After-school Science and Engineering Clubs Evaluation

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children, schools and families

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1 Executive Summary

The project

Around 250 schools were funded from 2007-2009 to set up and run After School Science and Engineering Clubs (ASSECs) over two years. They aimed to:

- enhance and extend the Key Stage Three curriculum;
- improve attainment in, interactions with and experiences of science among those pupils 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.

A model hypothesising how *enabling aims* (iii and iv above) could lead to the realisation of the *impact aims* (i and ii above) was used to inform the methodology

Methodology

Multiple methods were used including:

- a two stage pupil survey in 50 schools, 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
- 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

In the event, 174 schools - 71% of the 245 schools which have ASSECs - were involved in the evaluation, including schools which participated in the club leaders survey (158), other club staff survey (22), two pupil surveys (47), club leaders' phone interviews (20) and case studies (10). In addition, 23 schools that decided not to set up a club were briefly asked about their decision.

School and Club Profiles and Contexts

Schools were deliberately targeted by the DCSF to be offered club funding if they were high achieving but had a ‘low conversion rate’ of those achieving Key Stage 2 level 5 Science to Key Stage 3 level 7. Consequently club schools had higher than average percentages of pupils obtaining 5 or more A*-Cs including English and Mathematics, and had more positive than average recent Ofsted reports. Overall, the schools that responded to the club leader survey were typical of the entire club school cohort, however, there was a slight bias in the pupil survey towards smaller schools (<1000 pupils).

Findings

Selection of pupils to join the clubs

- A large majority of schools (79%) used the identification of pupils as being gifted and talented as a recruitment tool, or used open ‘invitation’ methods (74%), with most schools using more than one method. Only 29% of schools used borderline level 6 to 7 (predictions of attainment in key stage 3 tests) as a criterion. Many club leaders identified competition from other after school activities, e.g. drama club, music lessons, after school sports activities, as a barrier to recruitment.

Club organisation

- Most clubs (79%) had a core membership that attended every session, whilst a few clubs (5%) invited additional pupils to specific sessions. A small minority (9%) had different sets of pupils for each activity. In some schools older pupils were used as mentors. Club activity programmes were mainly developed by teachers, although in a minority of cases, pupils' ideas were taken into account.

Engagement with other organisations and support

- Museums and similar venues were most popular with clubs in terms of organising visits, with businesses being the main source of visitors *to* schools. The motivational value of events such as competitions was recognised, although in a minority of schools there was a view that the required time commitment was problematic.

- Most rural schools had not recognised the potential of agriculture and the rural economy as being suitable examples of STEM (Science, Technology, Engineering and Mathematics) business.

- The good practice workshops (organised by the Science, Technology Engineering and Mathematics Network or STEMNET) provided the most opportunity for school interaction, being attended by over 50% of schools but other inter-school links were scarce. Schools valued the BA (British Association for the Advancement of Science) and STEMNET web resources available to support clubs, although a minority of schools were not aware of their existence. Support, where accessed, from SETPOINTs, and the role of the STEMNET regional directors, was valued.

Pupil views on club organisation

- The majority of pupils (80%) thought their club was well organised and over 90% thought that they did interesting things in the club, and the majority of pupils' views about their involvement in their club became more positive the longer they had been a member.

- Most pupils thought they had developed their understanding of what engineers and scientists do (69% and 75%), although most discussions with pupils during case study visits revealed a lot of ongoing misconceptions. More pupils thought the club had helped their understanding of science (64%) and design and technology (D&T) (49%) than mathematics (40%).

Activities and competitions

- The most popular activities (all carried out in 50% or more of schools) were energy and environment, flight and/or rockets, building (and sometimes racing) cars, robotics and electronics. Other research evidence[1] shows that prevalence of 'cars and rockets' activities may be counterproductive with girls

- The majority (62%) of schools had run between 3 and 6 different club topics. Almost all schools (98%) had organised some form of celebration event.

1 Murphey, P and Whitelegg, E., (2006) Girls in the Physics Classroom Institute of Physics, London

Impacts on pupils

- The vast majority of club leaders and other staff saw improvements in practical skills, self-confidence and thinking skills of pupils. A significant majority also noted changing attitudes to and understanding of science, maths and engineering. However, when asked about outcomes relating to achievement, a small majority (e.g. 56% for science) were unsure whether there had been any change, and a small minority (e.g. 3% for science) disagreed that pupils were showing improved achievement, whilst 4% of leaders strongly agreed, and 38% agreed, that pupils were achieving higher in science.

- Pupils who participated in the clubs were, perhaps unsurprisingly, more likely to have positive attitudes to learning related to science and engineering, compared with the reference group, and were more likely to have sustained their interest and enjoyment in science over time. This was particularly true for girls and Year 8 and 9 pupils. Club members were more likely than reference group pupils to state they intend to carry on in education post-16 and go to university.

- Both club members and the reference groups showed a marked preference for studying science post 16 and at university compared with engineering or mathematics. Very low numbers of girls (club members and reference groups) intended to study engineering. However, where it was possible to match pupil responses to the two surveys, the evaluation team found that club members were more likely to have become more positive towards studying engineering at university compared with reference group members, and this was particularly true for girls and Year 9 pupils.

- The pupil surveys suggest that club members are more interested in future science and engineering careers compared with the reference group pupils. Again, girls showed far less interest in engineering as a career. Girls were more likely to have become more positive as a result of club membership about wanting to become a scientist compared with the reference group.

Impacts on club leader and other staff

- Significant majorities of club leaders identified new equipment, better understanding of the STEM agenda, increased STEM profile in school, enhanced collaboration within and between departments, and between parents and schools, and enhanced classroom practice as being benefits of club activity.

- Around half of other staff involved in the clubs had received training for their involvement. Involvement in clubs increased other staff members' perceived level of understanding of science and engineering careers and the STEM agenda, and the majority of respondents indicated their enthusiasm for STEM subjects had grown through involvement in their club.

- There had been a positive impact on staff-pupil relationships, and over half of the club leader respondents indicated a positive impact on their classroom practice and on their subject knowledge. A majority of these respondents indicated an increase in co-operation within and between departments. A large minority of staff identified time to prepare for and to run clubs as the biggest challenge.

Other impacts on the school

- There had been a rise in the profile of STEM across most schools. There is some evidence that the impact of clubs beyond club sessions was linked to the degree of management support.

Case Studies

- The case studies looked in more detail at 10 schools, and these sought to identify contextual factors that may affect how clubs were run, and club impact. In all case studies, the hypothesis that enabling aims (aims 1 and 2) led to the achievement of impact aims (aims 3 and 4) was supported providing strong confirmation that the programme is able to generate at the least short-term outcomes of increased engagement, enjoyment and enthusiasm.

- Club activities that allow pupils to think creatively and work independently create the biggest positive impact on attitudes, as does including pupils in decision making and choice of activities. Transferring club practice into normal teaching sessions was not evident in case study schools, possibly due to the short period clubs had been in operation.

Discussion and Suggestions for Development

- Evidence from all strands of the evaluation show that the aims of the programme are being achieved. However, more positive effects have been seen for science than for mathematics and engineering.

- Some schools have not recognised the availability of support from the clubs website and promotion of the site may need to be improved.

- Management support for clubs is important if they are to have impact in the wider school beyond club sessions.

- Club activities need to be chosen along the interests of the target group to ensure clubs retain their membership e.g. a prevalence of ‘cars and rockets’ activities may be counterproductive with girls.

- STEMPOINT brokerage activity has the potential to address issues of under-utilisation of external resources (e.g. SEAs, visits, enhancement and enrichment schemes).

- Good practice case studies, coupled with CPD, can address issues such as equality and diversity stereotyping, effective management of club activity, and the use of agriculture and the rural economy as a STEM context.

- There is a need for more Mathematics activities for clubs.

- Schools should be encouraged to develop more comprehensive approaches to STEM activity.

2 Introduction

2.1 Key Points

Around 250 schools were funded from 2007-2009 to set up and run After School Science and Engineering Clubs (ASSECs) over two years.

They aimed to:

- enhance and extend the Key Stage Three curriculum;
- improve attainment in, interactions with and experiences of science among those pupils 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.

A model hypothesising how *enabling aims* (iii and iv above) could lead to the realisation of the *impact aims* (i and ii above) was used to inform the methodology

2.2 The programme

The After School Science and Engineering Clubs (ASSEC) programme was established in England following the commitment made in the March 2006 in the Ten Year Science and Innovation Investment Framework 2004-2014: Next Steps.

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).

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. This second cohort of club schools will commence in September 2008.

The ASSEC 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), the national network of Science Learning Centres, and the Specialist Schools and Academies Trust.

2.3 Programme aims

The clubs aim to:

- enhance and extend the Key Stage Three curriculum;
- improve attainment in, interactions with and experiences of Science among those pupils 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.

Sheffield Hallam University's Centre for Science Education and Centre for Education and Inclusion Research were commissioned to evaluate the programme's early progress towards meeting these aims.

2.4 The policy context

Prior to the Roberts Review, *SET for Success* (HMT/Roberts, 2002), which looked at the national situation regarding the supply of scientists and engineers in the UK, a complete picture had not been constructed of the problem of declining progression into STEM subjects. A key aspect of the Review was its focus on the whole *supply chain,* starting with school STEM education, and leading ultimately through to highly qualified research scientists and engineers working in research and industry. The problem that stimulated the review was not new. Ever since the rise of the 'industrialised society' in the nineteenth century, Britain has had problems producing the right number of scientifically and technically capable people, compared to its competitors (Burgess, 1985). However, the seismic shifts in the global economy occurring in the late 20th century and the increasing importance of Science-based innovation in ensuring national competitiveness set a difficult-to-ignore alarm bell ringing. The most coherent response to the issue was captured in Sir Gareth Robert's seminal report, and in the various responses from government, particularly the *2004-2014 Science and innovation investment framework* (H.M.Treasury, DTI, DfES 2004)), and the *Next Steps March 2006* update of policy. The latest statement on STEM policy, *Race to the top* (Sainsbury, 2007) reiterates and expands on these points.

The Roberts Review cited evidence of increasing attainment in STEM subjects, but of ongoing decline in progression into the study of STEM subjects and careers.

'There is much concern that, during their time in school and further education, pupils are turning away from the study of Science, technology, Engineering and Mathematics. This is a significant factor in explaining the difficulties experienced by employers in recruiting people with high level Science and Engineering skills.' (Roberts, 2002, p33)

Some commentators have argued that market forces, e.g. increasing salary levels in STEM employment, or importing skills from abroad, were more likely to provide solutions to the STEM skills shortage (Shamos, 1995 - cited in Osborne et al 2003). This has been a widely held view in some sections of the Science education academic world. However, Osborne goes on to cite evidence of a direct link between national prosperity, and the proportion of Science and Engineering graduates in a population (Osborne et al 2003)[2], which suggests that it would be foolhardy not to address the identified problem of the 'drift away' from STEM subjects at school.

The Roberts Review identified a number of significant issues that need to be addressed to reverse the decline in progression rates. These include:

- Shortages in the supply of Science and Mathematics teachers
- Out of date scientific laboratories and equipment
- The ability of courses to inspire and interest students
- Ineffective or inadequate careers advice and guidance

He went on to make a series of recommendations, which provide the main thrust of the policy initiatives described in 2004-14 Investment Framework document, with further impetus provided by *Next Steps* (2006).

Coherence and co-ordination in STEM support: demand side, and supply side

Implementation of many of the recommendations and policy initiatives as set out in the 2004-14 Science and innovation investment framework, and the Next Steps policy update is now underway, based on the *STEM Programme Report* (DTI, DfES, 2006). A forward plan, taking the Actions set out in the STEM report, is now being implemented, structured around a series of 11 Action Programmes, as identified in *Race to the top* (Sainsbury, 2007).

[2] Osborne's paper (p1052) quotes the following figures for the number of Science and Engineering graduates per million of the population: Japan 3584; USA 2685 Europe 1632; Latin America 209; Asia 99; Africa 53.

Box 1.1

Action Programmes to raise standards and increase equality and diversity through

Recruitment of Teachers and Lecturers
AP1 Improving the recruitment of teachers and lecturers in shortage subjects *Lead Organisation: TDA*

Continuing professional development of teachers and lecturers
AP2. Improving teaching and learning through CPD for Mathematics teachers *Lead Organisation: NCETM*
AP3. Improving teaching and learning through CPD for Science teachers *Lead Organisation: National Science Learning Centre*
AP4. Improving teaching and learning by engaging teachers with Engineering and technology *Lead Organisation: RAEng*

Enhancing and enriching the curriculum, both inside and outside the classroom, to motivate students towards STEM
AP5. Enhancing and enriching the Science curriculum *Lead Organisation: SCORE*
AP6. Enhancing and enriching the teaching of Engineering and technology across the curriculum *Lead Organisation: RAEng*
AP7. Enhancing and enriching the teaching of Mathematics *Lead Organisation: ACME*

AP8. Improving the quality of advice and guidance for students (and their teachers and parents) about STEM careers, to inform subject choice *Lead Organisation: The National STEM Careers Co-ordinator (at Sheffield Hallam University)*
AP9. Widening access to the formal Science and Mathematics curriculum for all students, including access to triple Science and second Mathematics GCSE *Lead Organisation: DCSF*
AP10. Improving the quality of practical work in Science *Lead Organisation: SCORE*
Improving infrastructure and delivery mechanisms
AP11 Programme to build capacity of the national, regional and local infrastructure
Lead Organisation: DCSF

These initiatives are designed to impact positively on a variety of measurable factors, but all lead to two key indicators; improvements in pupil attainment, and improvement in progression rates into post-compulsory school study of STEM subjects and careers, including teaching. These have long been national priorities. Improvement in attainment, in all subjects, has been a constant theme of government policy for many years and some success has been achieved in terms of a general year-on-year rise in key stage assessment results and GCSE pass rates. However, and paradoxically, this has been achieved against a backdrop of an ongoing decline in the popularity of careers and qualifications in STEM subjects, in particular the physical Sciences, Engineering and Mathematics. More pupils are gaining A and A* grades in Science and Mathematics, but fewer of them are choosing these, or STEM subjects in general, post 16.

This *twin indicator* approach is reflected in the two *impact* aims for the Initiative, that is,

- improving attainment in, interactions with and experiences of Science among those pupils already showing interest and ability in these subjects;
- encouraging these individuals to consider continuing their education in STEM.
- the evaluation team have based our approach in this evaluation on the premise that the ASSEC Initiative is based on the hypothesis that these two aims can be achieved by realising the other two enabling aims, that is:

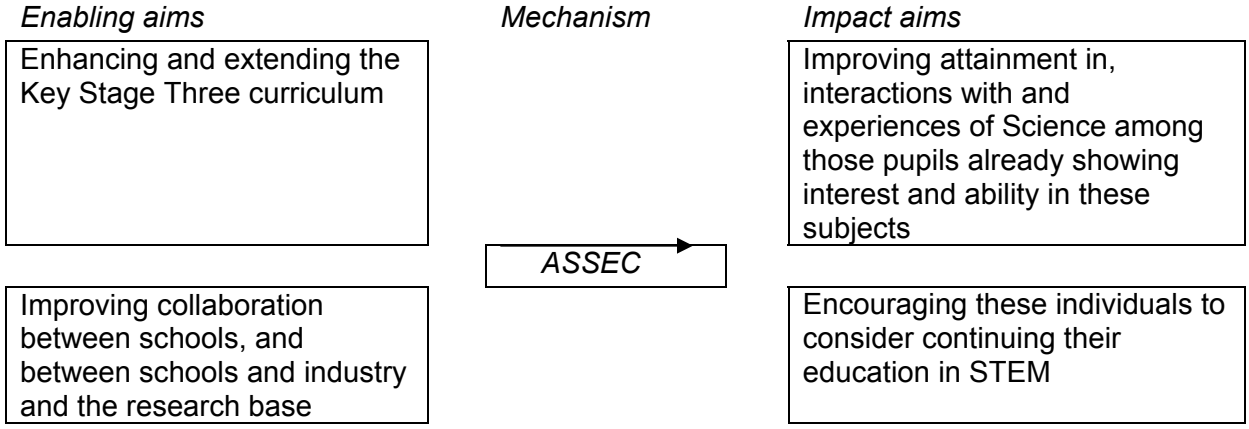
- enhancing and extending the Key Stage Three curriculum;
- improving collaboration between schools, and between schools and industry and the research base.

Clearly, it is not as simple as this, but this mutually supportive relationship between *enabling* aims and *impact* aims provided a simple foundation upon which the evaluation has been built.

Interestingly, much effort is being put into rationalising the *supply side* of the STEM Market to make it more intelligible to teachers. The ASSEC initiative provides a way for the *demand side* to become more effective in making use of that market, through the potential for schools to develop more coherent STEM policies and practices. Investigating the degree to which schools are maximising their involvement in the Initiative in this way has been an important aspect of the evaluation, as it would be an indicator of longer term sustainability of the uptake of STEM interventions, including but not restricted to ongoing club involvement.

2.5 Aims of evaluation

At an early point, the evaluation team interpreted the DCSF's aims for ASSEC in order to construct a hypothesis that the team believe the initiative is setting out to test. That is, *After School Science and Engineering Clubs (involving E&E activity and collaborations with external organisations) will increase pupil attainment and positive disposition to STEM progression.*



Including the supplementary issue of barriers to setting up such clubs, the team interpreted the DCSF's requirements as requiring 3 evaluation elements:

1) A process evaluation (focussing on Enabling aims), to produce realistic recommendations about
   a) best practice; and
   b) consequent recommendations for an envisaged wider roll out of this initiative, in coming years.

2) Pupil progress as determined by
   a) the professional judgement of teachers and others;
   b) intended subject choice at GCSE and A-Level
   c) Attitude of pupils to STEM subjects;
   d) Attitudes to future careers in STEM areas;
   e) Changes in any other general attitudes towards school, work, education etc.

3) An identification of barriers to schools' participation in the scheme

These elements should combine to answer 3 research questions:

a) 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? (To be answered via elements 1 and 3)

b) 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? (To be answered via element 2)

c) What other effects have ASSECs had on practitioners within the schools? (To be answered via element 1).

Given the *open system* nature of the ASSEC initiative, that is, each club will have unique characteristics (club format, school background, participating subjects, involvement with external organisations etc) the evaluation team have tried to contextualise the answer(s) to the question *what works*, to create a *what works, for whom, in what circumstances, and to what outcomes?*, through the use of a methodological mix involving quantitative as well as qualitative analysis.

2.6 Structure of report

In this summative report, the evaluation team draw on a number of data sources as outlined in Section 3, Methodology, to examine the contexts of the clubs (Section 4), evaluation findings (Section 5) and conclusions and recommendations (Section 6).

3 Methodology

3.1 Key Points

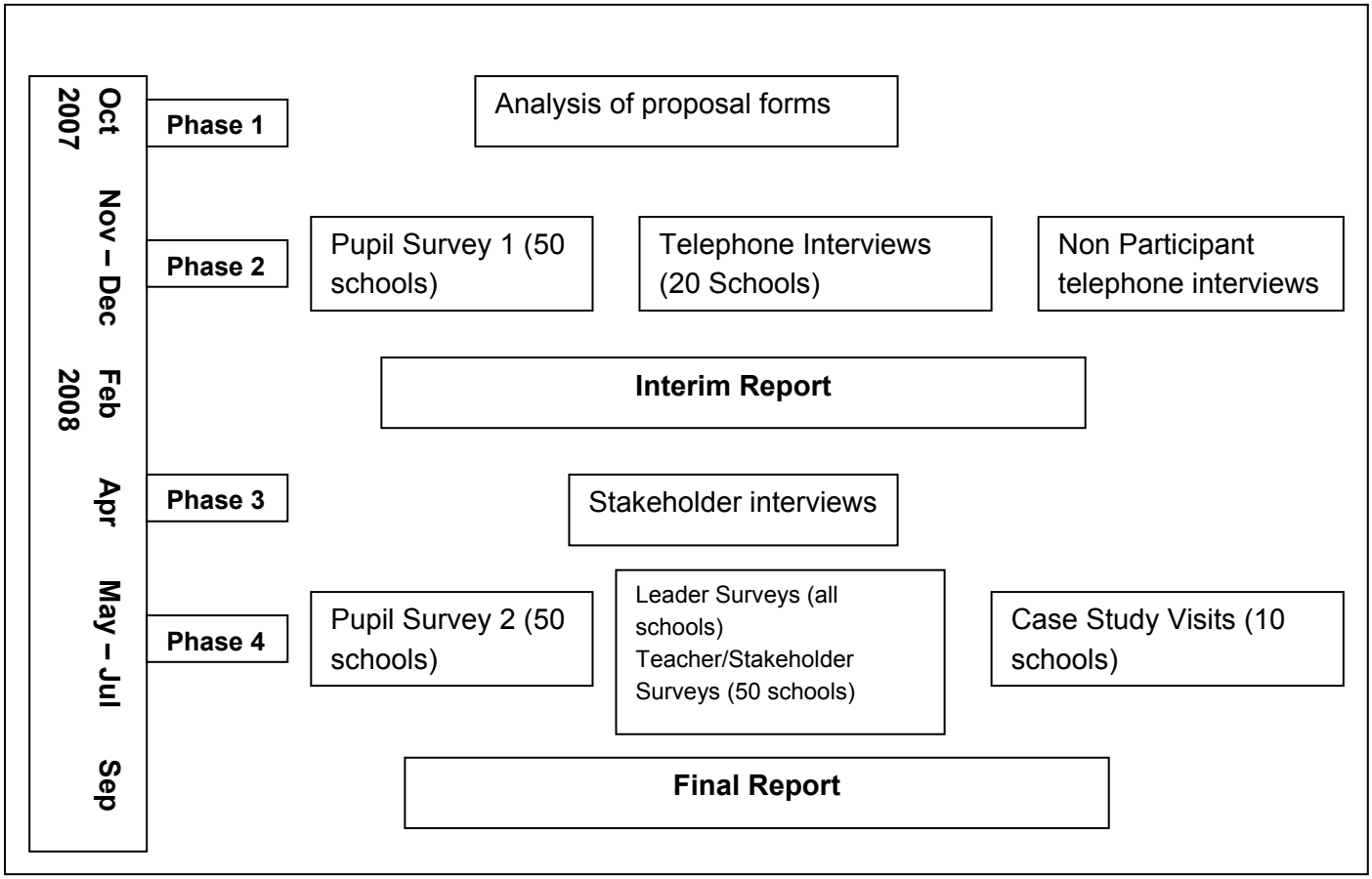
Multiple methods were used including:

- a two stage pupil survey in 50 schools, 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
- 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
- In the event, 174 schools - 71% of the 245 schools which have ASSECs - were involved in the evaluation, including schools which participated in the club leaders survey (158), other club staff survey (22), two pupil surveys (47), club leaders' phone interviews (20) and case studies (10). In addition, 23 schools that decided not to set up a club were briefly asked about their decision.

3.2 Overall methodology

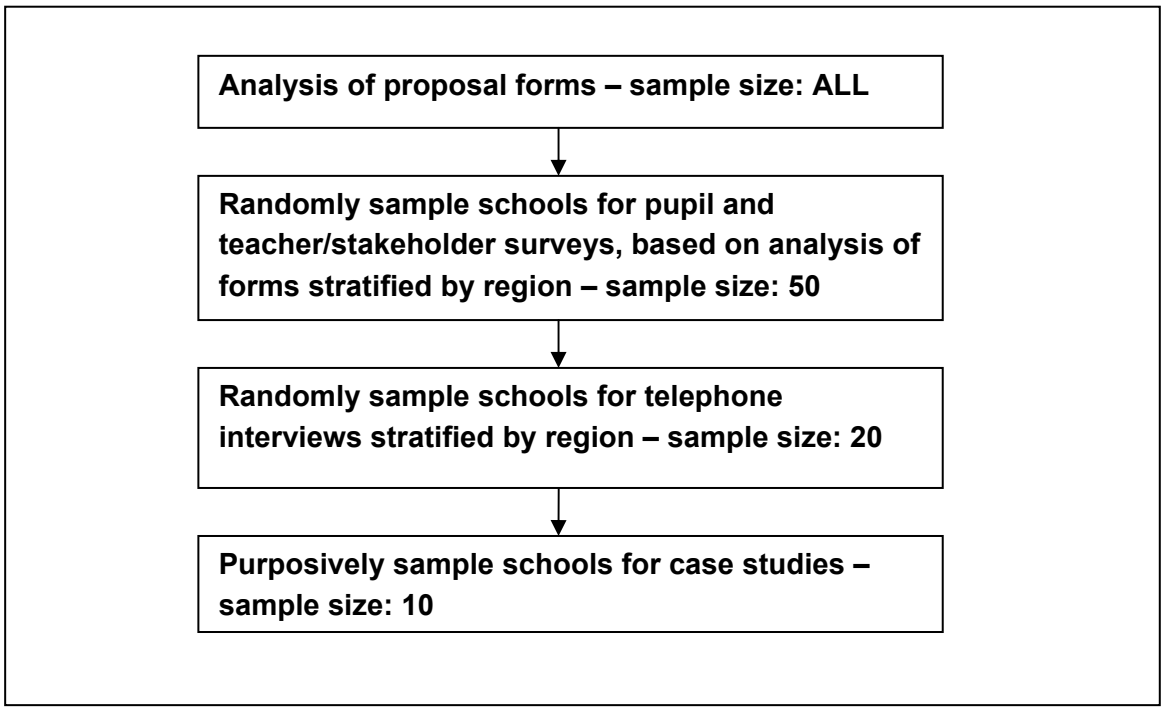
The evaluation team implemented an inter-related, multiple method methodology. The methodology and sampling strategies that were initially proposed are summarised in Figures 2.1 and 2.2 below.

