actions achieved and report them to the SLC. At an agreed time after the course, this form encourages the participant to consider the impact of the course on their work; to quantify the degree of impact from 0 (no impact) to 3 (significant impact); and to record the evidence used to make this judgement. Evidence might include consideration of improved test/examination grades, findings from observations and feedback from other teachers, and comments from students.

Level of evaluation

The Impact Toolkit can be used to gauge participants’ reaction, learning and changed behaviour, as well as the longer term impact on the results of their work. The degree to which this happens depends on what the participants themselves identify as their own Intended Learning Outcomes i.e. what they consider to be successful outcomes personally and professionally, as well as outcomes for their students, colleagues and school.

Unless the teacher chooses to do so, there is no consideration of additional impacts, for example control groups, before/after and so on.

Feedback/publication

All of the documents are reviewed by the CPD tutor, and the outcomes from the “Impact of your Professional Development” forms are returned to the SLCs for analysis. The combined outcomes of all courses are compiled and reviewed by the Network, and contribute to their reporting to the funders and to the wider education community, for example in the report *Professional Development in science education – Making a difference*.

What happened next?

Feedback on individual courses is used to adjust provision for the participants – whether at the start of the course, formatively during the course, or to influence later courses.

As a result of considering the feedback from participants in courses across the country, in 2009 the National Network of Science Learning Centres committed itself to:

- Design professional development by building on further collaboration with practitioners
- Using the Impact Toolkit on all programmes to aid targeting of professional development and reflection
- Continue to systematically analyse reflective records, combined with follow-up in schools of a stratified sample of participants
- Set up independent studies to explore in more detail the nature of impact and the professional development journeys of individuals
- Increasingly base programmes in schools and school clusters, as well as at Centres.

Case Study

4

Initiative

Chemistry for non-specialists

Organisation

Royal Society of Chemistry

Report details

Jones, M., Harland, J., Mitchell, H., Springate, I. and Straw, S. (2008). *Evaluation of the Chemistry for Non-Specialists Training Programme: Final Report*. Slough: NFER.

Published in August 2008 by the National Foundation for Educational Research, The Mere, Upton Park, Slough, Berkshire SL1 2DQ

www.rsc.org/Education/Teachers/INSET/ChemNonSpec/

ISBN 978 1 906792 07 7

Background to the initiative

Chemistry for Non-Specialists began in January 2007 as a three-year programme of courses which are designed to raise the confidence and expertise of non-specialist teachers teaching chemistry in UK secondary schools. The £1.3M project is funded by the former Department for Innovation, Universities and Skills (DIUS), GlaxoSmithKline (GSK) and the Royal Society of Chemistry.



Using the flow chart

Before starting

The evaluation aimed to explore both the 'soft' and 'hard' outcomes* and impacts of the Chemistry for Non-Specialists (CFNS) programme on teachers and students by:

- Investigating how far the CFNS programme leads to soft outcomes.
- Assessing early indications of how far the CFNS programme may lead to hard outcomes.
- Investigating reasons for drop out from days 1 and 2 to days 3 and 4 of the training programme.
- Exploring programme effectiveness to inform future policy and investment decisions.
- Developing a robust evaluation strategy and processes to investigate longer-term impacts of the programme.

(*'Soft' outcomes refers to any impact on the teachers undertaking the courses; 'Hard' outcomes refers to any impact on the learners who are taught by these teachers.)

The project started in January 2007 and was thus already underway by the time the evaluation work began (February to June 2008).

What was evaluated?

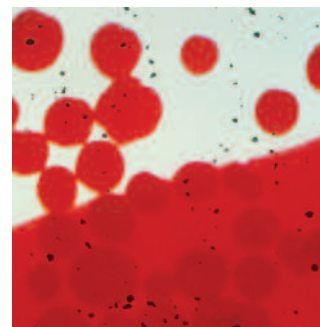
The objectives and intended outcomes of the initiative, as outlined in the evaluation report, are:

- To train 900 teachers per year, providing them with the *confidence, flair and enthusiasm* to teach chemistry at KS3 or KS4.
- To be affordable and high quality.
- To cover key chemistry concepts and provide hands-on experiences of both student practical work and teacher demonstrations.

Additional impacts are considered in that the work attempts to explore the developmental effect of the courses on teachers and learners. However, there is no consideration of what may have happened in the absence of the initiative.