Figure 2.1: Outline of methodology



As Figure 2.1 indicates, a 4 phase study was undertaken. The Research Brief reported on data collection for phases 1 and 2. This final report utilises data from these earlier phases, and integrates them with findings from phases three and four. Figure 2.2 outlines the sampling strategy.

Figure 2.2: Outline of sampling strategy



To gain the initial sample of 50 schools, the team created a matrix of schools involved in the programme (using data from proposal forms) according to region and prior involvement in a club. The team also took account of whether pupils were mainly selected or the club was open o all in our sampling. The team then randomly ordered the schools in each 'cell' of the matrix, and invited schools, starting at the top of the order, to take part in the pupil (see Phase 2 and Phase 4) and other staff survey (see Phase 4) elements of the evaluation. This enabled the team to create a stratified random sample of 50 schools in this way.

Table 2.1 Summary of evaluation methodology

Evaluation method	Total schools invited (n)	Schools participating(n)	% response rate	Individuals participating (n)
Club leaders' survey	245	158	65%	158
Other club staff survey	45	22	49%	53
1st pupil survey	50	45	90%	1019
2nd pupil survey	45	37	80%	1068
Both pupil surveys	45	34	76%	603*
Club leaders' phone interviews	20	20	100%	20
Non-participant telephone survey	43	23	53%	23**
Case study visits	10	10	100%	75

***** 603 pupils stated to have participated in both surveys; 421 returned completed questionnaires for both surveys.

** SHU were asked to interview 20 non-participating schools

Table 2.1 indicates the extent of coverage achieved in the evaluation. In fact, overall, **174** schools - **71% of the 245** schools which have Science and Engineering Clubs - were involved in the evaluation, including schools which participated in the club leaders survey (158), other club staff survey (22), two pupil surveys (47), club leaders' phone interviews (20), case studies (10). In addition, 23 schools which had not set up a Science and Engineering Club participated in the non-participant telephone survey.

The evaluation also involved in a significant number of pupils, both club members and members of the reference group: **1019** for the first pupil survey and **1068** for the second (Table 2.1). Among the pupil survey participants, **603** stated that they participated in both surveys, although only 421 returned completed questionnaires for both surveys.

Table 2.2 below indicates that the club leader survey was broadly representative by region. South East and London clubs were under-represented in most other elements of the research; otherwise, there was no systematic under or over-representation of schools in particular regions.

Table 2.2: Regional distribution Clubs

Evaluation method	S East	London	North West	West Mids	East England	East Mids	South West	Yorks & Humber	North East	Total
% of total (n=245)	17%	15%	14%	12%	11%	9%	9%	8%	6%	100%
% of total (n=158)	17%	14%	13%	14%	13%	10%	8%	6%	5%	100%
% other staff survey (n=53)	4%	0%	11%	21%	15%	19%	15%	8%	8%	100%
% 1st pupils' survey (n=45)	11%	11%	13%	13%	13%	13%	9%	7%	9%	100%
% 2nd pupils' survey (n=36)	8%	6%	14%	17%	14%	14%	8%	11%	8%	100%
% tel interviews (n=20)	10%	10%	15%	15%	15%	10%	10%	10%	5%	100%
% Case study visits (n=10)	0%	20%	20%	0%	10%	10%	20%	10%	10%	100%

3.3 Individual elements of the evaluation

For detailed information about the individual elements of the evaluation please see Annex 1.

3.4 Analysis

A discussion of the analysis of the first phase of pupil questionnaires, the telephone interviews and the non-participant interviews is included in the interim Research Brief.

For the leader survey, data were input to SPSS and frequency tables or charts generated for all questions. All relevant results are presented as percentages with total numbers annotated. For analysis of the club projects the evaluation team also used Excel, conducting some bivariate analyses, but variable and often low numbers for individual responses precluded reliable statistical analysis in many cases.

Quantitative data collected from the pupil surveys was input in an SPSS dataset for each of the two surveys. The pupil surveys are analysed and presented in two forms here. First, the team include a comparison of responses across the entire group at point one and point two, separately for the project and reference groups. This provides an indication of the views across the projects early in the programme and at a later point. This does not give a good indication of changes at an individual level, since the two groups are not identical. However, it does give a picture of the different views across the group as a whole at these two time periods, and as such is valuable when looking at the programme as a whole. Second, for pupils who completed

both questionnaires, the team conduct an analysis of changes in expressed views at the two survey points. This gives a more robust picture of change, although given that the surveys were completed at an early point in the programme - but not before the programme began - this analysis is likely to underplay some real changes that are related to engagement in the programme. Together with the other data sources, however, these two analyses reveal a rounded view of impacts from a range of viewpoints and data sources.

For the wider staff survey, quantitative data were inputted to SPSS and frequency tables or charts were generated for all questions comparing data from teaching staff and non-teaching staff. Due to the small numbers of respondents all relevant results are presented as values. Variable and often low numbers for individual responses preclude reliable statistical analysis. Qualitative data were collated under a number of broad headings and analysed using a thematic approach.

For the Case Studies, each case study school was compared to the logic model (see 2.2.6), which shows the expected linkages causal linkages between resources, inputs, activities, outputs and outcomes. All data (from interviews, observation, documentation etc) were interrogated with a series of overarching questions regarding how the club was being run, the activities and collaborations, and the impact on pupils, and on the school beyond the club. From this, ten short Case Reports were constructed. These are presented in Appendix 1.

4 Profiles and Contexts

4.1 Key Points

Schools were deliberately targeted by the DCSF to be offered club funding if they were high achieving but had large numbers of level 5 to level 7 non-conversions.

Consequently club schools had higher than average percentages of pupils obtaining 5 or more A*-Cs including English and Mathematics, and had more positive than average recent Ofsted reports.

Overall, the schools that responded to the club leader survey were typical of the entire club school cohort, however, there was a slight bias in the pupil survey towards smaller schools (<1000 pupils).

4.2 School contexts

School profiles were created for all 243 schools that completed the ASSEC proposal process to the specified time limits. In addition to this, two other schools took part in the leader's survey but were not included in our school profile sample as the evaluation team do not have access to their proposal information. Schools were deliberately targeted by the DCSF to be offered club funding if they were high achieving but had large numbers of level 5 to level 7 non-conversions.

The following data were collected for all 243 schools:

- school name
- region
- school specialism
- location
- admissions type
- selective status
- age range, size
- gender mix
- percentage obtaining 5 A*-C's at GCSE or equivalent
- percentage obtaining 5 A*-C's including Mathematics and English
- attendance data
- overall Ofsted judgements

These data were collected from ASSEC proposal forms and online resources (schools' own websites, schoolsnet, DCSF and Ofsted websites) and inputted to SPSS. Frequency tables were generated for all variables.

As can be seen from Table 2.2, our survey sample was spread across all 9 regions in England. Overall our sample was distributed proportionately. All schools were asked to take part in the leaders' survey and a regionally stratified sample of 50 schools was created for the other staff survey as well as both pupil surveys.

The location of the respondents who took part in the leader and pupil surveys are representative of our overall sample (see table 3.1 in Annex 3).

However, rural and urban locations are over-represented in our other staff survey sample and suburban schools are under-represented. The data from the telephone interviews (which was summarised in the Interim Report Research Brief) indicated that the geographical location of the school had a direct impact on the club impacting timing, activities and links with external organisations. For rural schools this was particularly apparent. However, responses to this challenge varied with schools taking an integrated approach to the club, running it within the school day to using a proportion of the available funding to provide transport home:

'Getting home is an issue. When we set up the club we had to make sure the kids were aware that we could provide transport. And we do provide transport for about a third of the group. That comes out of the budget. If we hadn't set that up I don't think we would have got half the applicants we did get, because most of the students are bussed in the morning and back again at night. So we did have to offer that, being in a rural school. I don't think being a rural school influences what we do in the club, I think what we've been doing is such a general topic it would apply no matter where you are. We don't really consider where we are in terms of what we do, we just think of what would interest the students.' School 7

While the rural location of the above school has not influenced the focus of the club or type of activities run funding has given schools in deprived, urban areas the opportunity to run activities and go on trips which previously would not have been possible:

'[This is an] urban deprived area so children can't go on trips, pay for activities. Funding has allowed club to run different activities which school wouldn't normally be able to run.' School 12

The geographical location of schools has posed different challenges to clubs. Clubs have responded to these challenges in different ways dependant on their particular environments.

Table 3.2 (which can be found in Annex 3) indicates that each of our survey samples is broadly representative of the overall sample of all clubs in terms of admissions type. It does indicate, however, that the clubs engaged in the programme are more likely to be Foundation or Voluntary Aided schools, and less likely to be Community schools.

Similarly, our survey samples are representative of the overall sample in terms of the selective status of schools (see Table 3.3 in Annex 3). However, selective schools are over-represented significantly in the schools with clubs.

Table 3.4 (which can be found in Annex 3) shows that 47% of our overall sample had a STEM specialist status, in line with national figures for all secondary schools. The respondents of our leader survey are broadly representative of this with 50% of schools having a STEM specialism. However STEM specialist schools are over represented in our other 3 surveys.

Table 3.5 (which can be found in Annex 3) shows that the leader survey sample is representative of the overall sample in terms of school size, but it should be noted that the largest and smallest schools are under-represented in the pupil and other staff surveys. Sizes of schools with clubs are broadly representative of all secondary schools in England.

Table 3.6 (which can be found in Annex 3) shows that the majority of the schools (79%) in our overall sample are mixed. The remainder are split relatively evenly between Boys' schools (9%) and Girls' schools (11%). All four of our surveys reflect this. The proportion of schools with clubs that are single sex is well above the proportion nationally. Since single sex schools are much more likely to be selective than mixed schools[3], this is in line with the over-representation of selective schools in the sample of schools with clubs noted above.

To give an indication of the representativeness of the samples in terms of attainment (measured by the percentage of the cohort obtaining five or A* to Cs including Mathematics and English at GCSE or equivalent) and attendance (measured by overall percentage absence), the team utilised published DCSF performance tables data for 2007. Table 3.7 (which can be found in Annex 3) shows that the data for all aspects of the research were close to the figures for all clubs, with only the other staff survey and Pupil survey w showing a slight mismatch. The overall data for clubs shows that the schools with clubs had similar attendance to schools across England, but were higher performing, by an average of 12.5 percentage points. This is not surprising as schools were deliberately targeted by the DCSF to be offered club funding if they were high achieving but had large numbers of level 5 to level 7 non-conversions.

[3] "30% of single sex schools are grammar schools" - DCSF (2008) The Composition of schools in England, p32

In examining Ofsted judgments (Table 3.8 in Annex 3), it can be seen that, as with other aspects our research, the leader survey is representative of the overall sample. The judgements of the schools with clubs when compared with judgements for all secondary in England 2007/8 indicate that the schools with clubs are judged to be performing better, on average, than secondary schools in England.

4.3 Club contexts

4.3.1 Staffing

Table 3.1 below indicates the spread of staff across clubs. All clubs included Science teachers, with over 10% including 4 or more. 75% involved D&T teachers, but in most cases this was just one teacher. Similar numbers involved technicians, but very few involved other support staff. Typically, a club involved 4-6 staff, with 97% involving more than one member of staff.

Table 3.1 Number of different types of staff involved with each Club

	Number of staff involved with Club							
Post	**0**	**1**	**2**	**3**	**4 to 6**	**7 to 10**	**More than 10**	**Total Clubs responded**
TEACHING STAFF								
Science teachers (n=157)		38%	31%	18%	10%	1%	1%	100%
D&T teachers (n=151)	24%	58%	15%	3%				100%
SUPPORT STAFF								
Technicians (n=147)	24%	55%	16%	3%	1%			100%
Teaching assistants (n=131)	89%	8%	2%	1%				100%
Other non teachers n=133)	83%	13%	3%	1%	1%			100%
TOTAL CLUB STAFF (N=129)		3%	11%	25%	45%	15%	2%	100%

All club leaders that responded to the leaders' survey were members of Science departments, although Table 3.2 indicates that they had various roles in their department. When the team cross-reference this group with the data from proposal forms, this indicates that a number of clubs appear to have shifted from being led by a non-Science department to the Science department. The proposal form data indicates that a fifth of the sample moved from initially intending to have a club run by non-Science departments to a Science department.

Table 3.2 Club leader roles

Club leader's job title	Percentage of responses
Head of dept	35%
Responsibility in dept	18%
Other teacher	8%
Senior school leader	35%
Teaching assistant	1%
Technician	1%
Other	4%
Total (n= 158)	102%*

*% are rounded up to the nearest whole number

Of the 53 staff who took part in the additional staffing survey, the majority (74%) of responses were received from Science departments, one response was received from a teaching assistant working across departments and the remaining 25% were received from people working within other STEM departments. As with the leader survey, this revealed a difference when compared with the intentions laid out in the proposal forms regarding collaboration with departments out with the STEM subjects, in which 14% of schools stated on their proposal forms that they were planning on involving teaching staff who worked out with STEM departments. These other departments included Geography, Art, English and Religious Studies, all of which have important and stimulating connections with Science. Of course, our finding does not necessarily mean that non-STEM staff are not involved in ASSEC clubs, but rather that they did not respond to our survey. 36 responses were received from teaching staff with the remaining 17 from non-teaching staff.

4.3.2 Composition of Clubs

Figure 3.1 indicates that, from the leaders' survey, there were 19 girls' schools, 14 boys' schools, and 21 schools with exactly equal numbers of boys and girls in their Science clubs. Of the rest, a greater number had more boys than more girls. Thus, altogether slightly more boys than girls took part in the scheme, with1582 boys compared with 1386 girls in the clubs whose leaders completed the survey. This level of participation of girls is encouraging.

Figure 3.1: Proportions of boys and girls in individual Science Clubs (%)

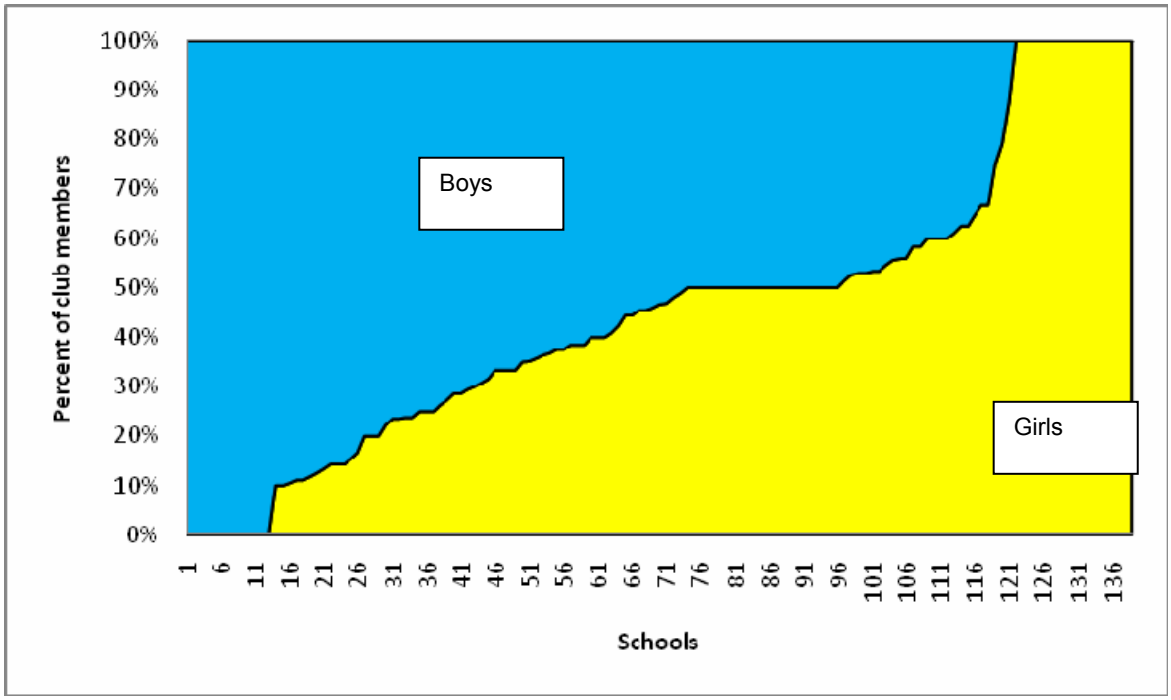


Table 3.3 Characteristics of pupil survey respondents

First survey (n=1019)						
Year group	**Year 7**	**Year 8**	**Year 9**			
%	17	54	29			
Gender	**Boy**	**Girl**				
%	49	50				
Ethnicity	**White**	**Black**	**Asian**	**Mixed**	**Other**	**NA**
%	85	2	4	5	1	3
Free school meal	**Yes**	**No**	**DK**	**NA**	**Club member**	**Class**
%	6	92	2	0	5	7
Science Club member	**Yes**	**No**	**NA**	**Boys**	**Girls**	
%	48	49	4	56	43	
Second survey (n=1068)						
Year group	**Year 7**	**Year 8**	**Year 9**			
%	26	46	28			
Gender	**Boy**	**Girl**				
%	47	52				
Ethnicity	**White**	**Black**	**Asian**	**Mixed**	**Other**	**NA**
%	85	2	4	4	1	3
Free school meal	**Yes**	**No**	**DK**	**NA**	**Club member**	**Class**
%	4	92	3	1	5	4
Science Club member	**Yes**	**No**	**NA**	**Boys**	**Girls**	
%	47	52	1	54	45	
Participated in the first pupil survey	**Yes (n=603)**	**No**	**NA**			
%	57	40	4			
Time in ASSEC (n=500)	**<1 month**	**1-3 months**	**4-6 months**	**7-12 months**	**>12 months**	
%	3	7	18	59	13	

In the first pupil survey, nearly equal numbers of club members and reference groups completed the questionnaire, but slightly more reference group pupils took part in the second.

Over half of the first survey respondents (54%) and 46% of the second survey respondents were in Year 8, though the second survey had 9% more Year 7 pupils, compared with the first survey. Amongst the total respondents of the first survey there is an almost equal gender distribution, whereas slightly more girls than boys participated in the second survey. However within the Science clubs, there are more boys. This is consistent with the findings from the club leader survey (see Figure 3.1) suggesting a slightly unbalanced gender composition in the clubs with more boys (53%) than girls (47%) taking part in the programme nationally.

Looking at the ethnic balance of respondents, the majority of respondents (88.8%) classified themselves as White British, and 11.2% as belonging to other ethnic groups. 5.2% were entitled to free school meals. These figures are lower than the national average[4] for secondary school pupils from minority ethnic groups (19.5%) and entitled to free school meals (13.1%).

According to the second pupil survey, the majority of members have been in clubs for more than 6 months (72%); with 13% of them for more than one year. 18% of club members have taken part in the clubs for 4-6 months, and only 10% for less than 4 months.

This composition of pupil survey respondents provides a dataset which enables an examination of attitudes towards Science and Engineering by comparing different groups of pupils. In addition, 60% of the second survey respondents (603 of 1068) participated in both pupil surveys which means the pupil data collected allows the team to explore further the changes of pupils' attitudes over time.

[4] DCSF (2008) *SFR09/2008: Pupil characteristics and class sizes in maintained schools in England, January 2008* http://www.dcsf.gov.uk/rsgateway/DB/SFR/s000786/SFR_09_2008.pdf last accessed 21st August 2008

5 Findings

5.1 Processes and project focuses

5.1.1 Selection

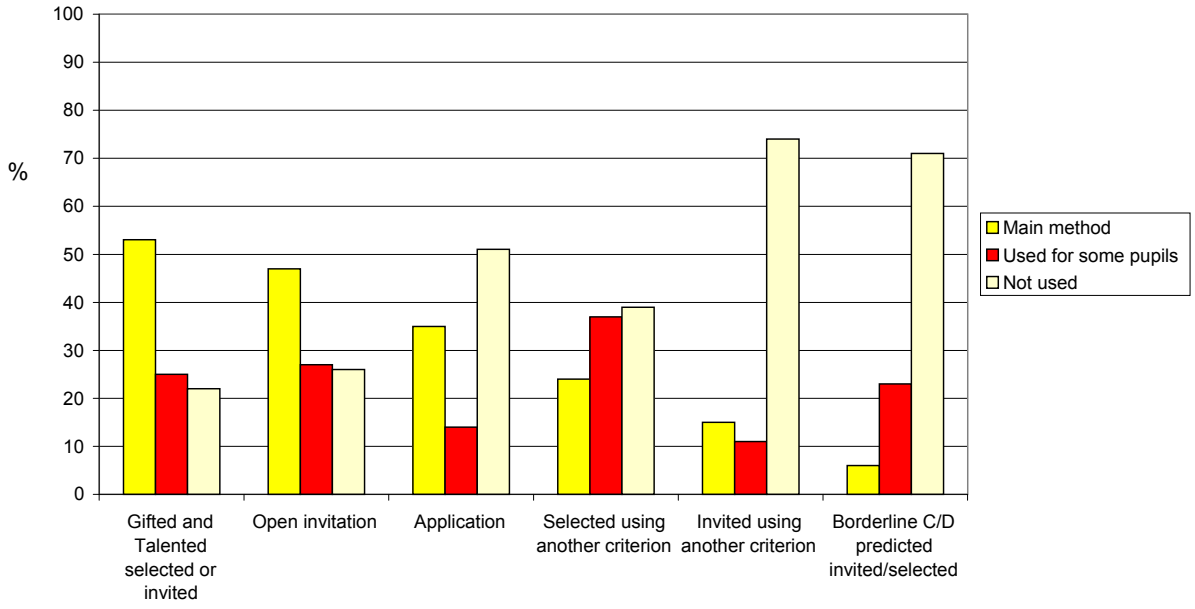
Key points - Selection of pupils to join the clubs

- A large majority of schools (79%) used the identification of pupils as being gifted and talented as a recruitment tool, or used open 'invitation' methods (74%), with most schools using more than one method. Only 29% of schools used borderline level 6 to 7 (predictions of attainment in key stage 3 tests) as a criterion.

- Many club leaders identified competition from other after school activities, e.g. drama club, music lessons, after school sports activities, as a barrier to recruitment.

The leader surveys indicated that a variety of methods were used to recruit pupils to the club. Figure 4.1 shows that the over half used a 'gifted and talented' criterion as main method of recruitment, and over three quarters (78.5%) used it in some form. Open invitation was the next most popular, used in 74% of cases. It is interesting that only 29% of clubs used Borderline predicted Level 6/7 as a selection criterion, since under-performance at the expected level at KS3 was one of the reasons used for selecting schools to be involved. It should be noted that 33% of the clubs surveyed used more than one main method, and around 30% had refused to allow at least some pupils to join the club.

Figure 4.1: Methods of recruitment to Clubs (%)



The telephone interviews supported this finding that a variety of selection processes were used to recruit club members and that a mixed methods approach was popular. Many teachers stated that enthusiasm for being in the club was as important as ability:

'We wanted to look at level 6 pupils, with the idea of them enjoying Science as much as possible in Y8 so they didn't get put off as much as they might otherwise have done by the curriculum. Try to keep them engaged. But how to convert that into people? So I went for everyone who wanted to apply, had 29 applications, accepted 28 - couldn't do any more. The other one is on the list to start next term (there is a waiting list). So, in fact, just those who

showed interest. The idea was it is meant to enhance the curriculum in an enjoyment not learning sense, so to let in anyone who might want to enjoy Science.' School 13.

Other schools focussed purely on ability:

'I went to the top two sets that we had and offered it up there to start with, we were sort of looking for a number in the 15 range, if we had many more kids, managing it would be a bit more tricky so we went for two fairly good groups, we kind of got that angle from the people who were running it that they were the sort of kids that they wanted.' School 4

Some innovative selection strategies included producing a mini scientific project and involving outside 'real life' scientists to interview potential club members:

'If they want to come along they have to do a project about a famous scientist. If they show enough work and commitment they can come along. It's working well. I wrote to them all, started with 16 of the 25 who had responded, and had a waiting list at the end of last year. As Y9s went to Y10, we could accept those on the waiting list. Kids want to come along and see what they do, and then do the project.' School 1

Some teachers were surprised by the pupils who wanted to join the club which allowed them to see the benefit of their mixed approach to selection:

'That was surprising, the different groups of students that applied for it. The students that we thought would apply didn't, I don't know why, because we told them could have transport home and we made sure that anybody could come. But we had a completely different group. We had the one or two who are really committed to technology, that wasn't a huge surprise, but in the Science, like some of the girls who applied we just had no idea that they would be interested at all.' School 7

While club membership was in some settings seen as a reward for good behaviour within school others took the opposite approach to enthuse those students who normally don't engage with Science within the classroom:

'There were one or two students who applied and we didn't think it would be appropriate, based mainly on the way they behave in Science and technology lessons, we felt if they couldn't behave in those lessons they didn't deserve to be rewarded for that bad behaviour by getting extra clubs. Even within the club we've told them that if their behaviour in school deteriorates we will have to ask them to leave. Whereas if their behaviour in school did improve we could change our decision.' School 7.

Many club leaders stated that they were competing with other extra-curricular activities and clubs (both within and out with school) when recruiting and retaining club membership:

'There were some we wanted to come who weren't enthusiastic about it, some it was not their top priority, some just had something on every night of the week, either at home or at school. This school does a lot of after school clubs it's also an arts college so there's lots of drama and productions, and sport, and music.' School 8

5.1.2 Club organisation

Key points - Club organisation

- Most clubs (79%) had a core membership that attended every session, whilst a few clubs (5%) invited additional pupils to specific sessions. A small minority (9%) had different sets of pupils for each activity.
- In some schools older pupils were used as mentors
- Club activity programmes were mainly developed by teachers, although in a minority, pupils' ideas were taken into account.

According to the club leader survey, the vast majority of clubs (79%) involved a single core group. A very few invited others to occasional activities (5%) and perhaps most interestingly 9% invited a different sets of pupils for each activity. Having got the group together, again the vast majority of clubs carried out projects over several weeks (96%) and involved the pupils themselves in planning the activities (92%) at least some of the time (see Table 4.1 below). Almost all the clubs operated on weekdays after school, which some telephone interviewees mentioned as allowing more time and a more relaxed environment than a lunchtime club, and 15% additionally met at weekends for particular events. Six clubs met always or usually at weekends, and very small numbers met during the school day, usually for reasons of transport.

Table 4.1: aspects of Club organisation

	Always	**Most of the time**	**Some of the time**	**Rarely**	**Never**	**n=**
Meet at weekends	2%	3%	10%	19%	66%	135
Involve pupils in planning activities	12%	29%	51%	5%	3%	150
Carry out projects over several weeks	31%	41%	24%	3%	1%	157
Involve older pupils to support the sessions	18%	16%	23%	19%	24%	143

Using older pupils as mentors, sometimes by accident, was seen as being beneficial both to club members and to the helpers themselves in the telephone studies:

'One year 11 doing BTEC was making fun of the club - saying my little brother's got to go to the club, and had been winding him up. Then she found out about building solar powered racers she ended up wanting to come along and give a hand, so we have a few Year 11s almost helping us by teaching.' School 1.

The telephone interview data indicated that different approaches were taken to organising and running activities. Some club leaders organised the activities while others involved club members in decision making. These data reveals that 17 out of the 20 clubs interviewed were entirely staff-led with only 3 involving club members in overall decision making:

'The first meeting we had, I got their feelings on what they wanted to do, obviously I had my ideas about what I wanted to do, they basically just wanted to blow things up or make cars, some of the original ideas I had were to do some fun activities to start with, and we did some work on sensor and how sensors work, and they bring a lot of the stuff in, they have ideas, and then we use those ideas to go forward, I have my topics and projects that we want to do, but they bring things in too, I do get their ideas.' School 4

The club was set up 'in collaboration with the SETPOINT Director. He suggested some ideas and I discussed them with colleagues. The pupils had already described their ideas so it was very collaborative I think.' School 11

The teacher-led approach implemented by the majority of clubs had a strong impact on the subject focus of activities ran in the club with one teacher remarking that the clubs' focus is *'driven by what staff can and want to do'* (School 15). Similar sentiments were expressed by other respondents (ASSEC Interim Report 2008):

'I mean to some extent it caters to our interests, as a physicist I'm more into rockets than I am into other things we could have done. But it is very much Science and Engineering, it is geared that way anyway. We wouldn't be doing a biology project in a Science and Engineering Club. So it was a certain amount of what we were interested in, but it was always going to involve vehicles of one sort or another. It was simply a case of which staff volunteered to do it on that basis.' School 8

There was some evidence in the Case Study schools that the degree of pupil choice or input affected motivation, with high levels of engagement shown were pupils were able to make decisions about themes and activities to be carried out.

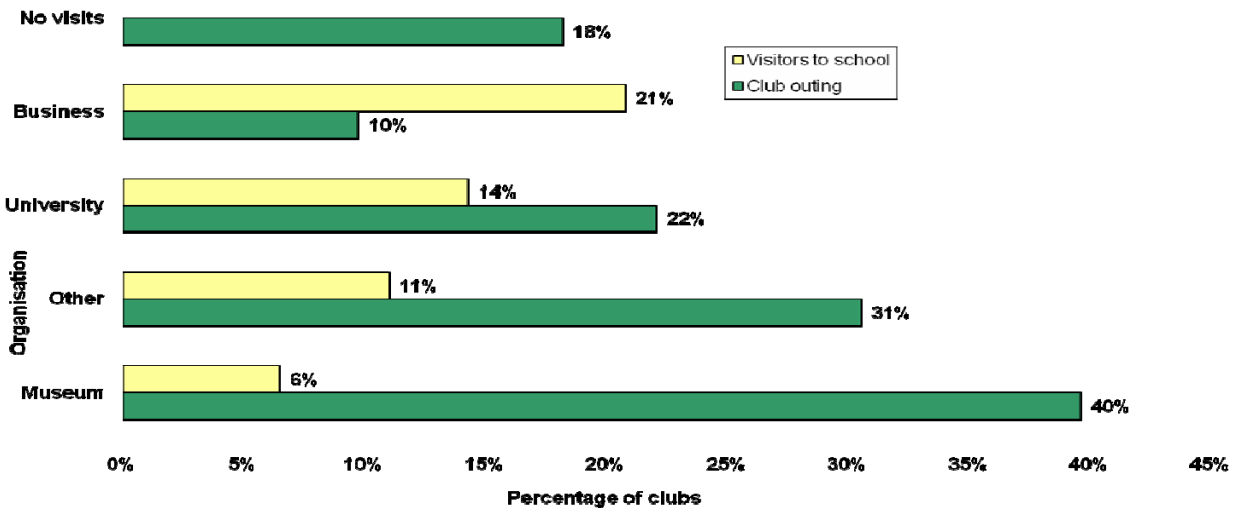
5.1.3 Engagement with other organisations and support

Key points - Engagement with other organisations and support

- Museums and similar venues were most popular with clubs in terms of organising visits, with businesses being the main source of visitors *to* schools.
- The motivational value of events such as competitions was recognised, although in a minority of schools there was a view that the required time commitment was problematic.
- Most rural schools had not recognised the potential of agriculture and the rural economy as being suitable examples of STEM (science, technology, engineering and mathematics) businesses.
- The good practice workshops (organised by the Science, Technology Engineering and Mathematics Network or STEMNET) provided the most opportunity for school interaction, being attended by over 50% of schools but other inter-school links were scarce.
- Schools valued the BA (British Association for the Advancement of Science) and STEMNET web resources available to support clubs, although a minority of schools were not aware of their existence. Support, where accessed, from SETPOINTs, and the role of the STEMNET regional directors, was valued.

The Leaders' survey indicated that there was a range of engagement with visits to and from different organisations and institutions. Figure 4.2 indicates that museums or similar (such as discovery centres) were most popular with clubs, followed by visits to a range of other institutions including go-kart or motor-racing, "Brainiac" at local theatres and the Centre for Alternative Technology in Wales and then university visits. It is interesting to note that less than 10% of clubs visited a business and only a fifth had been visited by one, however some visits to workplaces such as dockyards were classified as "other" rather than "business". Some visits from non-business professionals, such as a pathologist, archaeologist, optician and astronaut, were also successful. Several schools visited other schools and/or went out to take part in competitions. Eighteen percent had no involvement with visits or visitors.

Figure 4.2: Club visits and visitors to Club



It can be seen, from open comments in the other staff data, that the contacts that were made and maintained through club visits were viewed by teachers as being a major benefit of the programme, for example one noted that:

'Industrial links give an opportunity to motivate students and participate in activities not allowed in curriculum due to time constraints.'

A mixed response regarding club visits and links to external organisations is also clear from the telephone interview data. Again twelve out of the twenty schools have made, or plan to make industrial links. These links seem to be connected to the length of time the schools or individual staff members have been involved in out of school Science, technology and Engineering activities.

However, it should also be noted that out of the eight schools that had not made any industrial links, seven mentioned that they thought making contact with businesses was problematic. The reasons for this included limited teachers' time, the time needed to maintain and sustain these links as well as the apparent lack of Science-based industry in rural areas:

'No, we haven't unfortunately, the area we're in there aren't really any local industrial links. Because it is a rural area we don't have those sort of links in the area, but it would be nice to make those links. The industry is mostly arable farming; yes I suppose we could see that as a Science and technology industry these days, we hadn't really thought about it like that.' School 7

This view of the scarcity of STEM-related external resources (e.g. businesses) in rural areas also came across in several Case Study schools. It perhaps indicates a need to promote agriculture and the rural economy as suitable exemplars of STEM business and contexts.

Interschool links were sporadic amongst the schools who took part in the telephone interviews. Schools with pre-existing clubs were more likely to have some links with other schools either through competitions, or shared activities. As would be expected, these links tended to be between schools that were located in the same geographical area. This is a greater challenge for rural schools.

Data from the telephone interviews also reveals that schools were to varying degrees aware of the broader STEM agenda. This resulted in teachers having a variety of attitudes to STEMNET and SETPOINTs. A positive attitude to STEM was expressed by club leaders from six out of the twenty schools while another six appeared to be unaware of STEM related issues.

A number of schools drew attention to the practical and helpful resources available on the ASSEC website particularly in regard to ideas and examples of club activities:

'So the ideas really came from the Science and Engineering Club thing, the materials that came from them, "this is your starting point" and it was easy to go from there. You go through the website and booklet, sign up for things and they send you more details.' School 8.

At the other end of the spectrum one teacher who stated that he "*wasn't aware that there was a STEM agenda*" at his school and was also sceptical of policy initiatives in general, was surprisingly impressed with the ASSEC initiative:

'……this funding is the first time in say the last 10 years that I have seen anything useful that's come out as a government initiative that has improved the quality of teaching and learning in the school.' School 13.

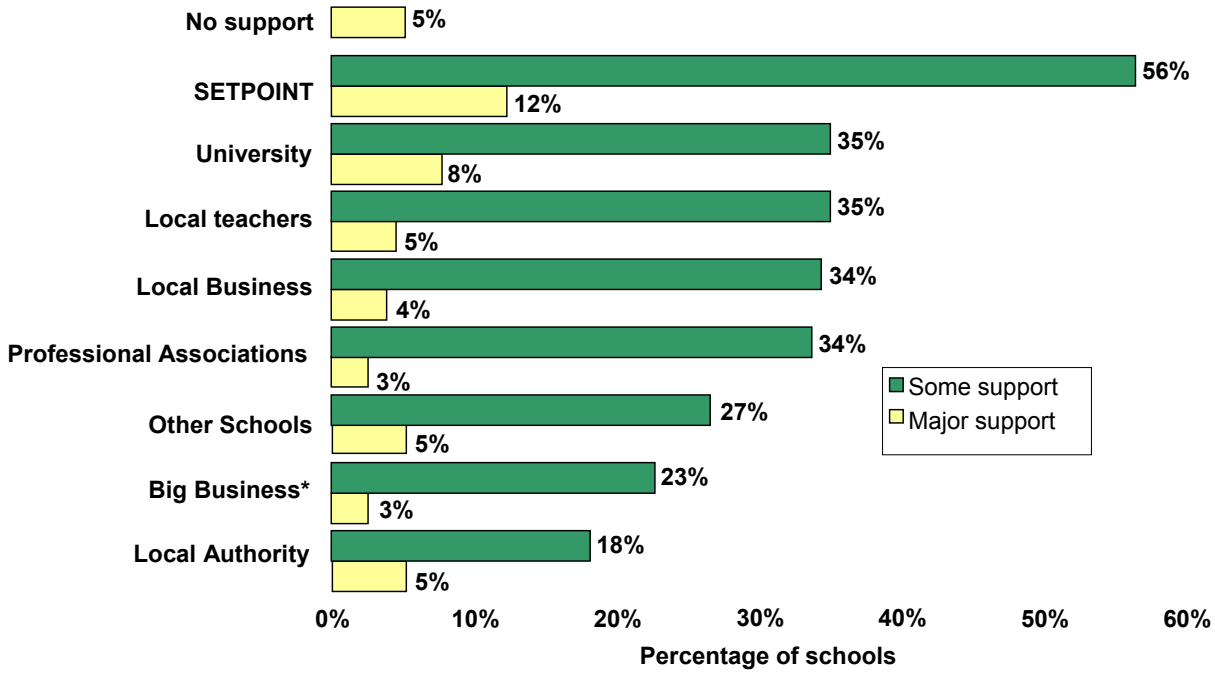
Given the central role of SETPOINTs[5] in providing schools with access to STEM enhancement and enrichment activities, the low level of involvement in clubs is worth noting. Six schools positively referred to SETPOINT, though two schools were basing this on future plans to interact with SETPOINT rather than on past or current experience.

Only seven of the twenty schools indicated that external contacts had influenced their plans for the clubs. Thirteen schools stated that they had received no external input at the club's planning stage though some did mention that they had sought help at this point in the process. The level of external input noted above is greater than indicated by this. This may be indicative of the way some schools view external support organisations (e.g. STEMNET, SETPOINT) as project and activity providers rather than sources of guidance in developing enhancement and enrichment activities.

Among newer staff members the initial STEMNET meeting to set up the club was valued. The same individuals stated that opportunities for further networking would be welcome (See the ASSEC Interim Report, 2008).

As illustrated in Figure 4.3, the leaders' survey indicated that schools made use of a variety of support, the most popular being SETPOINT (68%), with other teachers and universities used more than industrial contacts. It should be noted that 5% of the schools that took part in the leader survey said they had received no external support at all.

Figure 4.3: Sources of support (leaders' survey)



(* "big business" includes national/international business or industry)

[5] From August 1st, 2008 SETPOINT contracts ceased to exist. In general, SETPOINT contracts were held by larger, host institutions, or by businesses that 'traded as' SETPOINT in their sub-region. From August 1st, a new network of sub-regional organisations holding STEMPOINT contracts with STEMNET is providing STEM brokerage services, which will involve advising all schools and colleges on the availability and suitability of STEM Enhancement and Enrichment activities. The STEMPOINT contract does not however include any element of delivery but some of the host organisations may provide delivery services independently of the STEMPOINT contract. Some, but not all, STEMPOINT contracts are held by organisations that previously held SETPOINT contracts, some, but not all, original SETPOINT hosts organisations will continue to provide STEM support services, as may many other organisations and individuals.

The use of external resources such as SETPOINTs, SEAS, E&E schemes, and engaging with businesses, was low across the Case Study schools. This may be addressed through the new STEMPOINT Brokerage contracts. Greater school-level awareness of external resources would seem to be needed.

5.1.4 Celebration events

Key point - Celebration events

- Almost all schools (98%) had organised some form of celebration event.

Celebration events (events, prizes, displays) were seen as important in terms of raising awareness of STEM within the school and the local community, as well as recognising achievements of the pupils who have taken part. This was emphasised at the outset when the clubs were set up, and most schools indicated that they would hold celebration activities on their proposal forms. From the leaders' survey (Table 4.2, below) the team saw that 80% of schools had already held some celebration and a further 18% planned to do so.

Table 4.2: Celebration events held or planned

	Event only	Display only	Prize only	Other only	More than one celebration	Any event
Held	7%	12%	6%	3%	51%	80%
Planned	1%	2%	1%	1%	13%	18%

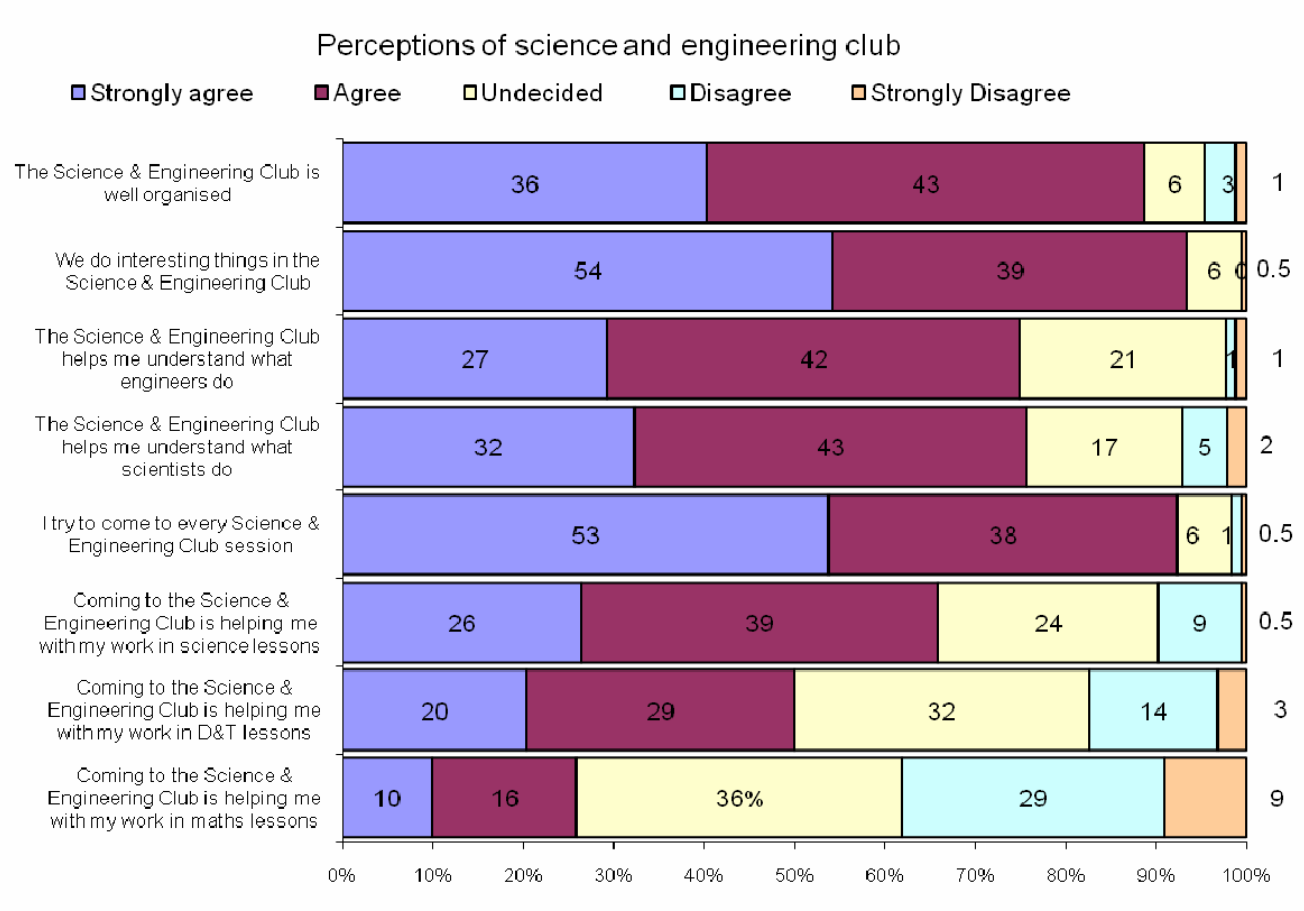
5.1.5 Pupil views on club organisation

Key points - Pupil views on Club organisation

- The majority of pupils (80%) thought their club was well organised and over 90% thought that they did interesting things in the club.
- Most pupils thought they had developed their understanding of what engineers and scientists do (69% and 75%), although most discussions with pupils during case study visits revealed a lot of ongoing misconceptions.
- More pupils thought the club had helped their understanding of science (64%) and design and technology (D&T) (49%) than mathematics (40%).
- Pupils' views about their involvement in their club became more positive the longer they had been a member.

Figure 4.4 shows that the majority (nearly 80%) of club members stated that their club was well organised. Over 90% thought they did interesting things in the club, and more than half (54%) strongly agreed with this statement. Compared with Year 7 and Year 9 pupils, Year 8 pupils enjoyed their clubs most with 92% of them agreeing that their club is well organised and 94% saying they do interesting things in the club (Table 2 Annex 4a).

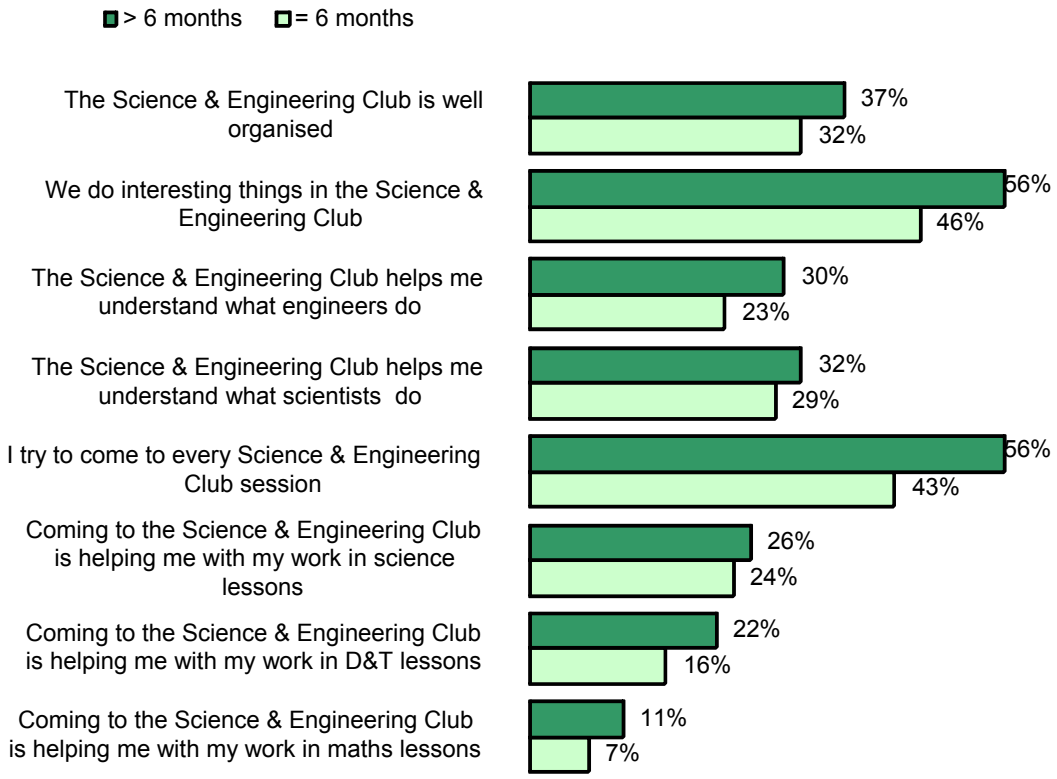
Figure 4.4: Pupil perceptions of the clubs



Around 70% of the pupils said that taking part in the clubs helped them to understand what engineers and scientists do, although evidence from the Case Study schools where pupils had been in direct contact with researchers showed a lack of pupil awareness of Engineering and Engineering careers. Around two thirds of club members thought the club was helping with their work in Science lessons and nearly half said it helps in D&T lessons. However only slightly over a quarter of club pupils felt it was helping them in Mathematics lessons, with nearly 40% of club members disagreeing with this statement. These findings tie in with attitudes to further study and career choice in these subjects as noted in the next sections. A higher proportion of girls (43%) than boys (34%) held such negative views (Table 1 in Annex 4a). The connection between club activity and STEM subjects is covered more fully in section 4.1.6 below.

Looking at pupils' perceptions of the clubs with respect to the duration of their club membership, it is interesting to find that the longer pupils' club membership is, the more positive views they have over all aspects of the club, in particular with the contents and activities of the club, as shown in Figure 4.5. Over half of those who had been in the club for more than 6 months stated that they did interesting things in the club and tried to come to every club session. This may suggest there is greater potential for impact on pupil attitudes to STEM with a stable group membership, rather than an ‘activity-by-activity’, membership. Of course, an alternative explanation is that pupils who are less positive drop out earlier, so the more positive pupils are the ones who tend to stay in clubs longer, so further investigation of these findings is required.