Formative or summative or both?

As can be seen from the aims of the research, although providing summative information on the effects of the courses on teachers, the evaluation was also designed to be formative and to influence future developments and policies.



How was it evaluated?

Resources

The evaluation was carried out by an external evaluator (NFER) following an invitation to tender. The time budgeted for the work was over 100 person-days, and estimated costs of more than £50k.

Evidence and methodology

The work was carried out in two phases to assess the initiative in terms of achieving the specified objectives:

- Phase one – a questionnaire survey to participating CFNS teachers
- Phase two – case studies with participating teachers, plus interviews with Heads of Department or CPD leaders (face-to-face and telephone interviews) and the completion of questionnaires by students.

Quantitative evidence was also considered regarding teacher participation and attendance levels, teacher career and other background information, school data such as type, location, gender information and science and chemistry performance data.

Level of evaluation

The methodology was seeking evidence, and was able to draw conclusions, at the levels of:

1 Reaction and learning of participants

For example, the evaluation report states that "Teachers were generally very positive about the effectiveness of the CFNS programme, indicating that they considered the programme relevant to their needs, appropriate in its content, of engaging delivery, appropriate in its activities and approaches and offering useful materials and resources."

2 Behaviour of participants and results (longer term outcomes on learners)

For example, the evaluation report states that "The programme was found to have strong positive impacts on teachers' confidence to teach chemistry and practical chemistry, their teaching practice and the resources and materials they were able to draw on in teaching chemistry."; "Pupils themselves, tended to agree, rather than disagree, that they understood chemistry better, were doing better in chemistry, used more materials, resources and equipment in lessons and enjoyed it more."

Feedback/publication

Each of the aims of the evaluation are reported on, in turn, in *Key Messages and Recommendations* which also includes suggestions for how to make the initiative more effective, and specifically considers potential implications for the programme's future. The report also makes explicit recommendations to improve evaluation in the next phases of the programme.

There is no reference to the cost-effectiveness of the initiative.

What happened next?

The evaluation showed the courses to be successful on a number of levels. The evaluation report *Executive Summary* states that "Based on the views of the majority of teachers consulted, the programme appears to be meeting its aim to provide non-specialist chemistry teachers with confidence, flair and enthusiasm to teach chemistry."

The recommendations of the evaluation were all considered. However, it was felt that as the courses were shown to be achieving their aims there was no need to significantly change them. While particular consideration was given to cutting down the courses to two days only due to reduced participation for days 3 and 4, it was felt that participants would lose the valued follow-up support and the opportunity to reflect on their learning in the classroom before returning to review any difficulties they had experienced.

At time of writing (Spring 2010), The Royal Society of Chemistry has not yet completed the recommendations made for the evaluation of the longer-term impacts of the programme mainly due to the cost implications involved. A web-based survey is planned to evaluate this at some point in 2010, which will be very simple in order to encourage teachers to complete it.

Case Study

5

Initiative

The CREST Award Scheme

Organisation

The British Science Association (formerly known as the BA)

Report details

Grant, L. (2007) *CREST awards evaluation – Impact study*.

University of Liverpool Science Communication Unit

Evaluation sponsored by AstraZeneca

www.britishsociety.org/NR/ronlyres/F0D49C9F-BFCC-48C7-BC7A-B5C33CCCF4A9/0/CRESTfinalevaluationreport.pdf

A separate part of the same review process made strategic and operational recommendations for the scheme's development. This report is available for internal and CREST stakeholder use only but is referred to here.

Background to the initiative

CREST (CREativity in Engineering, Science and Technology) is the UK's largest national award scheme for project work in the STEM subjects (Science, Technology, Engineering and Maths). CREST provides 11-19 year-olds with opportunities to explore real scientific, engineering and technological problems for themselves, as well as promoting work-related learning. Since CREST was established 24 years ago over 300,000 young people have achieved a CREST award; 25,000 11-19 year-olds achieved a CREST Award in the last year alone. Currently approximately 1,400 schools are engaged in the scheme.

In addition to the award scheme, students have the opportunity to have their work celebrated at Regional and National Fairs.



Using the flow chart

Before starting

The evaluation was a study of the impact of the CREST Awards on participants. The research aimed to identify the impact of the programme, as well as immediate outcomes for the young people and others involved.

The impact study was designed to include the opinions of students, teachers and mentors. The research questions addressed how the scheme is used and the participants' impressions of the scheme. They also addressed the impact of CREST on students, which was explored in the three domains of knowledge and skills; attitudes and aspirations; and intended behaviour.

A separate part of the same review process made strategic and operational recommendations for the scheme's development.

What was evaluated?

As outlined in the impact study, the CREST programme specifically aims to:

- Promote positive attitudes towards science and scientists.
- Provide skills for students in practical science, problem solving and communication skills.
- Raise awareness of the choice and availability of careers in science – particularly at the Gold level.

As a side product of these activities, it aims to:

- Enhance the skills of those who facilitate the scheme i.e. mentors (communication) and teachers (science teaching).
- Raise awareness of the choice and availability of science careers at the Silver and Bronze levels and encourage Gold level students to choose science courses for study in higher education.

Additional impacts are considered in that the work includes questions prompting consideration of pre-existing attitudes to aspects of STEM subjects and career routes, although these questions were asked after the students had been involved in the CREST initiative. There is no consideration of evidence of what may have happened to the participants in the absence of the initiative.

Formative or summative or both?

As can be seen from the aims of the impact study, it was designed to be primarily summative. The scope of the study included strategic and operational recommendations for the scheme's development. This report is available for internal and CREST stakeholder use only.



How was it evaluated?

Resources

The study was sponsored by AstraZeneca, and carried out by the University of Liverpool's Science Communication Unit, acting as an external evaluator. The evaluation budget was between £10k-25k, involving approximately 38 consultant days and 16 administrative days.

Evidence and methodology

The study used a variety of methods.

- Management information: Participation levels and other administrative figures were provided and analysed.
- Questionnaires for students: A questionnaire survey with $n > 500$ was used to canvass the opinions of young people that had participated in CREST during the 2005/6 academic year. A pilot questionnaire consisting of open items was used to develop a series of rating and categorical scales for data collection from the final sample. The questionnaires were distributed to all students that attended the CREST national final in London, and by post to 19 schools that were recruited into the survey by the British Science Association.
- Questionnaires for teachers: Questionnaires were also used to survey over 60 teachers at the national final and by post.
- Focus groups for teachers: A focus group of six teachers was convened which included science teachers that had a range of levels of involvement with CREST.
- Focus groups for mentors: A focus group was also conducted with three scientists who act as mentors at Gold level.

The questionnaires generated quantitative evidence regarding both statistics and opinions which was supplemented by qualitative evidence from the same source, such as participants' opinions of their experiences. Further qualitative evidence was derived from the focus groups. There

is also reference to interviews taking place with key stakeholders, including the British Science Association and Local CREST Coordinators.

Level of evaluation

The methodology was seeking evidence and was able to draw conclusions, in the three identified domains of knowledge and skills; attitudes and aspirations; and intended behaviour. As a result it is possible to consider the different levels of impact as follows:

For students, the CREST schemes produced different responses:

1. At reaction level, for example, "At Bronze, the main message was 'SET can be fun' and students developed teamworking skills."
2. At learning level, for example, "At Gold students developed their problem-solving and report-writing abilities and many said they had learned that they 'want a career in SET'."
3. At behaviour level, for example, "Many students also said that CREST had made them more interested in a career in science (30% Bronze, 33% Silver, 46% Gold)."
4. There was also some indication of the desired results (longer term outcomes on learners), for example, "Some students said that they had chosen or would choose more SET options (e.g. GCSEs or A levels) as a result of their involvement in CREST (16% Bronze, 16% Silver, 18% Gold)."

For teachers, schools and CREST mentors, the evidence led to conclusions mostly at reaction and learning levels, with relatively little indication provided of changed behaviour or long term results and outcomes for them.

Feedback/publication

The CREST programme aims listed above are reported upon in the Executive Summary conclusions.

The additional report on strategic and operational recommendations, written for internal use, included suggestions on how to make the initiative more effective, potential implications for the future of the programme, and how to improve evaluation in any future phases of the programme. Reference to the cost-effectiveness of the initiative is also included in this report.

What happened next?