Figure 4.5 Perceptions of science and engineering club by duration of club membership



5.1.6 Activities

Key points - Activities and competitions

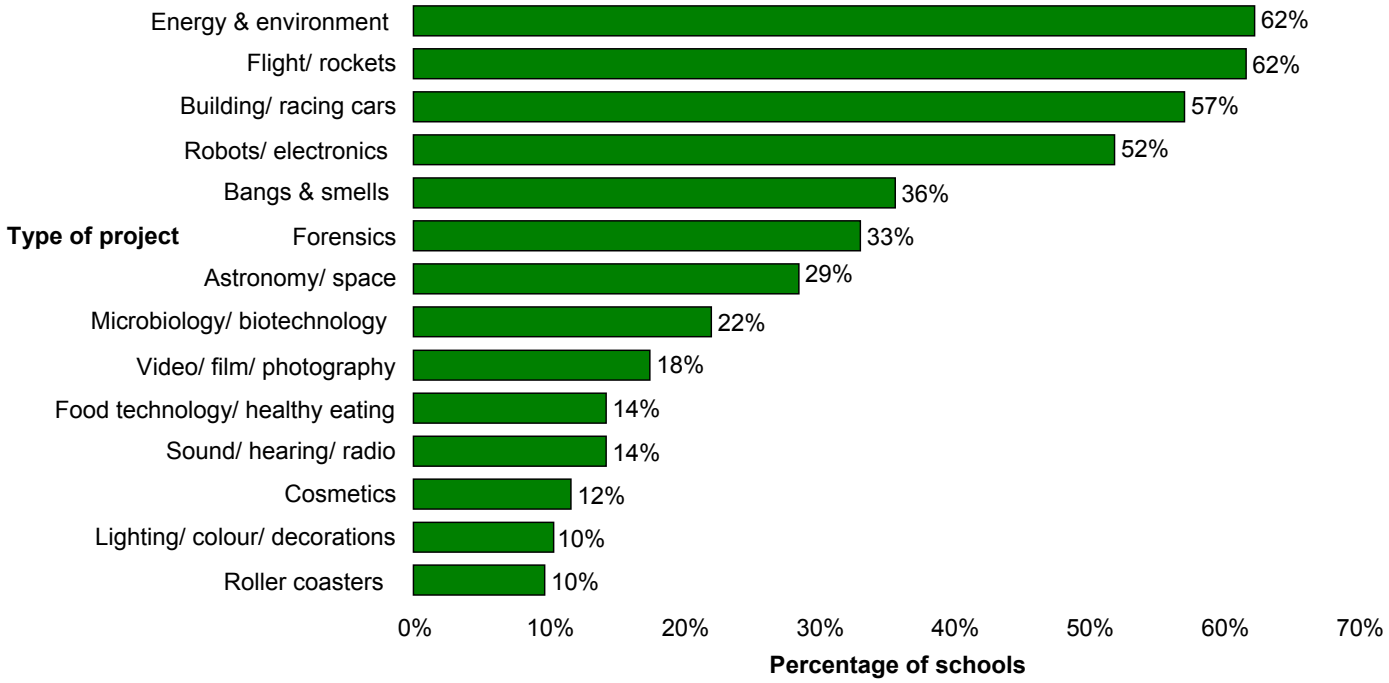
- The most popular activities (all carried out in 50% or more of schools) were energy and environment, flight and/or rockets, building (and sometimes racing) cars, robotics and electronics.
- The majority (62%) of schools had run between 3 and 6 different club topics.
- Other research evidence[6] shows that prevalence of 'cars and rockets' activities may be counterproductive with girls

All clubs were free to choose their own subjects and themes for projects, but at the outset they were provided with guidance from the BA and STEMNET about types of activities they could try, some of which had quite detailed outlines that could be followed. Several club leaders mentioned in the telephone interviews that, at least initially, they were keen to have some 'lesson plans' to help them get started. Perhaps for this reason, many clubs focussed on projects around renewable energy, cars, rockets and robotics (see Figure 4.6 below), where such materials were available. These are also projects that clearly incorporate both Science and Engineering. Several schools also carried out projects that could not clearly be linked into the categories below, such as catapults, earthquakes, sport Science or jewellery (see Annex 56 for the complete list of over 50 titles), but as only 1-4 schools did these activities the small numbers preclude further analysis. The name of the project often indicates whether it was likely to have been a one-off activity such as 'liquid nitrogen' or a longer term project such as 'living in space'.

6 Murphey, P and Whitelegg, E., (2006) Girls in the Physics Classroom Institute of Physics, London

Several of the Case Study school club leaders seemed unaware of the range of support materials available from the BA and STEMNET.

Figure 4.6: Percentage of clubs taking part in each type of project



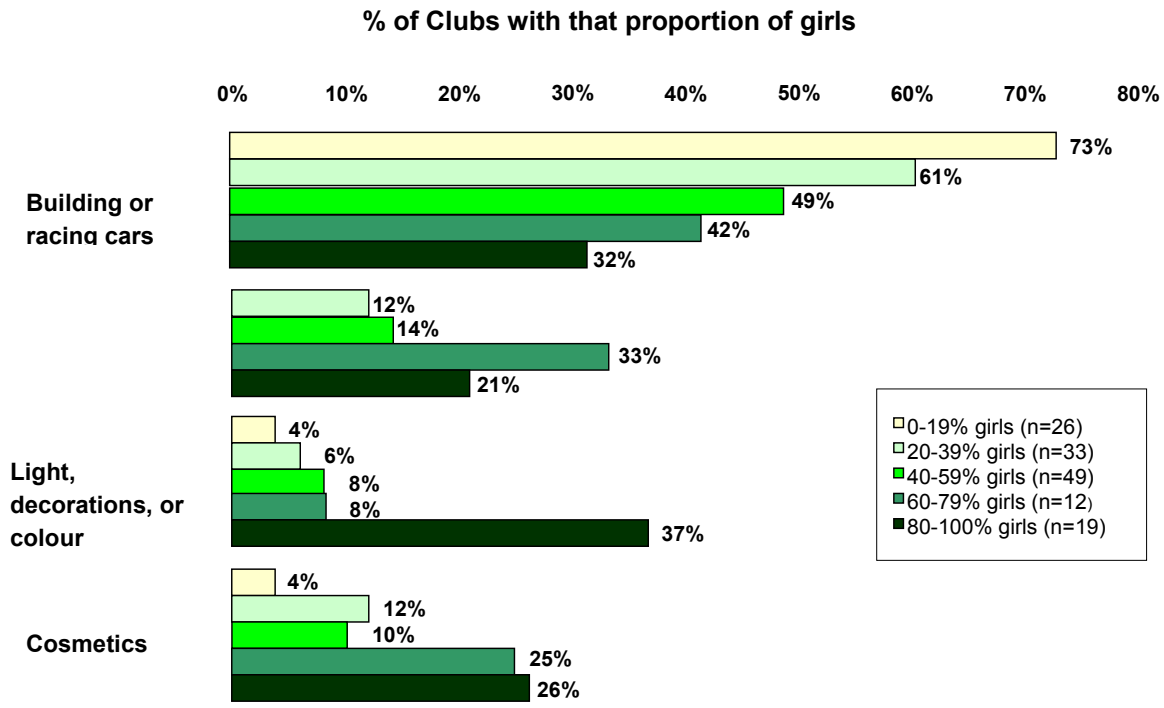
Similarly, the number of different projects carried out (Table 4.3) suggests how long has been spent on each one.

Table 4.3: Numbers of projects carried out in each club

Number of projects carried out by each club	1-2	3-4	5-6	7-8	9-10	11-12	13-14
Percentage of clubs (N=156)	12%	36%	26%	14%	6%	3%	2%

The evaluation team also looked at the types of projects carried out in relation to the proportions of girls in each club. For most projects there was no relationship, but Figure 4.7 shows the 4 activities where there was a correlation between gender composition of the club and projects undertaken. The higher the proportion of girls in the Science club, the fewer racing car projects, and the more sound, light and cosmetic projects were carried out.

Figure 4.7: Project types correlated with gender make-up of clubs



Of course the team cannot tell from this whether fewer girls joined clubs because of the project content, or whether the gender balance of the club influenced the choice of projects either by pupil members or by teaching staff. It is notable that some other gender stereotypical themes such as food or rockets did not show any correlation with the gender composition of the clubs. It is worth noting here that recent research into girls and physics[7] suggests that girls' interest in physics is higher for certain topics, such as light and electricity, and if topics covered related to them and their personal concerns. Boys were more interested in forces, particularly in relation to flight and cars.

The focus of club activities was examined in the telephone study. Addressing real life contemporary issues in club activities was seen as being important:

'You want to address things that are contemporary and relevant to the students that you are going to be delivering it to because otherwise you're not going to maintain their interest for very long.' School 6

Facilitating problem solving activities that allow pupils to work independently and think creatively was also seen as being an advantage of the club:

'Our overall vision is that we have some fairly long term projects that they come in and work on and is an ongoing thing. And that would be working towards their Crest award. ... The way it has been going so far is that we've done a couple projects, which we introduce to the students and tell them what the aim is but then for the majority of the lesson they will be working independently... They've been producing things and trying to design various things. We've found that with that group in particular the really key thing is to maintain a sense of challenge. So we've really been trying to stay away from giving them a set of instructions'. School 2

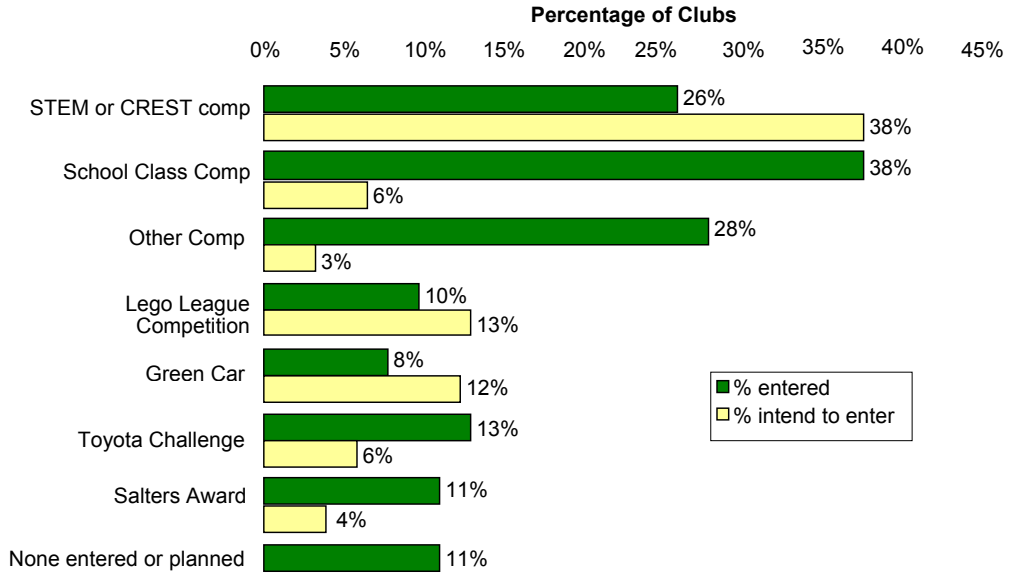
[7] Murphey, P., and Whitelegg, E. (2006) *Girls in the physics classroom* Institute of Physics, London

'We encourage them to follow instructions without asking lots of questions as they go along, I mean, to be more confident they are doing it right without being checked on all the time- but also to think, to explore, to be challenged, to look for clues, to use their Mathematics and Science knowledge in a different context.' School 20

5.1.7 Competitions

Figure 4.8 indicates that more than half the clubs had entered, or planned to enter, for CREST awards. As the time and funding available were greater than many previous Science clubs had access to, it is likely that more pupils were taking part than previously, and possible that they were gaining higher levels than before. However, the team did not ascertain whether they entered for bronze, silver or gold. Several of the other popular awards or competitions are sponsored by the motor industry, with easy to follow project guidelines and starter kits, which may account for the high proportion of clubs doing this type of project. In the telephone interviews the motivational benefits from engaging with competitions were highlighted. Twelve out of the twenty clubs have made use of or plan to make use of competitions such as those organised by Lego League or Toyota. The competition that was most commonly referred to (by eight schools) was CREST.

Figure 4.8: Entry or planned entry to competitions



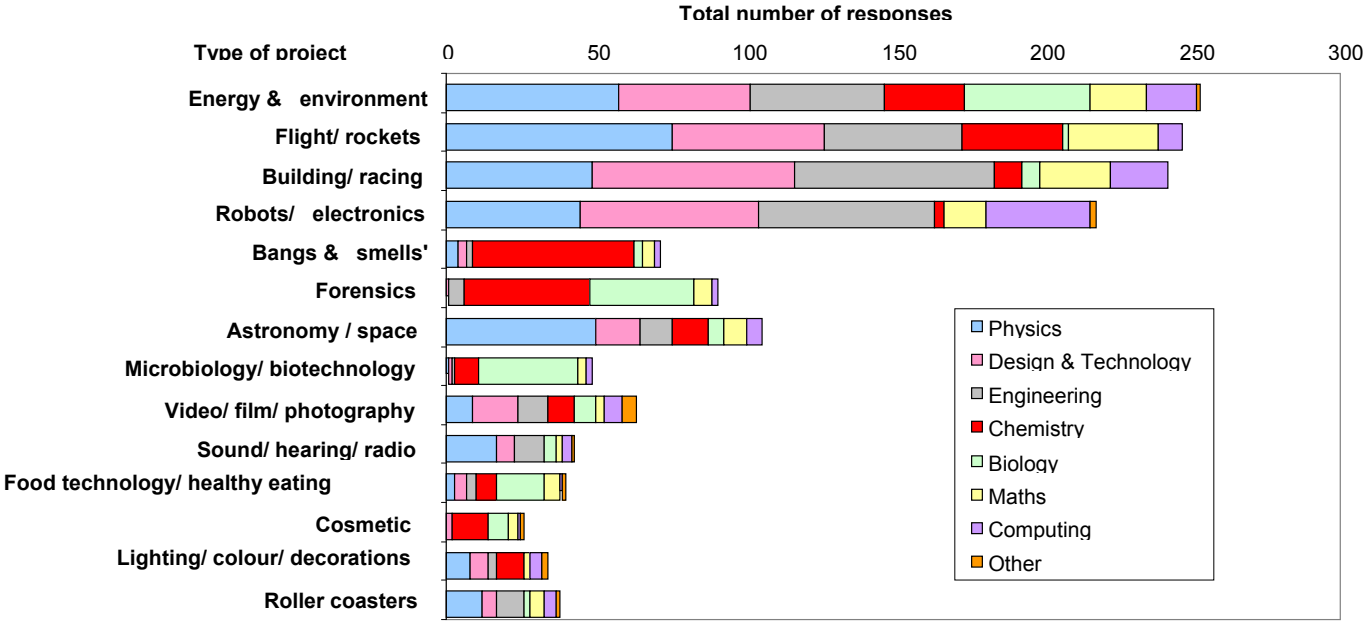
5.1.8 Links to classroom and teaching

Activities and curriculum

The evaluation team asked the club leaders which subject areas they included in their various projects, and it was encouraging to see that cross-curricular projects were the norm. Figure 4.9 shows the total number of responses for each project/ subject, so the longer bars represent more clubs carrying out that project, whereas the lower chart shows the proportions of each project that included each subject. This did not mean that they were relating the activities to the teaching curriculum for these year groups, but that the projects they carried out required the pupils to apply aspects of a variety of disciplines at the same time. So, for example, some food projects, in addition to predictable Biology, Chemistry and design & Technology, have involved Mathematics, physics and Engineering. The four most popular projects (energy & environment, flight/rockets, cars and robotics/electronics) and also roller coasters and sound/hearing/radio have a similar profile. It can be seen from the colour coding that the main subject elements of

club activities have been Physics, Design and Technology and Engineering. Chemistry also shows up relatively strongly, whilst Biology and Mathematics are not common.

Figure 4.9: Types of projects related to curriculum areas



Schools involved in the telephone study varied in the way they structured the club programme to link with the curriculum. Eight schools saw the club as enhancing the curriculum, whilst four saw it as extending curriculum activity:

'We try and extend what is being done in technology and Science lessons. We've looked at the curriculum in both Science and technology with the y7, 8, and 9, and we don't cover anything that we would cover in normal lessons, but look at what we've done and then extend that. So we've been doing, at the moment, using different renewable resources as power sources. So looking at solar powered vehicles, wind-powered vehicles, using both Science and technology skills for building the actual vehicles. Now we're moving on to some chemistry experiments, again to extend what they do in lessons. Next year we're thinking about moving onto biotechnology, and maybe bringing in some forensics or something.' School 7.

Three clubs had some degree of curriculum 'fit', with one club leader describing this as an *'absolute fit'*. Two schools described club activity as enhancing the curriculum through linking Science with design and technology (ASSEC Interim Report 2008).

Some used the club as a way to reinforce material covered in the classroom:

'We did some stuff with acids and alkalis. The year 9s requested that actually because when we were doing some work in class they were all looking clueless. When I said we've done it in Year 7 they said 'oh yea I remember doing that but I can't remember it.' So they asked if we could do some of the experiments in Science class and we did.' 'The plan was to develop an interest in Science' not necessarily to fit in with the curriculum.' School 12

Others used the club activities to extend work done:

'We try and extend what is being done in technology and Science lessons. We've looked at the curriculum in both Science and technology with the y7,8, & 9, and we don't cover anything that we would cover in normal lessons, but look at what we've done and then extend that.' School 7

While others still facilitated activities that aren't possible to cover in the curriculum:

'Its good for them to do things that aren't on the NC, it really widens the view of it, rather than the very discrete areas of Science and technology, doing all the stuff that is bridging in between. Really widening the curriculum, doing all the exciting stuff they are not allowed to do anymore.' School 1

Even when club activities deliberately don't have a direct link to the curriculum they can and still do support classroom learning:

'Deliberately avoid any link - I put curriculum Science into my form groups I've been doing it a long time and I'm an evangelical Science teacher in many respects and I put Science into everything, but I deliberately don't have any connection with the curriculum here. Through the Lego competition, half of it is a presentation this year on the carbon footprint of the school. So these year 8s are essentially doing Year 9 renewable energy work without even thinking about it. A fact I hadn't thought about until I'd seen the presentations. But of course curriculum comes up all the time, not just Science but Mathematics, calculating distance, rotation etc - got to do that sort of Mathematics all the time. It enhances the experience- they don't even realise they are learning.' School 13

Evidence from the Case Study schools indicated a low level of transfer of activity from clubs into general teaching, other than the use of club equipment.

5.2 Outcomes

5.2.1 For pupils

Key findings - Impacts on pupils

- The vast majority of club leaders and other staff saw improvements in practical skills, self-confidence and thinking skills of pupils. A significant majority also noted changing attitudes to and understanding of science, maths and engineering. However, when asked about outcomes relating to achievement, a small majority (e.g. 56% for science) were unsure whether there had been any change, and a small minority (e.g. 3% for science) disagreed that pupils were showing improved achievement, whilst 4% of leaders strongly agreed, and 38% agreed, that pupils were achieving higher in science.
- Pupils who participated in the clubs were, perhaps unsurprisingly, more likely to have positive attitudes to learning related to science and engineering, compared with the reference group, and were more likely to have sustained their interest and enjoyment in science over time. This was particularly true for girls and Year 8 and 9 pupils.
- Club members were more likely than reference group pupils to state they intend to carry on in education post-16 and go to university.
- Both club members and the reference groups showed a marked preference for studying science post 16 and at university compared with engineering or mathematics. Very low numbers of girls (club members and reference groups) intended to study engineering. However, where it was possible to match pupil responses to the two surveys, club members were more likely to have become more positive towards studying engineering at university compared with reference group members, and this was particularly true for girls and Year 9 pupils.
- The pupil surveys suggest that club members are more interested in future science and engineering careers compared with the reference group pupils. Again, girls showed far less interest in engineering as a career. Girls were more likely to have become more positive as a result of club membership about wanting to become a scientist compared with the reference group.

The responses for club leaders and other staff to a series of questions about pupil outcomes (Figures 4.10 and 4.11) show similar patterns. For the most clearly observable changes - improvements in practical skills, self-confidence and thinking skills - there are extremely high levels of agreement that there have been benefits to club members. For the set of questions relating to changing attitudes to and understanding of Science and Engineering, there is in most cases still a significant majority of teachers that agree that there have been benefits. However, when asked about outcomes relating to achievement, the majority of staff are unsure if there has been any change. A small proportion of respondents disagree that members are achieving at a higher level now than previously expected. This is particularly true for Mathematics (in line with pupil responses reported in section 4.1.5 above).

Figure 4.10: Leaders' perceptions of pupil outcomes as a result of club membership