Recommendations from the impact study (operational and strategic review) have been addressed:

- A stakeholder group with an independent chair was set up to inform the British Science Association's CREST decision-making. This group meets twice a year.
- Steps have been put in place to improve the positioning and identity of CREST in the current educational system and the STEM community. The British Science Association, through CREST, is a key player in the STEM Education Community; collaborative projects include the Big Bang Fair, STEM Directories, National Science and Engineering Competition and the STEM Clubs Network.
- The marketing and branding of CREST has improved – a marketing strategy is in place. The many benefits for students and teachers, identified by the impact study, helps the British Science Association to raise the profile of the scheme.
- A development plan for CREST funding was produced. The findings from the impact study validated the British Science Association's reporting to potential funders and other stakeholders. Their development team now look to a broader base for corporate/institutional support with various expertise. The British Science Association is currently being supported by the Department for Education to expand CREST in England.
- Information and support for teachers, students and mentors has improved – this has included the development of a new website and STEM project resources.
- Improved judging criteria information and quality assurance procedures have been put in place – this has included the formation of a Quality Assurance Group for CREST.
- The British Science Association include the opinions of teachers, mentors and Local CREST Coordinators in any proposed changes to the CREST scheme. Representatives from these groups are members of the stakeholder group. The British Science Association commissioned independent focus groups with teachers and local coordinators in 2008 before changing the resources and assessment criteria in 2009.

Since the impact study was completed in 2007, the British Science Association has increased its focus on evaluation practices. As part of the DfE-funded expansion programme, an independent evaluation team has been commissioned to carry out a formative evaluation study from 2009 – 2011. This study is building on the findings from the 2007 impact study.



Case Study

6

Initiative

After School Science and Engineering Clubs

Organisation

Department for Children, Schools and Families (DCSF)

Report details

Mannion, K. and Coldwell, M. (2008) *After-school Science and Engineering Clubs Evaluation*. Sheffield Hallam University.

www.stemnet.org.uk/resources/reports.cfm?widCall1=customWidgets.contentItem_show_1&cit_id=382753

ISBN 978 1 84775 268 0

Background to the initiative

The After-school Science and Engineering Clubs (ASSECS) programme was established in England following a commitment made in the Government report *Science and Innovation Investment Framework 2004-2014: Next Steps*. (March, 2006).

It is intended that the clubs will contribute to ensuring that the UK has a strong supply of people with STEM skills and to improve young peoples' engagement and interaction with STEM. The Chancellor of the Exchequer committed £5 million to establishing 250 schools to set up and run Science and Engineering Clubs over two years. (2007-09).

The ASSECS programme has been managed on behalf of the DCSF by STEMNET, with further support from the British Association for the Advancement of Science (the BA, now the British Science Association), the national network of Science Learning Centres, Ecsite-uk (now the Association for Science and Discovery Centres), the Association for Science Education and the Specialist Schools and Academies Trust.



Using the flow chart

Before starting

The evaluation was intended as a summative measure of the initiative for this phase, but with suggestions for the future development of the programme. It posed the following research questions:

- What can DCSF learn about the implementation and operation of the After School Science and Engineering Clubs for the possibility of a wider roll out?
- What are the impressions of those running and/or leading the clubs on the impact that they are having in terms of attainment and confidence in STEM subjects and the later choice of STEM subjects?
- What other effects have ASSECS had on practitioners within the schools?

What was evaluated?

The ASSECS programme aimed to:

- enhance and extend the Key Stage Three curriculum;
- improve attainment in, interactions with and experiences of science among those students already showing interest and ability in these subjects;
- encourage these individuals to consider continuing their education in STEM; and
- improve collaboration between schools, and between schools and industry and the research base.

The evaluation report was intended as a measure of the initiative using a twin indicator approach – by separating the project's aims into *enabling* aims and *impact* aims. As a result, for the purposes of the evaluation the programme aims were presented as:

1 *Enabling aims*

- enhancing and extending the Key Stage Three curriculum;
- improving collaboration between schools, and between schools and industry and the research base.

2 *Impact aims*

- improving attainment in, interactions with and experiences of Science among those students already showing interest and ability in these subjects;
- encouraging these individuals to consider continuing their education in STEM.

The bulk of the work was carried out after the ASSECS programme was underway in schools. As such, there is little reference to before/after consideration of impact of the programme, although it is clear that there is feedback from participants when asking for reflection, i.e. they were asked, looking back, to consider how their perceptions have changed. However, the report also includes: "a two stage pupil survey in 50 schools [was carried out], including both club members, and similar pupils who were not club members (reference group). Note, this was not a control group, so comparisons between club members and the reference group were useful but limited."