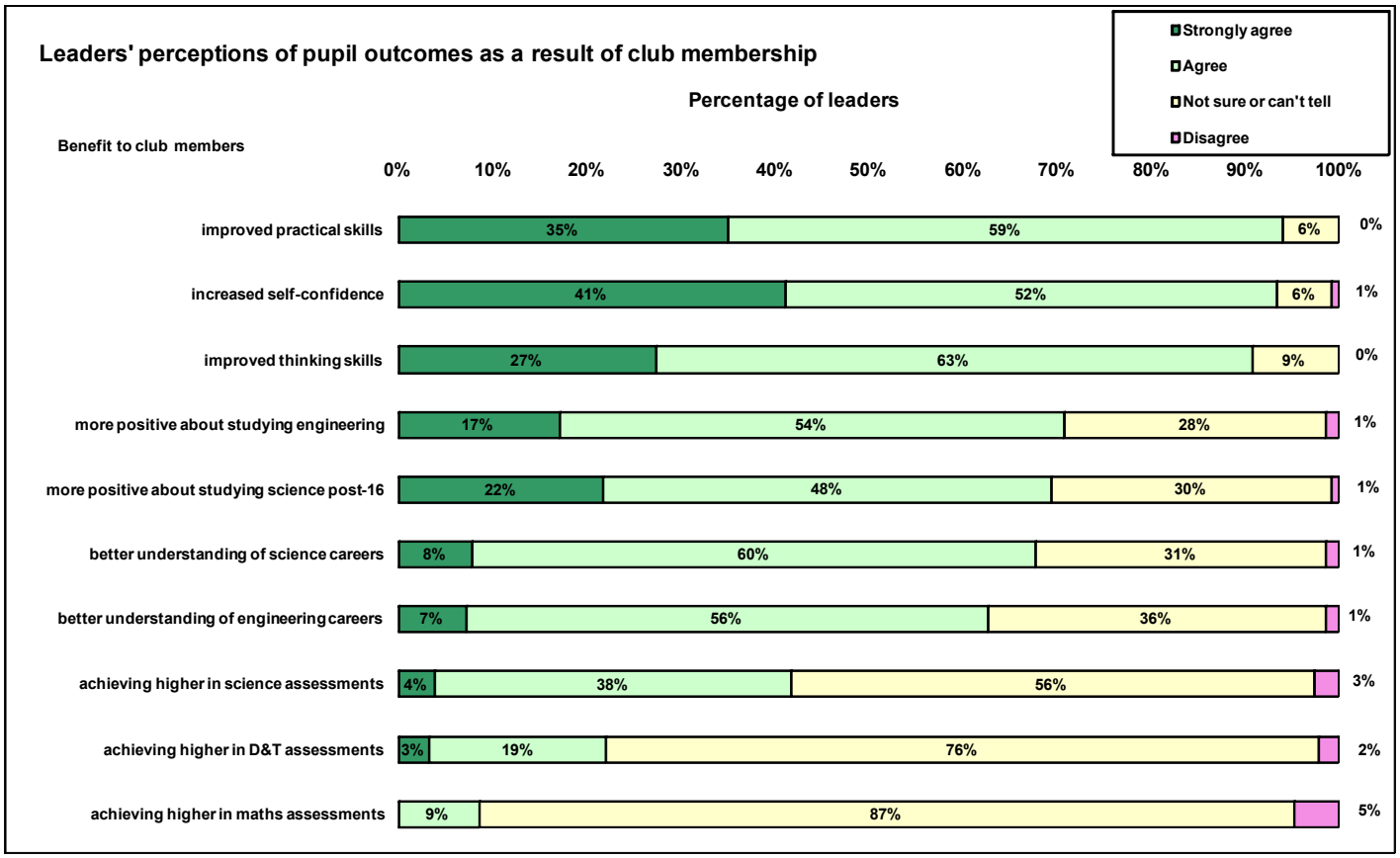
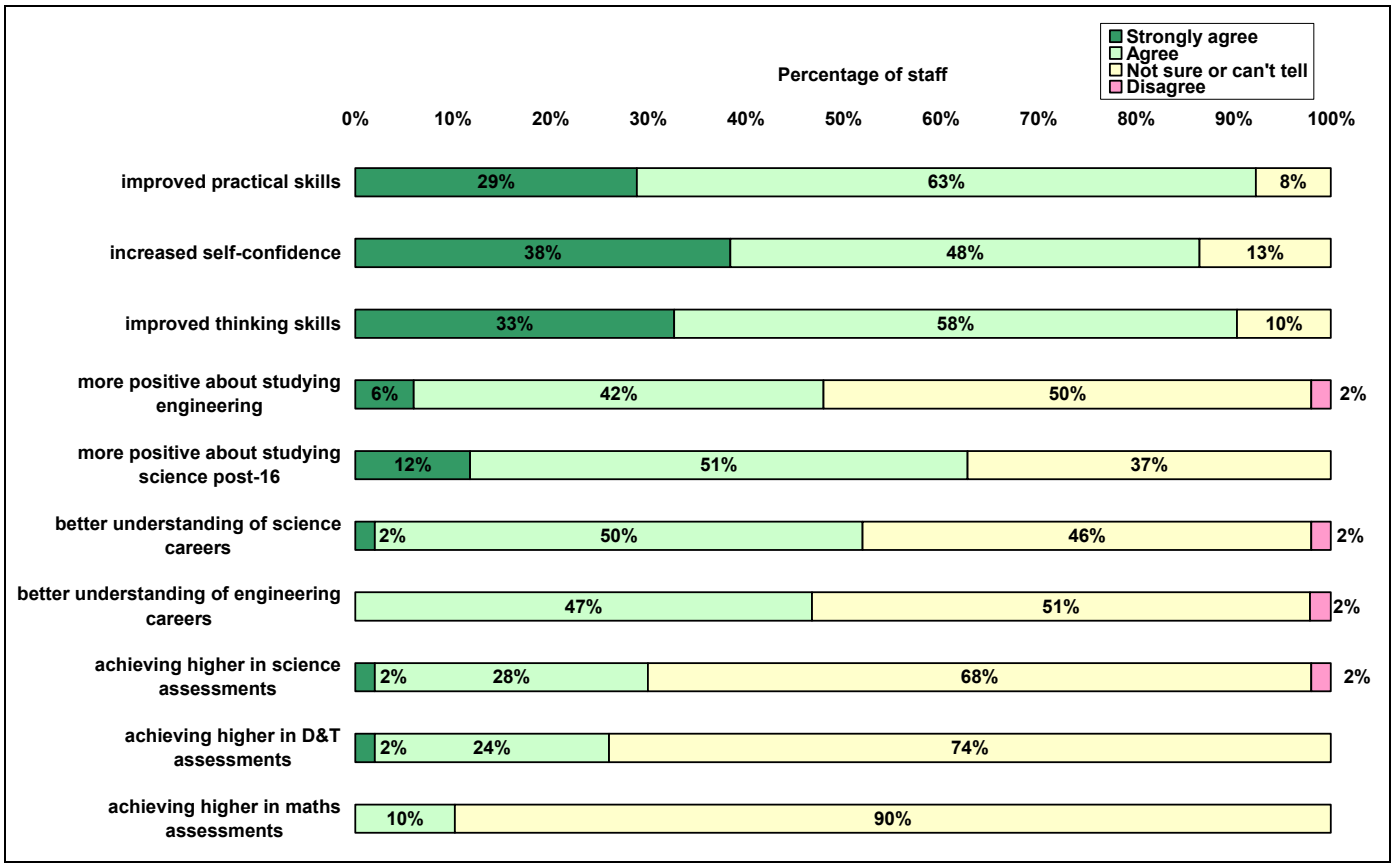
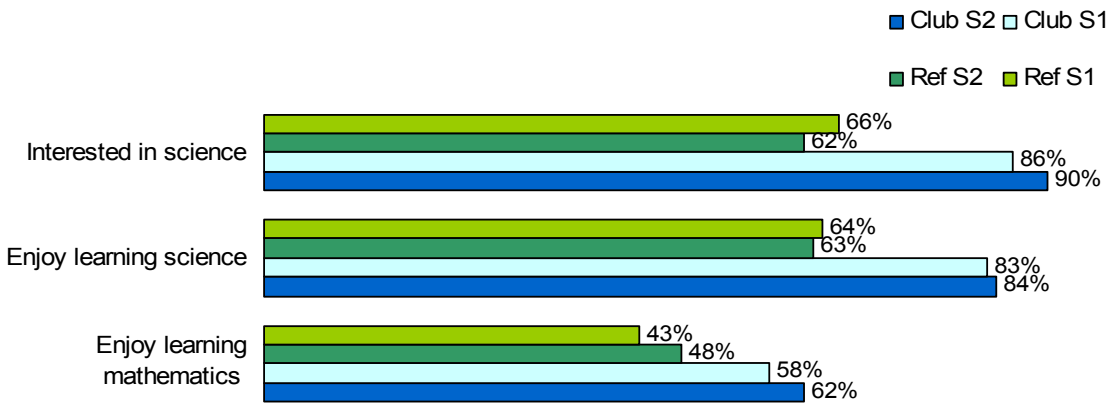


Figure 4.11: Other staff perceptions of pupil outcomes as a result of club membership



Pupils were asked to respond to a series of statements relating to their interests in STEM subjects, and their experience of learning in STEM subjects. Pupils' answers indicated that there were substantial differences between Science and Engineering club members and reference groups, and between boys and girls.

Figure 4.12 Positive learning experiences of pupils: some examples



S1 = Survey 1

S2 = Survey 2

Both surveys provide evidence that pupils who participated in the clubs were more likely to have positive attitudes to learning Science and Engineering, compared with reference groups. Figure 4.12; and - for a broader range of questions - Annex 4a Table 4 present the responses to questions relating to attitudes to learning about Science and Mathematics (broadly and narrowly conceived) for both Science club members and the reference groups. Overall much higher numbers of club members 'strongly agree' with all the positive statements about Science and Mathematics, and lower numbers of them disagree or strongly disagree, compared with the reference groups. Whilst over 80% of club pupils are interested in and enjoying learning Science - the percentage of pupils interested in Science in the second survey is 90%, the data are somewhat less positive towards Mathematics, with only around 60% of pupils claiming to have enjoyed learning Mathematics for both surveys (Annex 4a Table 4). This is even lower for girls: 50% for the first survey and 53% for the second, although it is still higher than those reference group girls - 41% for the first survey and 45% for the second (Annex 4a Table 5).

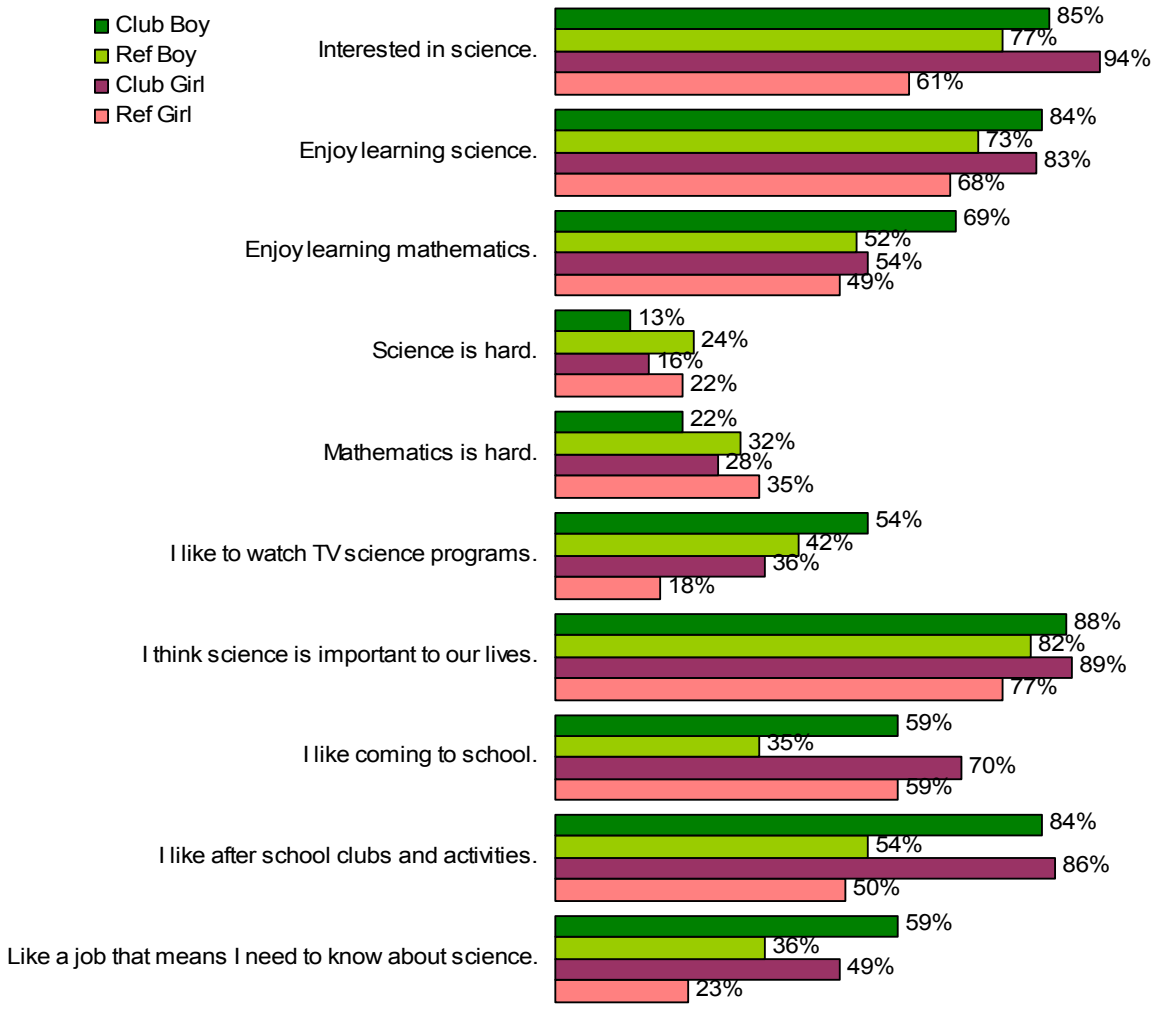
Splitting the data by gender shows that the boys have more positive views of both Science and Mathematics, enjoying them more and finding them easier than the girls say they do, both within and outside the Science club. Nevertheless, Figure 4.13 below shows more positive attitudes for club girls who participated in both surveys. (For more detail, see Annex 4a Table 6).

With respect to after school clubs and activities, there is a wider gap between responses from club members and reference group pupils: over 60% of the former stated they like coming to school and over 80% of them liked after school clubs and activities, compared with just around half of the latter. Fewer club members (about half) claimed they would 'like a job that means I need to know about Science' (Annex 4a Table 4). For those club members who participated in both surveys, nearly 60% of boys and 50% of girls strongly agree/agree with this statement, compared with 36% of reference group boys and 23% of reference group girls who participated in both surveys (see Figure 4.13 below).For most questions the girls recorded more 'undecided' answers than the boys. These data are in line with a number of previous studies in that they indicate that girls tend to be more positive than boys about school in general[8], but less positive than boys about Science and Mathematics.[9]

[8] See, for example, Warrington et al (2000) Student Attitudes, Image and the Gender Gap *British Educational Research Journal,* 26:1

[9] See, for example, Miller et al (2006) Gender Differences in High-school Students' Views about Science *International Journal of Science Education*, 28:4

Figure 4.13: Positive learning experiences: gender differences



The data for the pupils where the team can examine changes in their responses to these questions (Annex 4b Tables 1-3) indicate that where the club members are girls, Year 8 pupils or Year 9 pupils they are more likely to have sustained their interest in Science over time compared with the reference group pupils. The evaluation team also found that where club members are girls or Year 8 pupils, they are more likely to have sustained their enjoyment of Science, compared with the reference group. Where club members are girls, they were more likely to have sustained their interest in jobs that would need an understanding of Science.

None of the Case Study schools had a formal means of measuring the impact of club activity on pupil motivation or learning.

The team asked pupils a series of questions regarding their future study and career plans. The future educational and career plans of young people in the first years of secondary school are relatively fluid, and the ASSEC surveys may be the first time they have specifically considered their post-16 educational direction, or the possibility of a Science-related career. The proportions planning to stay on are likely to be higher than the proportions that actually stay on, both at 16+ and starting university. Nevertheless, both surveys suggest that club members are more likely than reference group pupils to plan to carry on in education post-16 and go to university.

Figure 4.14: intended future study plans: general

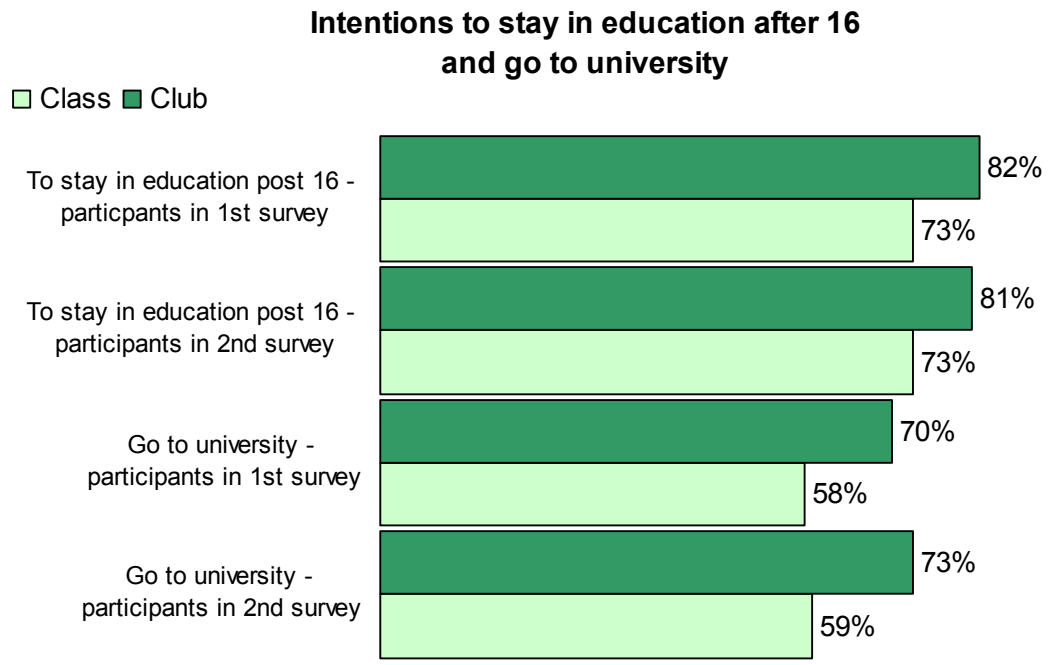
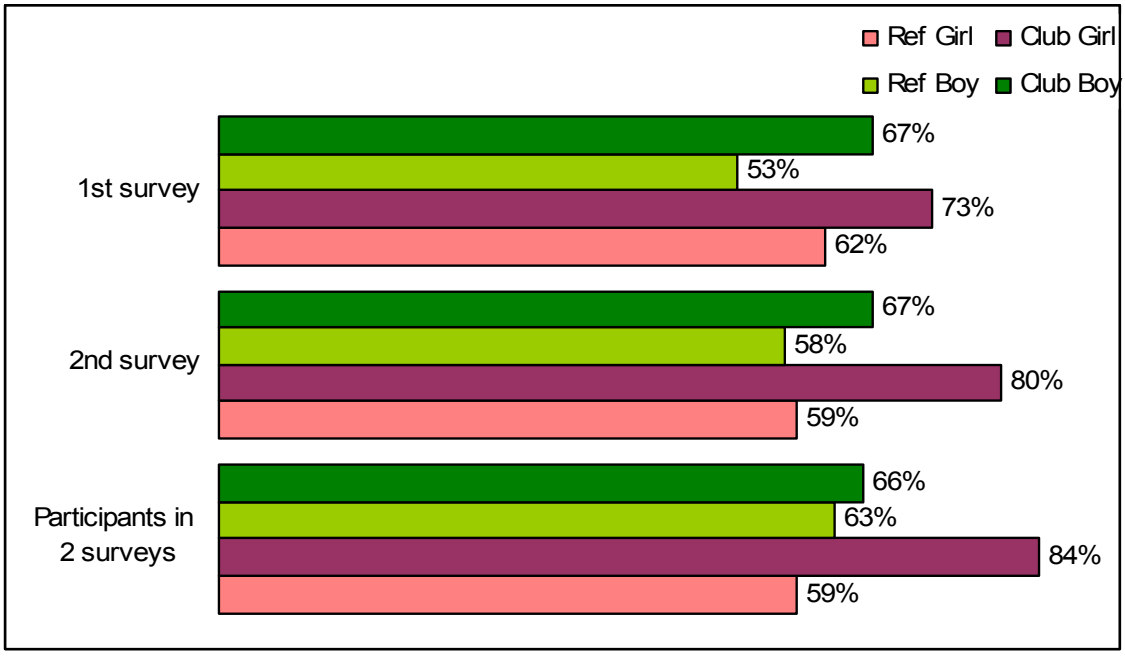


Table 7 in Annex 4a indicates gender differences in pupils' intentions to stay in education after 16, with these surveys suggesting that more girls than boys are likely to continue in education after 16 and plan to go to university. However if we look at pupils who participated in both surveys, there is a noticeable difference in club girls' intentions to go to university. As indicated in Figure 4.15, at the time of the second survey, 84% of them intended to do so, compared with 73% of club girls in the first survey. This is much higher than for the equivalent groups of boys, and it is also higher than the figure for girls in the reference group.

Figure 4.15: intentions to go to university by gender

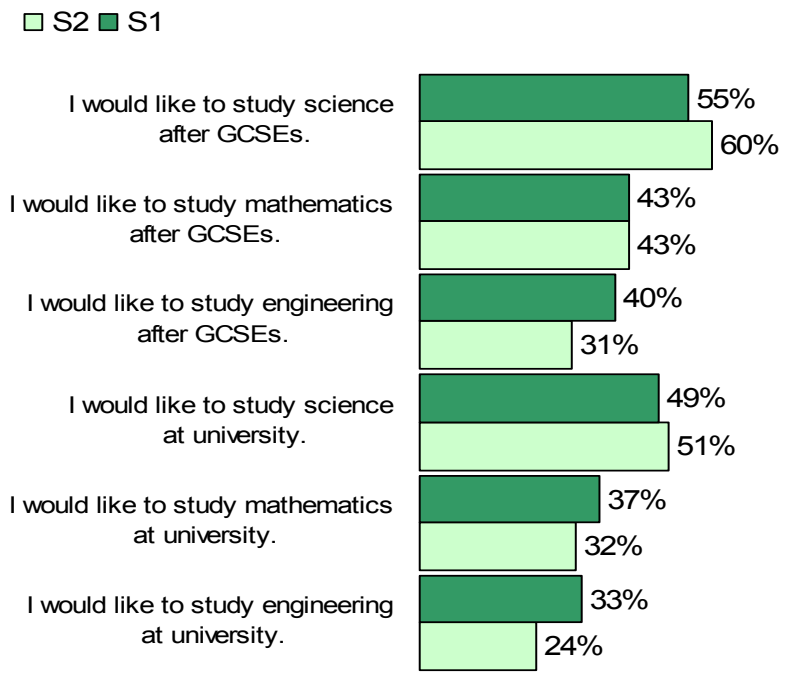


There are no major differences across the age range regarding post-16 plans and university plans (Annex 4a Table 8). In all year groups the club members are more interested in studying Science, Mathematics and Engineering subjects both post-16 and at university.

The data for the pupils where the team can match both survey responses for these questions (Annex 4b Tables 4-5) indicate that members of the reference group who are boys or in Year 8 are more likely to have changed their mind about whether to carry on in education post-16 compared with the project group equivalents, but there are no other clear differences using these datasets.

Figures 4.16 and 4.17 below present pupils' attitudes to studying Science, Mathematics and Engineering after GCSEs and at university. Both surveys suggest that Science is the most popular of the three choices with club members. The second survey shows that 60% of club pupils would like to study Science after GCSEs and slightly over half of them intended to do so at university. For the reference group pupils, though, there are few differences between the responses in the two surveys. Table 9 in Annex 4a indicates that many of pupils are undecided as to whether they would wish to study Science, Mathematics or Engineering at these levels, and this does not vary much between the club members and reference groups particularly in studying Mathematics.

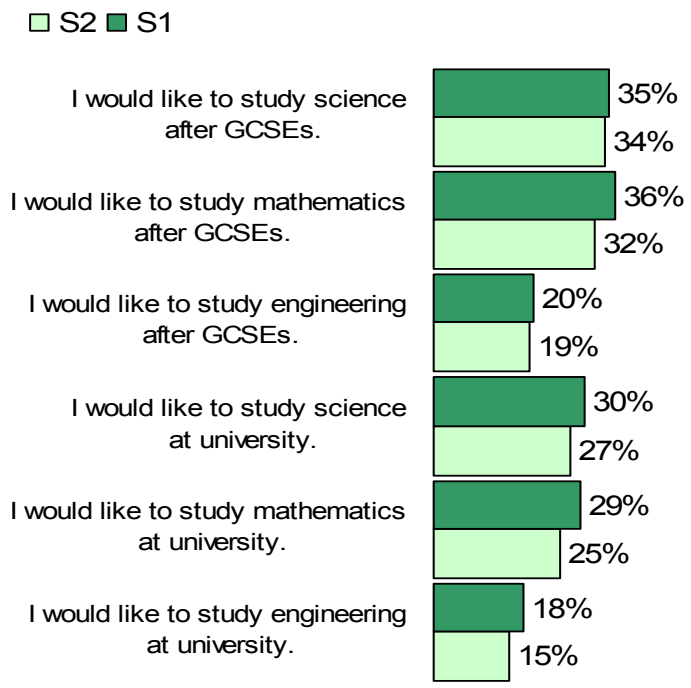
Figure 4.16: Club members' STEM study plans



S1 = survey 1

S2 = survey 2

Figure 4.17: Reference group STEM study plans



S1 = survey 1
S2 = survey 2

Table 10 in Annex 4a shows stereotypical attitudes to studying Engineering, with only 15-20% of girls in Science clubs and 5-6% of reference group girls wanting to study it beyond GCSE, and 12-14% of club girls and 4-5% of reference group girls wanting to study it at university in both surveys, whereas the corresponding figures for club boys are much higher. Here too, Science is more popular than either Mathematics or Engineering, especially with the girls in Science clubs. As above, the girls in the Science clubs are more undecided than the boys. However amongst the reference group girls around half indicated that they had decided against Engineering in both surveys.

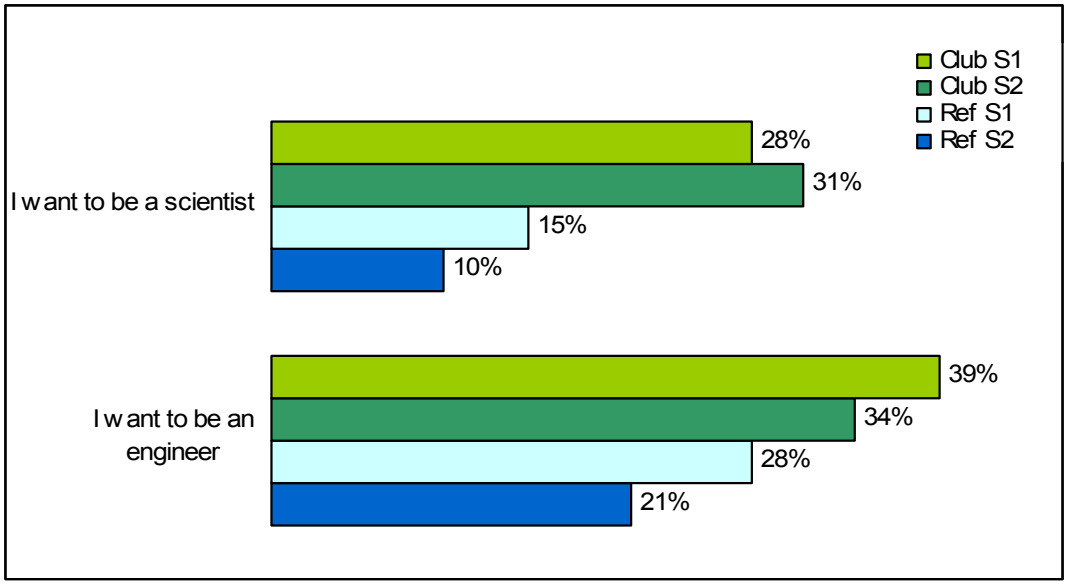
When the team examine the data for pupils for whom survey responses can be matched between the two surveys, there are few clear differences between project and reference group members when looking at choice-making related to further study in STEM areas. Overall, club members were more likely to have become more positive towards studying Engineering at university compared with reference group members, and this was particularly true for girls and Year 9 pupils (Annex 4a, Tables 5, 6 and 7).

The pupil surveys suggest that club members are more interested in future Science and Engineering careers compared with the reference group pupils, as indicated in Table 12 in Annex 4a. For example, nearly two thirds of club members in the first survey and 57% in the second stated that they would like to find out more about jobs in Science, compared with only 41% and 48% of reference group pupils in each of the surveys.

Figures below again show that the club boys and girls and the reference group boys and girls have similar attitudes to Science-based careers, with girls having far less interest in Engineering, even for those club girls with more than 3 months of club membership (Figures 4.18 and 4.19). Only 5-8% of club girls and 2-3% of reference group girls in the surveys would want to be an engineer, whereas a much higher proportion of club boys (39% for the first survey and 34% for the second) as well as reference group boys (28% for the first survey and 21% for the second) stated they would. This is despite the fact that the vast majority of club reference group girls believed that scientists and engineers have important jobs. However, far

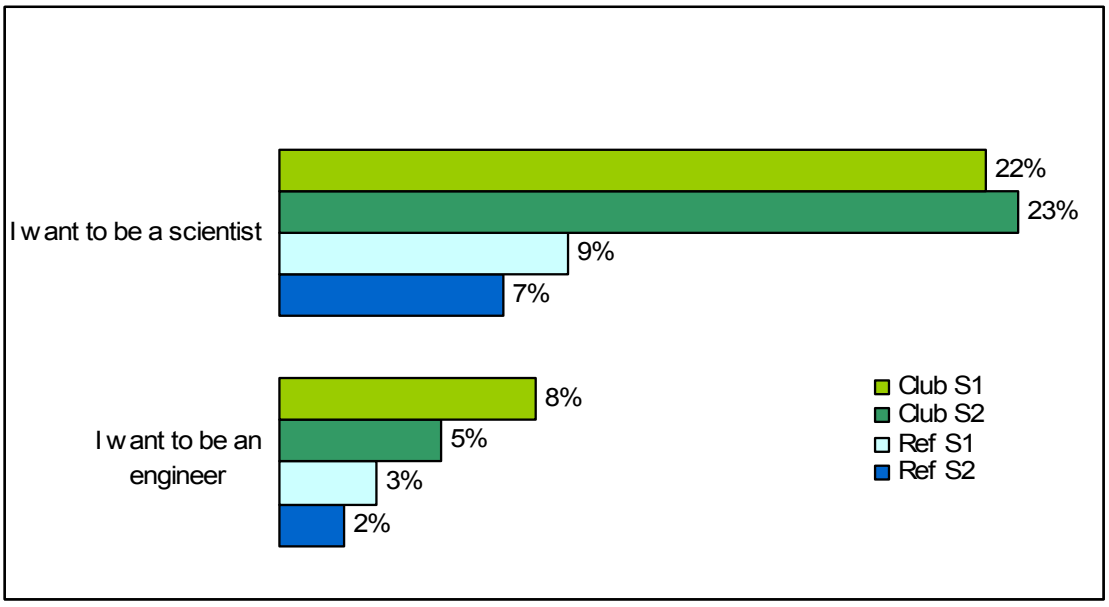
more club girls (22-23%) than reference group boys (10-15%) and girls (7-9%) stated that they would want to be a scientist.

Figure 4.18: Career intentions: boys



S1 = survey 1
S2 = survey 2

Figure 4.19: Career intentions: girls



S1 = survey 1
S2 = survey 2

Data for the pupils where it is possible to match responses to the two surveys (Annex 4b Tables 5 and 6) indicate that boys in the project group are less likely to have changed their minds about whether they want to become a scientist compared with reference group boys. Girls in the project group are more likely to have become more positive about wanting to become a scientist compared with their equivalents in the reference group.

There was little evidence from the Case Study schools that pupils were developing an understanding of Engineering, or what engineers did. Specific school circumstances were important here, for instance a club leader with a good understanding of Engineering had an aim to increase pupil awareness of these matters, whilst in another schools, a fairly 'go-it-alone' club leader who was a biologist, had no real insight into the problem in the first place. It may be the case that the general level of Science, Mathematics, and perhaps D&T teachers' operational knowledge of Engineering as a suite of disciplines and careers is a limiting factor.

5.2.2 For staff and school: individual staff

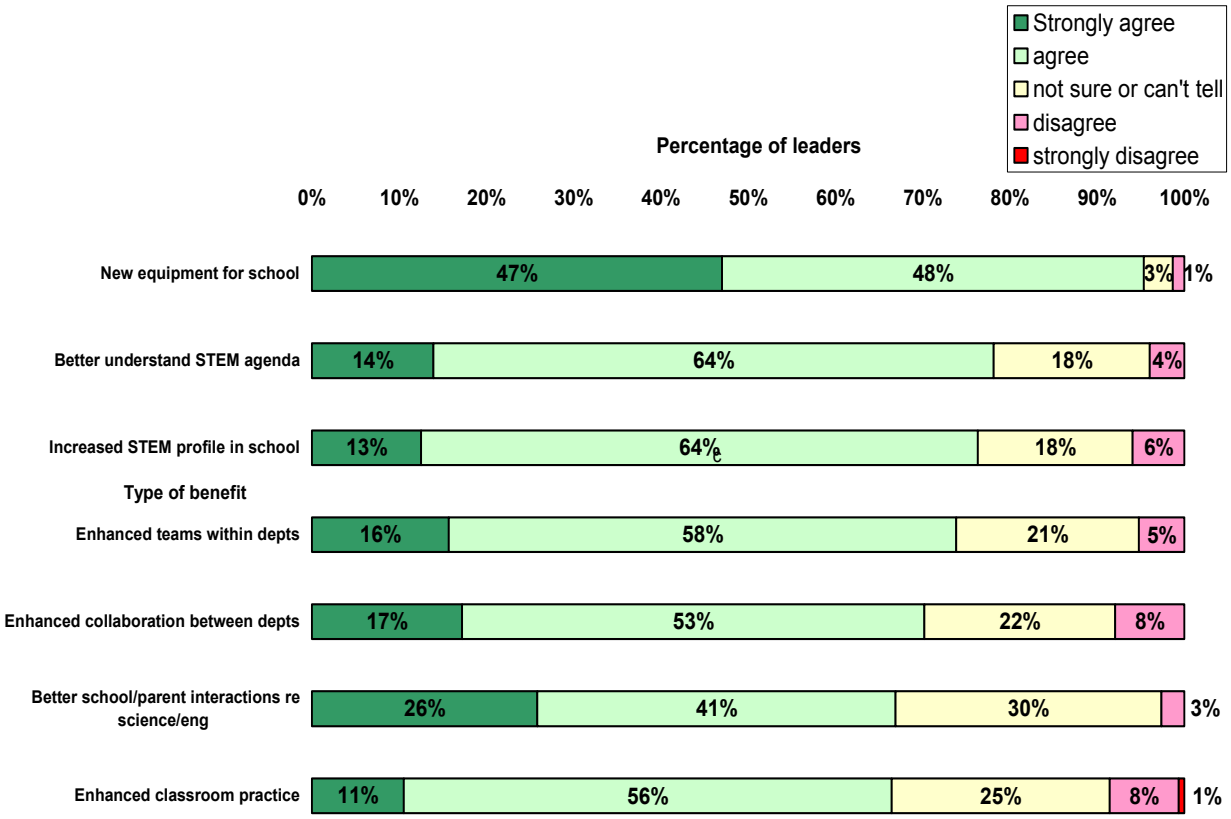
Key findings - Impacts on club leader and other staff

- Significant majorities of club leaders identified new equipment, better understanding of the STEM agenda, increased STEM profile in school, enhanced collaboration within and between departments, and between parents and schools, and enhanced classroom practice as being benefits of club activity.
- Around half of other staff involved in the clubs had received training for their involvement.
- Involvement in clubs increased other staff members' perceived level of understanding of science and engineering careers and the STEM agenda, and the majority of respondents indicated their enthusiasm for STEM subjects had grown through involvement in their club.
- There had been a positive impact on staff-pupil relationships, and over half of the respondents indicated a positive impact on their classroom practice and on their subject knowledge.
- A majority of respondents indicated an increase in co-operation within and between departments.
- A large minority of staff identified time to prepare for and to run clubs as the biggest challenge.

Club leader perceptions

Findings from the Leaders' survey have informed most of the previous sections of this report. Further findings are summarised in Figure 4.20 below.

Figure 4.20: Club leaders' perceptions of outcomes for school



The most positively viewed benefit was new equipment in school, which for practical subjects is not a surprising finding. Large majorities of club leaders also identified increased understanding of the STEM agenda, and increased STEM profile in school as perceived outcomes. Almost as high was enhanced teams within departments, and enhanced collaboration between departments. Over 100 schools also identified better school / parent interactions and enhanced classroom practice. On this last point, evidence from the Case Study schools indicated little if any direct use of club activities in timetabled classes. Evidence from the telephone survey (Interim Report, February 2008) indicated that involvement in clubs had increased some teachers' subject knowledge of particular topics

'Both my colleague and I find we're learning new things and new skills because of the 2 different subject areas having to be combined. I haven't done technology for a very long time and learning again how to build things has been interesting. We're learning different skills as we go through, practical skills to help the pupils.' School 7

The telephone interview data shows that 14 out of the 20 schools report having built or made use of existing links with other departments. The remaining six schools all stated that they had planned inter-departmental activities in the future. There was a link between those schools who have previously run a Science club, enhancement and enrichment activities, or who have prior links to SETPOINT and/or STEMNET, and those who have more established inter-departmental working relationships (see the Interim Report).

Only two schools deliberately linked involvement in the programme with staff career development plans. One school drew attention to the situation of staff on part time/temporary contracts within their school. Those staff members who fell into this category and who were involved in the club were able to use this opportunity as a way to aid their career development particularly in regard to them acquiring a more substantive contract. Another school used the programme to enhance newly qualified teachers' career development and prospects (ASSEC Interim Report 2008 and Case Studies).

Outcomes for other staff

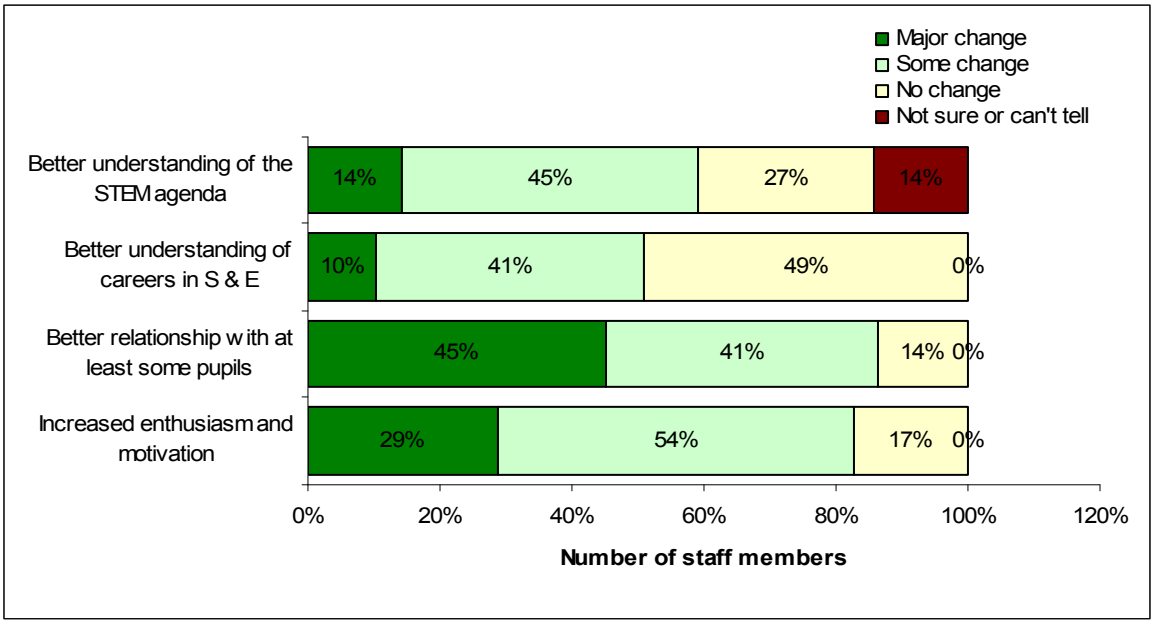
Of the 53 respondents to the survey of staff other club leaders, 47 felt supported by senior colleagues. However only 25 respondents undertook training for their involvement in the club and only 14 undertook training to support pupils' considering careers in Science.

Despite this, 25 respondents (see Figure 4.21 - numbers converted to percentages) felt that they had a better understanding of careers in Science and Engineering compared to their level of understanding before their involvement in the club. Only 4 of these were non-teaching staff. 24 staff members (12 teaching staff and 12 non-teaching staff) perceived no change. 29 respondents believed that they had a better understanding of the STEM agenda. Once again the majority of these (24) are teaching staff.

Eight cited their personal development as being one of the biggest benefits of their involvement in the club:

'STEM club [ASSEC] has given me much personal satisfaction this year. It has contributed in a major way to professional development. I enjoy inspiring and engaging the pupils.'

Figure 4.21: Perceived outcomes: staff other than club leaders



43 respondents stated that they perceive a positive change in their own enthusiasm and motivation of STEM through their involvement in the club. 17 of them cited that this was one of the biggest benefits of their involvement in the programme:

'It reminds me of the possibilities that Science project-based work offers.'

'It's been fun for me. I've enjoyed seeing students having fun.'

44 respondents noticed a positive impact on their relationship with at least some pupils due to their involvement in the programme, with 16 citing this as being one of the biggest personal benefits of their involvement in the programme:

'Building relationships with pupils not usually interested in technology/Science'.

'Forming relationships with students and staff outside the normal working environment.'

Statements made in the telephone interviews also highlighted the positive impact that the club had on their relationship with pupils and also the way in which the club has impacted staff members' own motivation and enthusiasm:

'For me, I have enjoyed it really. There have been times - I'm free on a Thursday afternoons I could go home at 5 past 1. A few weeks ago, I felt ill, I could have gone home, but I decided to stay and I didn't want to let the kids down - earlier in the day some kids stopped me and asked what we were doing that night, and I thought there's no way I'm going home. It can be really casual at D and T but not the same here. Even so it is building a completely different relationship with them - I've got to know a group of 16 kids really well.' School 1

'Has rekindled an enthusiasm in Science for the staff involved in clubs, has brought back the 'wow factor' of Science that can be lost.' School 6

Students' interest in the club and enthusiasm for activities has also had a positive impact on staff members:

'Getting to grips with some projects we wouldn't have taught through the curriculum. I feel personally rewarded by how positive the students are.' School 2

This is a reciprocal relationship as staff enthusiasm for the club and activities has rubbed off on pupils in the same way that pupil enthusiasm has had a positive impact on staff:

‘The teachers who are running the class can take their own interest and enthuse the kids with that really.’ School 4

29 out of 53 respondents emphasised that their classroom practice has been enhanced due to their involvement in the programme. 20 of these were teaching staff and the remaining 9 were non-teaching staff. Two non-teaching staff highlighted this as being the biggest benefit that they have got out of being involved in the club:

'Getting more involved with pupils. More confidence to take on demonstrations in main lessons and answering pupils questions during club time and main lessons.'

'Trialling more adventurous ideas with smaller and more motivated groups before using them with whole teaching groups.'

However, one teacher drew attention to the negative impact that their involvement in the club has had on their classroom practice:

'Lack of time and even with resources it is unfair to leave other classes with "cover".'

37 out of 53 respondents stated that they had increased their knowledge of their own subject area through their involvement in the club. Only 3 stated that this was a major change. These were all teaching staff.

Similarly 36 respondents stated that they had increased their knowledge of other subject area(s) through their involvement in the club. Of the 5 who stated that this was a major change 2 were teaching staff and 3 were non-teaching staff.

In open comments both teaching and non-teaching staff emphasised increased subject knowledge (both in their own subject area as well as in related disciplines) as being one of the major benefits to their involvement in the club.

Data from the telephone interviews also supports this evidence of staff members improving their knowledge and skills of their own and other subject areas (ASSEC Interim Report 2008):

'It's very different from the rest of the teaching week. Both my colleague and I find we're learning new things and new skills because of the 2 different subject areas having to be combined. I haven't done technology for a very long time and learning again how to build things has been interesting. We're learning different skills as we go through, practical skills to help the students.' School 7

'Technicians especially are taking books and software home so they can become more actively involved.' School 20

While many staff members, who took part in the telephone interviews, found the programme supported professional development in the wider sense through expanding their personal knowledge of their own and other subject areas:

'Mixing with staff from other departments is a bonus ….I think our practice will improve gradually anyway as we collaborate with other disciplines and learn more and see different approaches' School 11

Outcomes for staff engagement: Challenges

Time was cited as the biggest challenge for 17 respondents, although 7 respondents (5 teaching staff and 2 non-teaching staff) who took part in the other staff survey stated that so far they have perceived no difficulties from their involvement with the programme teacher's time (or rather lack of it).

'Time constraints are the main problem facing any teacher attempting to do anything other than day to day teaching.'

'Time constraints - no time given to allow for planning or preparation.'

These sentiments were echoed in the telephone interviews conducted with club leaders:

'It's not a drain on time but it does take time. Need to prepare for sessions.' School 3

'Time is an issue, and there is a knock on effect on the timetable in reducing the time for enthusiastic and motivational teachers in the classroom.' School 17

Time coupled with the connected issues of understaffing and limited staff resources within a small department were also seen as a barrier to schools applying for club funding in the first place. This can be seen from telephone interviews conducted with those who declined to proceed with their application (Interim report).

The other staff data also reveals that those staff members on part time contracts have found it particularly hard to engage in the club:

'As a part timer this year it has been more difficult to engage with the ASSEC.'

Linked to this the lack of any financial reward for the time and effort put into the club was also mentioned as a difficulty:

'Planning a scheme and delivering took several hours - some financial reward or time allowances would have been appreciated.'

'While I'm not particularly mercenary, I have given up at least a dozen hours of my time for no reward - monetary or freed-up other time.'

Making and maintaining contact with SETPOINT and STEMNET were also cited in some cases as being a challenge:

'At times we have been unaware of deadlines/requirements. We have had difficulty contacting the groups involved in supporting our work.'

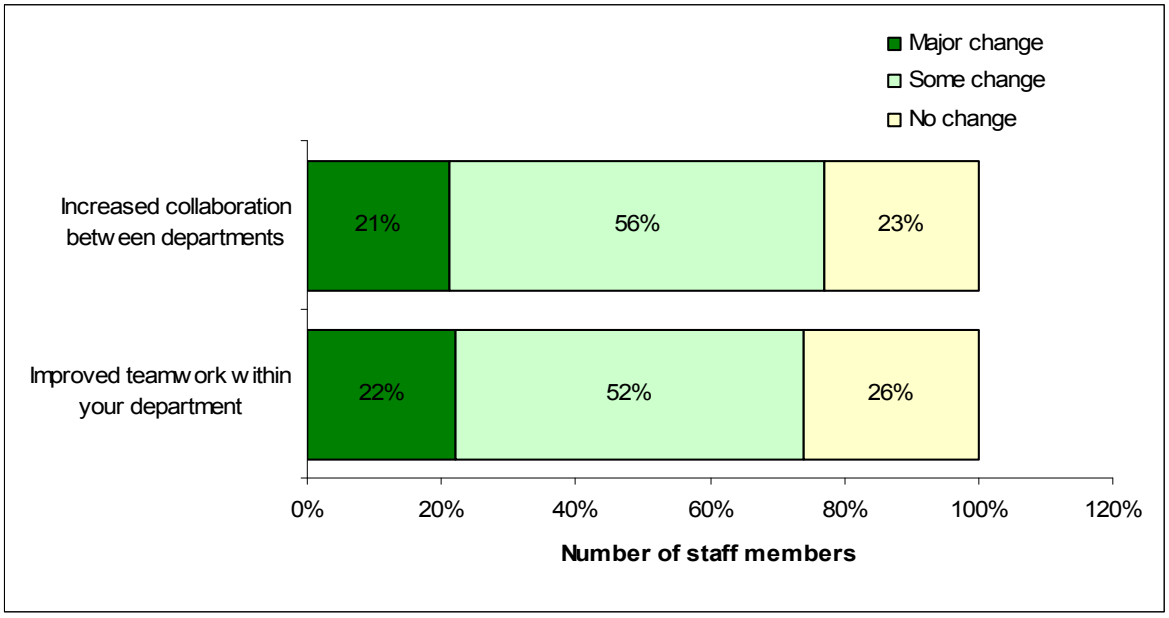
5.2.3 For staff and school: department level

Key findings - Other impacts on the school

- There had been a rise in the profile of STEM across most schools.
- There is some evidence that the impact of clubs beyond club sessions was linked to the degree of management support.

From the other staff survey data (Figure 4.22 - numbers converted to percentages) 37 out of 53 respondents have seen an increase in teamwork within their department and 41 respondents have seen an increase in collaboration between departments involved in the club.

Figure 4.22: Perceived departmental outcomes: staff other than club leaders



10 respondents highlighted this team spirit as being one of the biggest benefits of being involved in the programme:

'Links with other departments being enhanced. Seeing collaboration with staff and between pupils.'

'Staff working together outside classroom.'

Staff turnover, however, was seen as being detrimental to this:

'Personnel changes in Maths and DT have impacted on collaboration and co-operation between departments.'

5.2.4 For staff and school: whole school level

From the telephone interview data twelve out of twenty schools report that STEM subjects have a higher profile across the school as a result of the ASSEC programme. This is mainly manifested through notices, meetings, assemblies, events and school newspapers. Out of the other eight schools, the majority already have a high profile as Science or Technology Specialist Schools.

One secondary school cites noteworthy ‘spin offs’ of the club, particularly in contacts made with three feeder middle schools:

'As a spin off of the STEM club [ASSEC], I am actually doing a watered down version with each of the three middle schools at lunch time. We did the Science of sound for a bit, obviously watered down because we didn't have the budget, and that's created quite a vibe as well, because the funds that we have in STEM club [ASSEC] have filtered down to the funds that we have in middle school lunch Club because I have got a proper scheme, it has a proper follow through and a proper structure to it.' School 5.

The impact of the programme on school development planning is variable. Once again this appears to relate to broader issues in the school such as a historical commitment to a club approach to STEM at school level or application for specialist status (see the Interim Report). However, evidence from the Case Study schools does seem to indicate a link between the impact of the clubs beyond the club sessions, and the degree of senior management team support.

Case Studies

In all cases, the model[10] held up to comparison with what was observed in each school, thus providing strong conformation that the programme is able to generate at the least short-term outcomes of increased engagement, enjoyment and enthusiasm. This conclusion is also supported by the differences in responses between club members and non-club members in the two pupil surveys, which is generally positive in terms of the achievement of the overall *impact aims* of the ASSEC programme. That is, it supports the proposition that the cause of the measured changes in attitude was involvement in the clubs. Alternative hypotheses for positive shifts in attitude can always be suggested. However, there is a correlation between the statistical generalisations of the quantitative survey and the analytical generalisations of the qualitative case study work, which points to a causal link between club membership and positive attitude change.

The least evident outcome was 'transfer to teaching, and wider impact in the school', although this could be due to the early phase of development of club practice in schools, or to schools not seeing this as a priority. A reciprocal relationship between club practice and wider school STEM approaches could be seen in some schools, with these schools fitting the ASSEC into a pre-existing STEM programme. Identifying increased learning, attainment and progression were not within the scope of the evaluation. None of the Case Study schools had in-house evaluation to measure club impact.

[10] See Section 2.2.6 for a description of the underlying logic model being tested.

6 Discussion and Suggestions for Development

6.1 Key Points

- Evidence from all strands of the evaluation show that the aims of the programme are being achieved. However, more positive effects have been seen for Science than for Mathematics and Engineering.
- Some schools have not recognised the availability of support from the Club website, and promotion of the site may need to be improved.
- Management support for Clubs is important if they are to have impact in the wider school beyond Club sessions.
- Club activities that allow pupils to think creatively and work independently create the biggest positive impact on attitudes, as does including pupils in decision making and choice of activities.
- A prevalence of 'cars and rockets' activities may be counterproductive with girls.
- STEMPOINT brokerage activity has the potential to address issues of under-utilisation of external resources (e.g. SEAs, visits, enhancement and enrichment schemes).
- Good practice case studies, coupled with CPD, can address issues such as equality and diversity stereotyping, effective management of Club activity, and the use of agriculture and the rural economy as a STEM context.
- There is a need for more Mathematics activities for Clubs
- Schools should be encouraged to develop more comprehensive approaches to STEM activity.

6.2 Teacher suggestions

Before we state the evaluation teams conclusions and recommendations, the evaluation team thought it important that the views of teachers, in response to the question 'Would you have any suggestions for the DCSF, or anyone else setting up an ASSEC, about implementation?' were presented (see box 5.1 below). We draw on these, as well as the teams other research findings in Sections 5.2 and 5.3.