Formative or summative or both?

The evaluation was intended primarily as a summative measure of the initiative, but it included suggestions for the future development of the programme.



How was it evaluated?

Resources

The study was commissioned by the DCSF, and carried out by external evaluators from Sheffield Hallam University Centre for Science Education and Centre for Education and Inclusion Research. The cost of the evaluation was more than £50k.

Evidence and methodology

In four phases of work over a year, multiple methods were used including:

- A two stage student survey in 50 schools, including both club members, and similar students who were not club members (reference group)
- A survey of staff other than club leaders in these 50 schools
- A survey of all club leaders
- Telephone interviews with club leaders of 20 schools
- Case studies of 10 schools
- A brief survey of 20 schools that decided not to run clubs at all.

The evaluation reports in some detail what happened in the way the clubs were set up – the school and club profile and context – for example, in which types of schools, how they were run, who ran them, attendance (by student gender, ethnicity, ability etc.), types of activity in the clubs, links to the formal curriculum, links with other organisations and sources of support, and so on.

The evidence of impact comprises quantitative data, for example numbers of students with different backgrounds, views and attitudes, outcomes, as well as a significant amount of qualitative data gathered through interviews and the case studies. Some of the latter directly influenced the suggestions for improvement in the report.

Level of evaluation

Impact on students was gauged by the feedback from both students and school staff. There was clear evidence collected regarding the reaction to, and learning while attending, the clubs. There was also collection and consideration of evidence around intended changes of behaviour with regard to future study and career choices. Given the timescale of the evaluation, however, longer term impact on learning of students is not evaluated. Actual changes of behaviour with regard to future study and career choices are also not evaluated, as the programme only aimed to encourage individuals to consider continuing their education in STEM, rather than look at whether they actually did.

Impact on teachers and schools was also gauged for club leaders, other staff, the STEM departments and the wider school.

Feedback/publication

Each of the enabling and impact aims are considered in turn and compared with the evidence gathered, such that a final concluding statement can be provided. For example:

- *Impact aim:* encouraging these individuals to consider continuing their education in STEM
- *Statement:* evidence from all strands of the evaluation show that this aim is being achieved, although more so for Science than for Mathematics and Engineering.

There is extensive discussion and suggestions for development of the project, including barriers and promoters of success in the initiative, and suggestions for policy and implementation for the future of the programme.

There is no reference to the cost-effectiveness of the initiative.

What happened next?

As part of the October 2007 pre-budget report and comprehensive spending review statement, the Government announced plans to fund a further 250 schools through the Science and Engineering Clubs programme. The second cohort of schools started their Clubs in September 2008 and as such their Clubs were expected to run for a minimum of two academic years.

The evaluation echoed sentiments highlighted by the project team and the DCSF that the CPD involved was one of the positive elements of the ASSECs programme, and reinforced the decision to make attendance at the two annual sessions mandatory for the second cohort of schools.

As part of the development of the wider STEM Clubs network, the ASSECs website was replaced with the STEM Clubs website (www.stemclubs.net), to which all ASSEC schools and public users now have access to. The site allows schools to publicly highlight their activities and enables project information to be shared. One of the points for discussion in the evaluation report was the importance of allowing club members to be involved in the direction of the club. The STEM Club site enables students – both club members and older students as mentors – to have access either to post comments but also to edit school content, which some schools have started to do.

Communications to schools are also improved by the use of termly, region-specific newsletters, which ensure that information is tailored to local needs.

One of the strong themes that emerged from the evaluation was that club leaders found CPD and networking events, where they were able to meet with other club leaders, invaluable. As such, events allowing both students and teachers to meet with other club schools have been a prominent feature of the ASSECs programme. These extend beyond the mandatory CPD and include school-hosted celebration events throughout the country and sharing good practice workshops that were funded by the Gatsby Charitable Foundation.



References

1. *Summary of Public Sector Guidance for Evaluation with respect to STEM Initiatives* is available at www.nationalstemcentre.org.uk
2. *RCUK Evaluation Guidelines*, which provide an accessible introduction to evaluation in general is available at www.rcuk.ac.uk/aboutrcuk/publications/corporate/evaluationguide.htm

Acknowledgments

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Notes

The Department for Children, Schools and Families (DCSF) became the Department for Education (DfE) in 2010.