Box 5.1: teacher suggestions on implementing ASSECs

'I think it needs to be planned into your timetable, that is a real key thing to get projects going which are going to run for a number of weeks so its easier to do, and make sure someone has the time to do it and does it properly.' School 4

'I think I would suggest a bank of lesson plans to start the club on, before you get to know the students. The first 2 or 3 club sessions, a sort of set lesson plan, so they could get to know us, we could get to know them, their abilities and what they're capable of, before you then plan what you're going to do next. So everybody has the same starting point, so less confusion or lack of confidence at the start. It would make it much easier setting up the clubs if you had that bank, on-line.' School 7

'To be structured and have initial ideas before beginning. Also, it might have been better to stage funding over five years rather than two years.' School 10

'Interviewing the kids was a really good experience because we got to know more than we would normally do in school about their likes and needs. Especially using an industrial contact to sit in on the interviews… It gave the kids a good learning experience too.' School 11

'A big booklet of ideas like the website at the moment and a list of suitable people from industry to come and work with the club (who have had previous experience working with children).' School 12

'More cohesive ways to approach involvement in Science. Sometimes the focus is on City schools. External Agencies including SEPOINT/SETNET could be joined to provide a more coherent offer, rather than depending on busy teachers in schools. Focus on equality and those pupils who do not think Science is for them because no-one in their family is interested or has been to university. More time given to promoting exemplar projects which can be used as off the shelf activities. Ongoing regional events. Additional funding rather than taking people off timetable, as this represents its own unfairness in access to the best teachers.' School 16

'There is a worry about exclusivity for the bright kids emerging - recruitment is an issue across the board. The Thematic approach is important in moving away from the flash bang approach of Science clubs. £8-9k a year represents an unusual level of capitation - more than the entire departmental budget - and gives an opportunity to try new things. Explore potential to extend funding beyond 2 years - both to identify impact, and for long term development - continuation activity for older pupils - this would need to be well marketed and packaged to gain buy in - i.e. not a club, and should learn from the enthusiasm of younger students.' School 17

'Initially the effort needed to set up and run the club is a drain on energy. But this should become easier, particularly when we have good external contacts built up. Also, people should use some of the funding to create time for club team to be able to meet to plan activities. We have done a little of this, this year.' School 19

6.3 Discussion

This evaluation has allowed the team to determine the degree to which the programme aims, both *enabling* and *impact*, are being met, and to identify barriers (and promoters) for schools participating in the scheme.

Enabling aim: enhancing and extending the Key Stage Three curriculum

Pupils in clubs have been engaged in activities they would not have done without this initiative. Whilst there has been a dominance of activities with a vehicle or robotics theme (sections 5.1.6 and 5.1.8) the full breadth of new activities has been large, with over 50 types of club project

being listed, including fruit batteries, mountain Science, Fibonacci numbers and food technology (see Annex 5). The emphasis was on projects that could be linked with physics, D&T and Engineering (section 5.1.8), but whatever the topic, it was usually possible to identify the links with curriculum subjects, and these included biology, chemistry and Mathematics. However, in almost all cases, the activities were not ones that would have been carried out in subject lessons (5.1.6), although in some cases club activities were seen to be an extension or reinforcement of lesson activity, or even as a precursor to what pupils might study in future years.

Enhancement and extension was also achieved by the use of competitions (in-class/school, or using external schemes), with just under 90% of clubs engaged in a scheme, or planning to. CREST Awards was the most popular choice. Chemistry was represented, with 11% of schools opting into the Salters competition (section 5.1.7).

Celebration events were also well used, with 80% of schools having held them already, and a further 16% planning to (section 5.1.4).

Evidence from all strands of the evaluation points to this aim being realised.

A key enabler here was the use of off-the-shelf-kits, BA/STEMNET materials, and knowledge of what was available. Lack of such knowledge was a barrier to realisation of this aim.

Enabling aim: improving collaboration between schools, and between schools and industry and the research base

To some degree, this aim could be recast as one that seeks to bring pupils (and their teachers) into contact with Science and Engineering from the real world, although the inclusion of 'collaboration between schools' has a more schools-focussed intent. That is, it fits with the current push for schools to work together, to collaborate on delivery and to provide support in mutually beneficial ways, such as sharing resources and good practice. There was little evidence that schools had collaborated in delivery of ASSECs, although CPD and workshop sessions, provided by the Science Learning Centres (CPD), and by STEMNET (good practice workshops), represented opportunities to share good practice. During the spring of 2008, 164 club staff, from 127 schools attended good practice workshops organised regionally on behalf of STEMNET (STEMNET, 2008). This provided the main element of 'between school' collaboration and sharing, and involved around 50% of pilot schools.

Interaction with industry and research (making visits, or hosting visitors such as SEAs) had been achieved in just over 80% of schools, although there was evidence that some schools found linking with businesses problematic. A theme in rural schools was a failure to recognise agriculture and the rural economy as examples of STEM-related business.

Evidence from all strands of the evaluation point to this aim as being realised in the majority of schools.

Impact aim: improving attainment in, interactions with and experiences of Science among those pupils already showing interest and ability in these subjects

The evaluation of the ASSEC pilot began and ended within one school year, and so empirical evidence of improvement in attainment was not available. However, sufficient data has been collated to allow DCSF to track individual pupil progress over the coming years. The evaluation team's approach to analysis included the use of a logic model, which linked improvement in attainment with improved attitudes to Science and Engineering, and there is much evidence of a positive impact on the attitudes. Teachers' views of changes in pupils' attitudes, skills and level of understanding of Science all indicated positive changes in these factors, although the majority of staff were unsure as to whether there had been any improvement in achievement. These improvements in attitude were higher for club members than other pupils in the study, and were particularly evident in girls and Y8 and Y9 pupils. There was a small measured decrease in positive attitudes to Science in non club members, in line with the well-established

reduction in interest in Science and other school subjects that occurs as pupils move through their secondary years. In this sense, a positive initial impact is that the clubs seemed to sustain positive attitudes.

Members' attitudes to carrying on in education post 16 and going to university were also more positive than non-members, and increased during the period of the evaluation, with girls' attitudes being both higher and increasing more than boys. This is in line with other evidence about the gender gap in terms of attainment (Younger et al, 2005). Given that a key aim of the whole STEM Programme is to increase progression into Science and Mathematics subjects post-16, and the generally positive attitudes developed by girl club members, then the potential of the club approach to keep girls interested in Science and Engineering is great. However, the prevalence of 'cars and rockets' activities may depress what could be significant changes in girls in terms of post-16 choices relating to physics.

Clubs provided enhanced and extended opportunities for learning in Science, through contexts for club projects, and the use of visits and visitors (e.g. SEAS). All clubs surveyed provided experiences which were not available through the normal curriculum.

Evidence from all strands of the evaluation show this ongoing aim is being achieved, although firm data on attainment is not yet available. Impact on attitudes to Science is more positive than for Mathematics and Engineering.

Impact aim: encouraging these individuals to consider continuing their education in STEM

Expressed intentions to continue study of Science post 16 improved among members, and were at best static in non-members. However there was no positive effect on Mathematics, which was static for members, but higher than in non-members, whose intentions towards post 16 Mathematics fell over the period of the study. The lack of Mathematics-based activity in clubs may be a cause of the low impact. Intentions toward Engineering followed a similar pattern, which may reflect on the nature of the Engineering-based club activities, which were often 'kit' based.

The proportion of girls taking part in the programme indicating a possible choice of Engineering post 16 was low (8%) at the start of the study, and for the sample of pupils overall this had in fact fallen to 5% at the time of the second questionnaire. However, both figures were higher than for non-members. Recent research (Royal Academy of Engineering, 2008) indicates less positive attitudes, and lower levels of awareness of Engineering among girls as compared with boys, and the evidence is that club membership has not affected this more general situation. However, girl members stated intentions towards Science were higher than for boys. And, for STEM subjects taken as a whole there was more and growing interest, among members than among non-members, whose interest fell.

Evidence from all strands of the evaluation show that this aim is being achieved, although more so for Science than for Mathematics and Engineering.

6.4 Barriers and promoters

Overall, the aims of the enabling and impact aims of the initiative are being met. Whilst the model holds up, there are a number of 'barriers and promoters' identified at individual school level. These were often caused by specific school contexts, although general points can be made that assist in learning lessons for future practice

Stage	Barriers	Promoters
Inputs (ASSEC Programme Implemented in school)	Lack of awareness of external support available[11] 'Conscript' recruitment policy Lack of cross-departmental co-operation	Funding from DCSF Existing STEM programme in school SMT support Enthusiastic club leader(s) Cross-departmental cooperation CPD and workshop provision to support Clubs Dedicated time given to club leaders to organise activities
Outputs - activities (pupils engaged in new activities)	Availability of resources to support new Science investigations in a club context Availability of resources to help school make use of external links, business, SEAs etc Quality of input from some external partners Agriculture and rural economy not always perceived as a STEM context	Availability of off-the-shelf resources and kits Involvement of pupils in deciding on club activities Activities different to normal classroom practice Coherent, thematic approach Variety of activity
Outputs - participation (Pupils complete projects, make visits, interact with SEAs etc)	Low level of current engagement with external organisations or support Little or no previous track record in school of engaging with external	Support from STEMNET Regional Directors Contact with local SETPOINT Engagement with external organisations and support e.g. SEAs Dedicated staff time to engage with external support
Outcomes - short term (Increased engagement, enjoyment, enthusiasm)	"Conscripts" approach to selection for club membership Single teacher-led clubs with no collaborations (internal or external) Science teachers' lack of awareness or knowledge of Engineering and Engineering careers Changing membership for each project	Pupil-led approach, e.g. involvement in decisions about activities and themes, self-directed activity High SMT expectations High behavioural expectations Placing of club activities in everyday or motivating contexts Club activities that allow pupils to think creatively and work independently Challenging diversity stereotypes and encouraging inclusivity Visits by SEAs (particularly Engineering)
Outcomes – short to medium term (impact beyond the Club sessions)	Lack of SMT support Lack of any in-house evaluation (or other impact measures) No strategy to build on club members' enthusiasm (in terms of peer-to-peer interactions, lesson planning etc) Departmental insularity No clear vision or strategy for how the club supports school priorities or development planning	Use of purchased kits and apparatus in normal lessons Highlighting club activity in newsletters, school web sites etc School displays, posters etc highlighting club activity Interactions between clubs and other STEM activities in school Parental engagement and support Positive impact on SAT scores Community engagement School-base celebration events

[11] Some schools seemed unaware of the material available on the BA web site (http://www.the-ba.net/the-ba/ccaf/Clubs/index.htm).

6.5 Suggestions for development: policy and implementation

The following recommendations are themed, and the organisation that might take the lead in implementing each one is identified, although it is acknowledged that resource implications may reduce the scope for such further developments. The items in bold are the suggested priorities.

The recommendations are allocated according to organisations' responsibilities for the different aspects of the ASSEC scheme. Whilst a large number of suggestions are allocated to STEMNET, it is understood that it may be other organisations such as the British Association for the Advancement of Science (the BA) or the Science Learning Centres that may take responsibility for developing specific recommendations. However, we would suggest that these are carried out under the strategic direction of STEMNET, hence the attribution of responsibility to them.

6.5.1 Setting up and running Clubs

- DCSF / STEMNET to consider how clubs can be supported to become self-sustaining in the long term
- **STEMNET to promote the availability of support materials more effectively, e.g. through a termly newsletter highlighting what is available, as well as providing an opportunity to share good practice**[12].
- **STEMNET and DCSF to engage with school managers, governors, head teachers, to promote the aims of the scheme, and the benefits for schools and pupils**.

STEMNET to develop good practice case studies of specific aspects of Club operation, e.g. cross-departmental collaboration.

STEMNET to encourage schools to provide time allowances (against timetable commitments) to Club leaders, and other contributing staff.

STEMNET to encourage the use of more formal evaluation approaches to measure pupil responses to Club activities, e.g. through the development of a simple, off-the-shelf tool.

6.5.2 Promoting enhancement and extension of the KS3 curriculum

- **STEMNET to support schools in identifying and making better use of external (industry, research) contacts, through focussing some STEMPOINT brokerage activity on supporting Club operations.**

- **STEMNET to promote the recognition of Mathematics as a suitable starting point for Club activities, and to identify suitable materials and ideas for schools.**

STEMNET to identify and promote existing resources suitable for use in Clubs, and identify significant gaps (e.g. resources to support the use of agriculture and the rural economy as contexts for STEM activity). This could include identifying suitable sponsors to support the development of resources specifically designed to motivate girls.

STEMNET to develop a quality standard for external inputs into school activities, e.g. code of practice, charter-mark, 'Investors in Schools' system. This could be incorporated, for instance, into SEAs training.

12 In August 2008 a new Clubs web site (www.assecs.org) was established which could provide the 'one stop shop' for Club leaders.)

6.5.3 Creating increased impact on members

- **Schools to achieve greater pupil participation in choice and decision-making regarding Club activities.**

- **Schools should create cross-curricular Club staff teams, including Science, D&T, Mathematics, and Engineering in those schools where it is a subject, and to encourage other subject staff to become involved as appropriate. Good practice case studies, for use in CPD, workshops and newsletters could be developed by STEMNET.**

- **STEMNET to encourage all Clubs to make use of SEAs. This could be a STEMPOINT brokerage objective.**

- **STEMNET to provide support and guidance for schools in how to challenge and overcome perceptions of gender, ethnicity and disability stereotyping. Good practice case studies could be used here.**

STEMNET to develop approaches (e.g. resources, CPD) to increasing subject teachers' awareness and knowledge of Engineering and Engineering careers, and build on teachers existing knowledge of careers in and from Science, Technology and Mathematics.

6.5.4 Creating impact beyond Club sessions

STEMNET to encourage, through good practice case studies, SMT engagement, and 'how-to' guides the communication of Club activities and outputs to the wider school and the local community.

Schools should plan to achieve greater involvement of parents and carers in Club activities

STEMNET to encourage schools to develop more comprehensive approaches (e.g. whole-school policies) to STEM activity, within which Clubs have a significant role.

Additional recommendation - Young Engineers Clubs

The ASSEC initiative has been launched into schools whilst a long standing and successful after school engineering club programme (Young Engineers Clubs) has also been running. This evaluation has not looked into these Clubs in any way. However, we would recommend that DCSF and STEMNET seek to identify ways that the ASSEC programme can be aligned in some way to the Young Engineers Clubs, possibly following the second phase of the pilot scheme. Sufficient evidence of good practice exists in the public domain to suggest that such a coming together would increase the firepower of the DCSF programme and reduce duplication of effort, in line with other rationalisations that are likely to occur as the national STEM programme evolves over the next few years.

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8 Appendices

Appendix 1: Case Studies

Key findings - Case Studies

- The case studies looked in more detail at 10 schools, and these sought to identify contextual factors that may affect how clubs were run, and club impact
- In all case studies, the hypothesis that enabling aims (aims 1 and 2) led to the achievement of impact aims (aims 3 and 4) was supported providing strong confirmation that the programme is able to generate at the least short-term outcomes of increased engagement, enjoyment and enthusiasm
- Club activities that allow pupils to think creatively and work independently create the biggest positive impact on attitudes, as does including pupils in decision making and choice of activities.
- Transferring club practice into normal teaching sessions was not evident in case study schools, possibly due to the short period clubs had been in operation

School A

School A is an 11-16 mixed Community school situated in a Metropolitan Borough, and serves an area with high levels of socio-economic disadvantage. There are around 900 pupils on roll, and over 26% have SEN (supported at School Action). There are fewer than the national average proportion of pupils from minority ethnic backgrounds. Key Stage 3 results are below local authority and national averages, and in science less than 10% of pupils achieved level 6 or better in 2007. Results at GCSE are below LA and national averages for 5 A*-C grades (including English and Mathematics, but have recently risen above both these benchmarks for 5 A*-C grades cross any subjects, and around 70% of pupils in Y11 achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school has been recognised as improving.
The club meets on Tuesdays for one hour after school, and has around 10 members (down from 15 at the club's inception), all from Y7 and Y8. Members are volunteers who responded to information about the club's establishment by volunteering to join. The club is run by a classroom science teacher in collaboration with a colleague from the maths department. Planning is now taking place for a new cohort in September 2008 and numbers are expected to reach between 15 - 20. The large majority of members are high achievers although membership of the club is not based on academic ability and is open to all interested pupils.

The ASSEC programme implemented in the school

The club seems to be effectively and imaginatively run, although there is a lack of perceived senior management involvement or even knowledge of the club's potential to raise standards at KS3. Given that a recent OFSTED praised the SMT team, but pointed to a need to improve standards at KS3, this indicates a need for greater communication between the club leaders and school management. This also leads to an apparent lack of commitment, beyond recycling purchased equipment, to the longer-term sustainability of the club.

Club activities

The club has delivered a number of activities based on several themes:
- Forensic science
- CAD
- Data logging
- Jitterbugs
- K'nex

Activities are well supported through equipment and teacher-produced resources, and pupil activity is purposeful and driven by objectives. Delivery of activities differs from normal classroom learning and teaching through a sustained use of practical approaches and through a more informal atmosphere. Although members do not direct the clubs themes/topics they are encourage to voice their opinions on activity and topics and to suggest areas for development. A key element of the club is that the members are encouraged to work in pairs or groups and to share ideas and findings with each other. Activities are stimulating and distinct from normal classroom-based science

Collaborations

Good links with the local SETPOINT have been made (particularly for K'nex), and these are planned to grow in year 2. A trip to a theme park is planned where pupils will engage in activity investigating 'speed and motion'. Both the science and maths departments collaborate. Design and Technology also support the club by making available relevant resources and rooms. However, no staff resource is offered. The lead teacher recognised the benefits of greater links with business and stated that they will be planning to develop links with local businesses, although there was no evidence of such links existing at the time of the study.

Impact on pupils

Pupils are responding very well to club activity, and that they have positive attitudes towards science and engineering. Members particularly enjoy the hands-on, practical and 'fun' approaches used during club sessions, and the opportunity to develop self-confidence through collaborative working. They perceive science lessons as having more limited opportunities for 'learning by doing' and investigating. Members are also aware that the club is promoting a pupil-led approach, which they value and appreciate. Members described the value they place on the "structured autonomy" afforded them by the club leaders. They stated that they appreciate being trusted to learn for themselves and to share ideas and ask questions within their peer group. Members highlighted the topic of 'forensics' as particularly interesting, while 'plants, rocks and animals' was viewed as least interesting. All pupils intend to remain members of the club for the foreseeable future. In the observation of a club session, members demonstrated high levels of enthusiasm and concentration.

On questioning, pupils demonstrated some awareness of science and engineering careers. Most were uncertain about their future career plans but suggested that they would consider science and engineering.

No formal evaluation taken place regarding a potential increase on pupils' knowledge and understanding of science and engineering.

Impact beyond the club sessions

Teachers were not using ASSEC activities and ideas in their normal teaching apart from a stated desire (lead teacher) to utilise the sensor equipment for classroom science sessions. As little support had to date been offered by the Senior Management Team (SMT), teachers interviewed hoped that as the club develops its profile within the school the SMT will be alerted to its potential for contributing to the growing profile of the school as a whole. The potential to enthuse other pupils, through transfer of successful activities from the club to classroom teaching (where appropriate) and through promoting science and engineering in the school through club publicity and staged events (e.g. displays, assemblies) would seem to be under-developed aspects of the how the club was being managed by the school. However, the club is still in its infancy. Future plans are well structured and realistic and should help to boost the club and establish a firm place within the schools portfolio of enhancement activity, particularly if the interest of the SMT can be engaged effectively.

School B

School B is an oversubscribed 11-16 comprehensive school in a rural area, serving a range of small village communities. Most pupils are bussed in. There are approaching 900 pupils on roll, with around 5% having SEN (supported at School Action). The vast majority of pupils are white and have English as a first language, and there are fewer than the national average of students receiving free school meals. The most recent Ofsted report (2007) says this is an outstanding school. It has a specialism in mathematics and computing. The school is currently seeking a third specialism (possibly science), but this is one of several areas being considered. Key stage 3 results are above LA and national averages, and in science 56% of pupils reached level 6 or above in 2007. Results at GCSE are also above LA and national averages. Around 74% of pupils achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school is introducing triple science as a GCSE option in 2008.

The club meets for one hour after school on Tuesdays, and has 15 members. There is a lot of competition across a variety of popular afterschool activities, and well supported by parents. Pupils are from Y8, and were volunteers recruited from the top two sets. The club is run by the Head of Science and a science teacher with responsibility for KS3 science, but other science staff as well as those from D&T, maths and art also contribute. Planning for next year includes building time into staff timetables to allow for club involvement.

The ASSEC programme implemented in school.

The club seems well run and is supported strongly by the SMT, who had assisted in putting the original club proposal together, and provided time to attend the STEMNET briefing. The Head Teacher had been over to see the club in action. It is likely that SMT support will see the club continue following the current 2 year programme, with some resources being diverted into science department staffing. It was also possible that some specialist school status funding would be used to cover some club costs. Staff would like to visit other clubs, or attend a showcase of club activities. There was also a feeling that too many disjointed activities had taken place in the first two terms, and that a more consolidated programme would be developed in future.

Club activities

Club activities are varied. Some are teacher driven, but pupil ideas are also included. Highlights included a ‘village of the future’ project. This included modeling the heat exchange process that occurs during geothermal energy transfer, involving glass bending and model building. Other topics covered included wind turbines, projectiles and hydrogen-powered cars. A ‘green’ theme seemed to pervade much of the work. Whilst the underlying science in many club activities linked with the curriculum, the approaches taken, particularly extended investigations, meant that club activity was distinct from lessons. During observation, different groups were seen to be engaged in widely differing activities, but linked to the overall ‘village’ theme. The school had distributed to pupils a bought booklet of ideas for use in clubs, but staff indicated that they would value other topic guides from external sources, including advice on linking with businesses.

Collaborations

Cross-departmental collaboration was working, but there was a lack of engagement with external organisations. No visits had been made, and no visitors had been to work with club members. No business links had been made, and the rural environment was seen as part of the cause for this, indicating a common failure to recognize agriculture as a context for science, maths, engineering etc. However, the lack of business links was acknowledged as an area to improve. Apart from the original STEMNET course about setting up clubs, no evidence of ongoing links with external providers of enhancement and enrichment activities was in evidence. The club seemed to be driven by the enthusiasm and interests of the teachers and the pupils, but this may lead to a limited understanding of the real-world contexts of science and engineering including careers in these fields.

Impact on pupils

Pupil enthusiasm for science, and club activities, was high. This could partly be down to the choices pupils were able to make within the club, and the fact that their ideas were taken into account in setting up activities. Club observation, where different activities were seen to be carried out by different groups, indicated a high degree of pupil self-direction. The 2007 Ofsted report highlighted independent learning as the only significant area the school should improve further. It is possible that the club is helping to address this issue, which could impact further if lessons learned are shared. No specific evaluation of pupil attitudes had been carried out or was planned - high attendance rates were cited as evidence of enthusiasm. Wider developments within the school, including staffing changes, were identified as creating a general rise in enthusiasm for science. This had been identified through whole-school 'evaluation' (eg Y11 exit interviews, School Council and form group meetings). Pupil understanding of engineering as a discipline had not been monitored, but anecdotal evidence indicated that the engineering background of one of the club leaders was aiding pupils' understanding. Pupils involved in a focus group showed an under-developed understanding of what scientists and engineers did. SMT expectations were that the club would have a positive impact on attainment in science.

Impact beyond the club sessions

There was some understanding of the potential for the club to increase inter-departmental working and that this could lead to revised curriculum. It was also expected that the club would raise the status of science in the school, which had in recent years fallen somewhat, but with new staff was now on the rise. There was no evidence that the club had impacted on normal science lessons, although club topics could be cross-referenced to a degree to the programme of study, and so there might be an increase in members' understanding of some topics. There was some understanding of the potential for members to influence other pupils through talking about science and the club, although the potential for club activities to assist in developing independent learning strategies did not seem evident.

School C

School C is a co-educational comprehensive Foundation school in a Metropolitan borough, with over 1400 pupils, of whom just under 10% have SEN (supported at School Action). There is a higher than national average number of pupils from ethnic minorities and is line with national averages for free school meals. The school has triple specialist status, including science. KS3 results in 2007 were above LA averages, but in line with national ones. In science, 6% of pupils achieved level 6 or higher. Results at GCSE were above LA averages, and at or slightly higher than national scores. Just over 50% of pupils achieved the equivalent of 2 GCSE A*-C grades in Science in 2007.

The club is run by the D&T department and Science department, has 21 members, and meets on Wednesdays from 2.30 to 4.00. The members were selected from around 100 applications, using a recruitment campaign mainly based on posters around the school. Parental consent was required, and 40 responded positively. Sessions are run separately some of the time for science and D&T topics, and sometimes jointly.

The ASSEC programme implemented in school

The club has the full support of the senior management team (SMT), who have indicated that the club would continue post-funding using school resources. Further DCSF support, even at a much reduced level would be welcome, although this would require school resources to cover club costs. There was an understandable reluctance to see the effort and achievements from the Pilot Phase to be lost following the initial funding period - it would have been 'all for nothing'. The SMT allows club activity to proceed without 'meddling', but provide the club leader (Head of Design and Technology) with clear expectations. The Club was initially established mainly through the efforts of the club leader, with technician support. All support materials for the administration of the club had been developed in-house, based on prior experience of what was needed for this sort of activity, but the club leader suggested that a pack containing proformas, examples of letters and 'press releases' and ideas for activities would be useful for less experienced staff. The school did not seem to be aware of the resources on offer from the BA web site. The club seemed to be well run, although there was a fairly narrow range of activities being used. However, pupil engagement was high.

Club activities

The main activities have been the *F1 Challenge* and rocket science. During the visit observation was made of a session on robotics, which was the fourth of six planned sessions, which involved an external provider of engineering activities who made a living from going round schools running sessions on robotics. Contact with this provider was provided through the local authority education service provider.

The club activities differed from lessons - the main activity of the club was the F1 Challenge, which is an established enhancement and enrichment (E&E) activity, and used in a large number of schools across the country. The club allowed expansion of the cohort of pupils that had previously been engaged with the project (ie. prior to the establishment of the club), as well as allowing other, newer activities to be experienced by pupils (eg robotics, rocket science). Up to now, none of the activities used in the clubs had been used in normal classroom lessons. The two stands of activity, clubs and lessons, seemed to have been carried out independently of each other and with little cross-fertilisation in evidence.

Pupil activity in clubs had shown a transition from initial, mainly prescriptive sessions, to the point now where pupils are able to tackle problems themselves. Linking with competitions, eg the F1 challenge, and a national rocketry competition has created a goal-orientated framework for activity, which provides a structure for problem solving work.

Collaborations

Little use is made of external resources offered by the sub-regional SETPOINT, although contact with and support from the STEMNET Regional Director was valued, particularly a well-received Engineering Awareness Day. The F1 challenge is a nationally available scheme, and was well used. The observed robotics session also made use of an external provider. No use had been made of Science and Engineering Ambassadors, CREST Awards or Young Engineers Clubs. The local SETPOINT had not provided sufficient information about SEAs for engagement to take place. The club leader confessed to a lack of awareness about what was available externally to support club, or curriculum, activity. The club had created links between the science and D&T departments, and to a lesser extent the maths department. However, club activities themselves seemed to be identified as either D&T, or as or Science. Cross-curricular approaches had not been tried. The club leader had utilised local business in assisting club activity, as well as providing input to the wider school population, eg talks to Y8 pupils about engineering and careers. This was mainly an attempt by one company to link with schools in an effort to secure sufficient uptake of engineering apprentice schemes. The lack of awareness about other, more widely available schemes to support clubs, and to develop more holistic approaches to STEM education, may be improved as a result of the new local brokerages for STEM E&E activity. However, the school has identified albeit a narrow range of external opportunities that seem to meet its needs.

Impact on pupils

Formal evaluation was not being carried out. Use was being made of professional judgement and ‘gut feeling’. The main success criterion was whether pupils could carry out a holistic ‘design, build, test’ project, and whether they enjoyed it. At the end of the first year of operation, it was decided that the criteria had been met. Observation of the club in action supported this view to some extent. Pupil behavior in clubs was very good. The school had identified good behavior in the club as an essential requirement for membership, and this seems to have created a very on-task atmosphere during sessions. Pupils look forward to the club, and are disappointed if it has to be cancelled for any reason. Pupils are very enthusiastic, and see themselves as a ‘special group’, even an ‘elite’. This has had a knock-on, positive effect to their attitude in lessons, and to their attitude to STEM subjects. Pupil awareness of engineering has been raised, along with an increased understanding of the role of science and maths in engineering. Creating this holistic grasp of the subject roots of engineering seemed to be a key issue for the club Leader.

Impact beyond club sessions

The profile of the STEM subjects had increased in the school. A copy of a school magazine seen on the Case Study visit highlighted a group of pupils that had been involved in an external, community event. Club activity, pupils’ responses to it, and the Poster campaign had created a high visibility for the club. Option choices, particularly for D&T had increased to the point of oversubscription. D&T was now seen as a ‘leading department’ in the school, with a high status. Involvement in other engineering schemes other than the club including a local Young Engineers Rotary Tournament. Less impact was in evidence for the impact on science.

School D

School D is a large, over-subscribed co-educational 13-18 comprehensive school in a medium sized town in a county LA area. It serves both the town, and the surrounding villages. There are over 2200 pupils at the school, with over one third being in the sixth form. Just under 4% of pupils have SEN (supported at School Action). The number of pupils from ethnic minorities s lower than the national average, as is the number on Free School Meals. Pupils arrive at the school from middle schools where they have already done their SATs during Y8, so there are no school statistics for attainment at KS3. The school performed well above the LA and national averages at KS4 in 2007, as it had done for a number of years, with around 68% of pupils in Y11 achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school was described as "outstanding" in a recent Ofsted report (2007). The school has three specialisms, including science.

The school has a wide range or extra-curricular provision for science (including other 'science clubs'), and adopted a strategy of recruiting pupils to the ASSEC who were not perceived as being interested in science, that is, 'conscripts' rather than 'volunteers'. The club meets on Mondays from 4.00-5.30pm, and began with 15 members. Some members have left, and others have joined, and it now has 13 members. The club is run by an 'outreach teacher', with modest timetabling commitments, who has many other roles, such as liaising with middle schools, and engaging with external provider organisations. A unique feature of the club is that the members are from 3 feeder middle schools, rather than the school itself.

The ASSEC Programme implemented in school

The club has been imaginatively run, and largely efficiently (although a Case Study visit was book in on a day when most members were not able to attend the session due to a school trip!). The outreach teacher is responsible for the club and has personal qualities suited to this task, and is well supported by the SMT, who have committed to keep the club going post the current well funded pilot phase, using school resources. The club targeted middle school pupils who were not necessarily interested in science, but who had the ability to improve their attainment, particularly from an estimated level 6 to level 7 in science and maths. However, retention issues (over 30% turnover in year 1) caused problems that the school sees as being solved by altering their recruitment policy in future years.

Club activities

The topics chosen for the club were stimulating, particularly the first term topic of "Junk Music". Other topics included the science of the bicycle, and food, but these have met with varying success. The second term topic was bikes (facilitated by a local bike mechanic) had not gone down well. This was seen as being due to the mechanic being unable to enthuse the members. The third term topic of food (chosen by members) went much better. However, some of the content being covered could have been covered in KS3 science lessons (taught at the members' feeder schools), and this may have had an effect on pupil motivation and retention.

Collaborations

The club itself is an example of collaboration between the secondary school and its feeder middle schools. However, a vast array of other external contacts was in evidence, including SETPOINT, universities and companies. The existence of an outreach science teacher has allowed such external contact to grow, and releases classroom teachers from the requirement to make their own links. Other evidence, eg from the school web site and newsletters, indicated a general, school wide involvement with external organisations and events, and a group recently came third an international science competition. Good use had been made of SETPOINT and STEMNET offerings.

Links internally had been made with the music department for the Junk Music topic, although the club leader recognized the missed opportunity to link with maths for the bike topic, which included mathematical work on gearing.

Impact on pupils

The school adopted a recruitment policy based on selection rather than volunteering. In some aspects, the club leader was fighting an uphill battle to retain interest, and this resulted in some 'shying away' from real science activity. However, the sequence of activities for the junk music topic showed that science had been interwoven with technological (building instruments) and music-making activity, which had motivated the pupils. Given the 'conscripts' nature of the club membership, such broad and highly context-based approaches to science may prove more beneficial in the long run in terms of interesting pupils who were not 'switched on' to school science. However, running most activities through a single club leader (a biology teacher), albeit supported on many occasions by outside help, had not resulted in any evidence of enhanced pupil awareness of engineering.

Impact beyond the club sessions

The school has a wide variety of science enhancement and enrichment activities going on, including other science clubs. The specific focus on middle school pupils who had not shown significant interest in science, but who were perhaps capable of achieving level 7 scores, has the potential to increase interest and attainment with pupils who would not voluntarily opt for science after school sessions, or for more than the minimum allowed of science subjects at GCSE. By not focusing on volunteers, who may well opt, for example, for Triple Science at GCSE, the school's approach has greater scope for increasing the volume of post-14 science subject choices for science.

The school already integrates STEM enhancement and enrichment activities into its daily life, and this initiative has been moulded to address the specific issue of motivating pupils with little interest in science. There was no evidence of teachers using club ideas in everyday teaching, although data gathered on the Case Study visit suggests that there is potential for this to happen. If the activities in a club format have the desired effect, it would be interesting to see their effects if transferred to general teaching approaches, particularly in terms of motivating the "less than keen".

School E

School E is an oversubscribed, Church of England girls' 11-18 comprehensive school in an urban area within a large city, and serves an area of significant social deprivation. There are over 900 pupils on roll, and 11.9% have SEN (at School Action). Free school meals are received by around three times the national average proportion of pupils. Around 50% of pupils have a first language other than English, and there is a wide range of ethnic backgrounds, with around one third being White British in origin. Key stage 3 results for 2007 show significantly higher levels than either the LA or national averages, with 58%of pupils attaining level 6 or above in science, and 65% in maths. Key stage 3 tests are taken in Y8. Results at GCSE level are outstanding, with almost double the LA and national averages for pupils gaining 5*A-C grades including maths and English. Almost 80% of pupils gained the equivalent of 2 GCSE A*-C grades in Science in 2007. A recent Ofsted report (2007) stated: "the school is outstanding in all respects". The school has specialist status in arts.

The club meets after school on Tuesdays, for around 50 minutes, and has 12 Y7 and Y8 members from the identified Gifted and Talented group. Members were invited to join the club, and all had shown some interest in science previously. The club is run by two NQTs from the science department. A consequence of its Arts specialist college status is that the ASSEC competes with the many enrichment activities on offer in the school which do not receive the extra club funding

The ASSEC programme implemented in school

The club is run in an effective and imaginative manner by the two co-leaders, who bring a youthful enthusiasm to its organisation. Speaking to them it is clear that the school has an expectation that staff will run after school clubs and so there is an expectation that the club will continue after any reduction in funding. Another after school club has been running in the school for many years, so the setting up of the ASSEC was seen as making distinctive provision for Gifted and Talented pupils. Evidence gathered indicates that the SMT involvement is 'structural' or implicit, that is, by establishing school norms for what teachers are expected to do, and that this includes providing support for extra-curricular activity. Also, the selection of the two teachers to lead the club could be seen as using the opportunity as an element in their own CPD, and for them to achieve some recognition. The club leaders were confident that the club would continue after the current funding period, as the budget had not been a significant factor in setting up the club.

Club activities

A range of project topics have been tried, of varying length. These include a Young Engineers project, and a longer topic on Astronomy, using a newly bought telescope. Crest Awards had been used, but staff commented on the problem of the cost of entering the scheme. In observing the club in action, it is the case that the pupils engage in purposeful practical activity with the opportunity for personal reflection through discussion. In discussing this with the Head of Science - who is also a Deputy Head - this aspect of club activity was seen as a counterbalance to the pressure to concentrate upon theory brought about by adherence to the National Curriculum which gave club activities a distinct feel when compared to normal classroom work.

Collaborations

The teachers running the club spoke warmly about the CPD experience that had been organised by STEMNET staff. They said they had gained much from this which was a sentiment echoed by the Head of Science who felt that it was a very valuable staff development activity particularly for NQTs because it had brought them into contact with the wider world of STEM opportunities, delivery organisations and projects. Other links with external organisations included CREST Awards. Links with the maths department had been used to assist with the astronomy project, but there was no evidence of linking with the D&T staff.

Impact on pupils

On speaking to the pupils, it was quite clear that this was a group of highly articulate and confident girls who not only enjoyed membership of the club but also shared its philosophy. The activities evidently provided stimulation to discussion that led beyond the curriculum. Indeed, despite the fact that the club is strongly science-based, the girls were able to articulate very well an Aristotelian distinction between science and engineering drawing upon those activities that had employed an engineering approach for their reflection. One can only feel that this enhanced awareness of engineering is a by-product of club activity since, in general, the school has tended to compartmentalize responsibility for STEM activities: engineering has been the domain of the mathematics department whilst the technology department has focussed upon craft skills. In this regard possibly more could have been done to encourage collaboration across the departments.

Impact beyond the club sessions

The initiative has the support of parents, teachers and the school management; in which sense it is clear the project has had a significant impact on the life of the school. In a school that has a strong Arts specialism, it is acting to bring the most able pupils into contact with STEM and to consider STEM subjects seriously.

The school has high academic expectation of its pupils with KS3 SATs being taken a year early; it is difficult therefore to determine how effective ASSEC has been in converting level 6 to 7 since the emphasis in the school is upon allowing more time to be spent on preparation for GCSE - even if it artificially depresses KS3 SAT scores a little. This strategy seems to be having a positive benefit on science take-up in the school since at A level there has been expansion with a move towards having two groups in each of Physics, Chemistry and Biology.

Whilst there is a clear benefit developing in the use of ASECC ideas in classroom teaching, and the adaptation of existing classroom materials for use in a club context, limited evidence for this transference of practice has been identified.

School F

School F is an 11-16 catholic school in an urban area in a large city, taking pupils from a wide geographical area. There are over 700 pupils on roll, of whom just under 7% have SEN (at School Action). It has a higher than average proportion of ethnic minority pupils. Key stage 3 results are well above LA and national levels. 54% of pupils achieved at least level 6 in science in 2007, as did 81% in mathematics. Results at GCSE are also well above LA and national averages for 5 A*-C grades (including English and Mathematics), for 5 A*-C grades cross any subjects, and around 74% of pupils in Y11 achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. In a recent Ofsted report (2008) the school was described as outstanding.

The club meets on Thursdays for one hour after school, and it has 14 members from Y9. Potential members were initially identified from the Gifted and Talented register, and of 15 invitations to join sent out, 14 took up the offer. The club is run by three staff, from science, mathematics and D&T. It is also supported by an excellent technician, who plays a highly significant role in the success of the club, and who in fact provided pupils with a key insight into the relationships between STEM subjects.

The ASSEC programme implemented in school

The three staff running the club spoke of working in a real partnership despite them representing separate academic disciplines. The school had clearly made good use of the opportunities for collaboration since this cross-curricular approach was strongly supported by the School's SMT. The running of the club was carried out effectively and with some considerable enthusiasm. When discussing the CPD support for the club the teachers said that they enjoyed its hands-on approach but said that they would have preferred more information on the website. The experience had given them a good sense of ownership of the material but they did feel that they would have benefited from a little more direction particularly in terms of club management and choice of activities. In particular, it was suggested that resource packages that provided suggestions for both long and short-term projects would be valued as would the inclusion of more mathematics based materials. This would seem to indicate that they were not aware of the materials available on the BA web site.

Club activities

Although the original choice of topics was perhaps a little obvious (renewable energy) the development of the longer term group project showed some imagination. The initial topic included making solar panel cars, and ferris wheels powered by solar power. Other topics included dissection, colour chemistry, forensic science and cooking. These were generally small scale individual projects. The technician played a key role in helping pupils transfer onto the group design and construction of a go-cart. This drew heavily upon the technician's previous industrial experience and hobby of go-cart racing. This transition also marked a movement towards stimulating activities that were much more distinct from lessons. The technician had a strong idea of how the integrated nature of the project would involve the students bringing together the science, mathematics and technology aspects and in doing so he emphasised the non-trivial goals of their project. It is clear that the success of this part of the club's work is highly dependent upon his gifts and skills. So, although the club had not used a Science and Engineering Ambassador in a formal sense, it was clearly the case that in this technician the school had a valuable resource who brought enthusiasm, skill and knowledge to the club.

Collaborations

Excellent cross-curricular links had been established between science, maths and D&T. Little use had been made of external support. The pupils were aware that they had not been outside the classroom and said that they would have valued the opportunity to see real factories and real countryside. They hoped that the go-cart project might give this opportunity. The had also had no one visit the club (eg a SEA). No evidence was seen of use of other externally-sourced

schemes. However, the original bid for funding did include reference to visits and outside visitors.

Impact on pupils

The pupils taking part were a mixture of boys and girls and it was interesting to note in discussion with them that, when one of the girls explained how much she had enjoyed the cooking and that the go-cart might appeal to the boys, she had been challenged by one of the boys who said that this was an example of gender stereotyped roles. Clearly the school has worked hard to address issues of equality and gender awareness. The pupils were also aware that they had not been outside the classroom and said that they would have valued the opportunity to see real factories and real countryside. They hoped that the go-cart project might give this opportunity.

On speaking to the club members it was clear that the strong identity of the school was overlaid upon - and served to unite - a wide variety of pupils whose cultural background took in many parts of Africa and the Caribbean. The pupils were lively and prepared to discuss the purpose and work of the club in an articulate manner. These positive attitudes were pleasing to see since the pupils had only been members since September 2007 (8 months - although there had been a previously existing science club). Their view was that the club enhanced their learning because the science was taught in a more practical way and so had a positive benefit for learning in the wider curriculum. When discussing the nature of engineering and science the pupils adopted a view in line with modern thinking that science and engineering are separate but related and interpenetrating disciplines (cf. Vincenti).

Impact beyond club sessions

The school is very exam-based and great priority is placed upon testing with performance in English and Mathematics being seen as paramount. The ASSEC club is seen as part of a strategy to improve the profile of science within the school and has had the effect of giving the opportunity for mathematics and technology to engage with a club which they had not done before. One felt that the club would not be permitted if it did not produce a measurable a positive benefit in terms of SATs scores. Indeed it was clear that this was the single most important factor in deciding the future of such a club in the school. The teachers had made a conscious effort to make the ethos of the club distinct from classroom lessons and this had paid off in terms of the pupils' engagement which the teachers measured by the fact that the pupils had continued to attend over a long period and that more wanted to join. It was hoped that the motivational aspects of the club would lead to improved grades.

School G

School G is an 11-16 mixed comprehensive school in rural part of a county LA. There are around 850 pupils on roll, with just under 8% having SEN (supported at School Action). The vast majority of pupils of white British ethnicity, and there are fewer than the national average proportion of pupils receiving free school meals. Key stage 3 results in 2007 were slightly above LA and national averages: 70% of pupils reached level 6 or above in mathematics, and 48% in science. Results at GCSE are above LA and national averages for 5 A*-C grades (including English and Mathematics), but slightly below for the proportion gaining 5 A*0C grades not counting these subjects. Around 46% of pupils in Y11 achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school has specialist status for science.

The club is held on Monday afternoons between 3.15 and 4.15. The 22 students are a mixed ability group chosen because of their interest, but are mainly high achievers. The club is run by two teachers, one from science and one from D&T. As the school serves a rural area, a large number of the pupils require school transport. In order that they can attend the club a taxi service is provided for them.

The ASSEC programme implemented in school

The club leaders have been given time to organise the club and moral support from the SMT, but otherwise feel that the ASSEC is thought of as just one of a number of science related clubs in the school. The ASSEC training day confirmed their approach but offered them little else, they have had no other contact with STEMNET and no other input from the school. Neither teacher had previously run a club of this type and felt that they would benefit from further assistance, particularly focussed on ideas for activities that really work and where to find suitable resources. Resource packages would be useful if they contained a few activities to do in the first few weeks, ideas on how and where to spend the money and some good reviews of the equipment. *Lego Mindstorm* kits were bought after attending a local club leaders' meeting, where they found that other clubs had similar problems to themselves. The main criterion for success is pupil enjoyment of science and engineering judged mainly by verbal feedback.

The funding has allowed the club to obtain equipment that would not normally be available. When the annual funding is reduced after year 2, it would be spent on basic equipment and consumables but might not cover visits or further training. If there is a need the club will carry on after the funding period when the cost would probably be met within the school science status budget.

Club activities

The main aim of the club has been to stimulate interest and excitement in science and engineering. Although the general topics of alternative energy and space can be found in the curriculum, the approach developed by the club was very different. Much emphasis has been placed on designing, making and improving, with activities such as wind buggies, solar powered boats, solar powered mini robots, water powered and balloon powered rockets. The pupils said that they had enjoyed these activities and had spent considerable time improving their designs.

The observed session was a continuation of the previous week when pupils were learning to construct and programme *Lego Mindstorm* robots. A number of Lego kits had been purchased for the club and students were obviously enjoying using the new equipment. The purpose of the session was for pupils to understand the software and sensors sufficiently to use the robots in the next stage of the project. This is to be called 'Mission to Mars' and will involve the use of the robots for remote sampling.

The club programme has been mainly determined by the staff but pupils can veto some aspects. When both pupils and staff become more experienced, pupils may contribute more to the planning.

Collaborations

The club is run by science and D&T teachers, which represents a significant internal collaboration, in line with the aims of the club. The club has had no contact as yet with the various external schemes but pupils may be entered for the silver CREST award at the end of the year. The club leaders had not previously heard of SEAs but would like to learn more. There are few perceived science or engineering concerns in the area, the main business is farming, which is often not recognized in this light. However, one industrial link has been made with EDF energy.

Impact on pupils

Pupils have reacted well to the club and the informal feedback is very positive. There is no direct evidence of a knock on effect in terms of attitudes, but pupils taught science by the club leader seem to enjoy the subject more and are more enthusiastic. Most of the Year 9 pupils in club have opted to study Triple science. Pupils clearly enjoyed the club to quote one female pupil “It’s what I like about Mondays” and some said that it had made them more aware of STEM subjects. No evaluation exists but new club members may be surveyed in future.

The club leaders believed pupils were more aware of science, but thought they still see engineering as an extension of technology. Little or no attempt had been made to emphasise engineering as such, but the club is soon to visit a nearby large energy company. Pupils also said they would like to see real engineering, a visit to a car factory was suggested. They have stereotypical views of engineers and scientists but realised this was mainly because few pupils had met any. Although too early for most to think of a career some pupils felt that the club had opened their eyes more widely to jobs in science and engineering.

Impact beyond the club sessions

Club leaders see the ASSEC activities as very different from normal teaching and were unable to see a useful connection with the curriculum. As a specialist science school, science already has a high profile and the teachers expressed the view that the ASSEC programme has made a little difference.

The club leaders felt that the programme has had no influence on the conversion of SATs Level 6 to 7 performance. They wanted to give everybody a chance to get involved and so had picked a mixed ability group based on interest. A possible link between motivation and attainment had not been acknowledged.

School H

School H is an 11-14 mixed comprehensive school in a small town in a county LA. There are around 500 pupils on role, of whom 15% have SEN (supported at School Action). The pupils are mainly of white British ethnic origin, and 10% receive free school meals. Key stage 3 results are slightly below LA averages, but are above national ones. In 2007 in science 38% of pupils achieved level 6 or above, with 63% achieving this in maths. There is no Key stage 4 teaching. The school is applying for specialist status in science.

The club meets for 1 hour after school on [day], and initially planned for 15 members, but has been run with 8. Membership was open to all Y8 pupils, resulting in a mix of abilities, but with a majority of high attaining pupils, but also including those with lower attainment but high enthusiasm for science. The school plan to use current members as 'leaders' for next years new recruits.

The ASSEC programme implemented in the school

The club leader (a science teacher) works with another member of the science department to run the club. The club staff do not perceive significant SMT support for the club, which seemed to left to develop in its own way, solely within the science department. The issue of sustaining the club post funding was something that concerned the club leader because of the lack of management support but by reducing the costs on the second year and looking for outside sponsorship she felt the club would be sustained.

Club activities

Topics covered so far include robots, rollercoasters, solar panels and forensics. Pupils expressed an interest in doing more chemistry and biology.

What happens during each session is suggested by the leader but the pupils have the freedom to develop this suggestion in their own way so giving them ownership of what they do. Each session has the same basic plan with pupils arriving immediately after school finishes. They have some refreshments during which the session's activity is discussed prior to its execution.

Collaboration

No cross-curricular links had been created. Potential links with mathematics were put on hold due to a clash of commitments of a key mathematics teacher, and this is being addressed for year 2. Use of external resources has been more successful. Visits to external organisations have taken place, including an 'eco house' and a local university. The session observed was one of background research for a competition entry at a local science discovery centre. During this observed club session, a local SETPOINT representative visited to discuss how SETPOINT could be involved, e.g. using Science and Engineering Ambassadors. Staff also expressed a desire to see regional club events established. The school attended the STEMNET launch event but would have valued more ongoing support, including resources containing club activity ideas.

Impact on pupils

Pupils are fully engaged and motivated. Club leaders made a conscious decision to make the sessions different from lessons but stated that they can see the difference in club members during lessons and they feel that there will be an improvement in grades. Awareness of 'what a scientists does' was evident during the visit, but awareness of engineering had to be brought out through pupil discussions during the visit, reflecting perhaps the lack of science teacher awareness of engineering.

Impact beyond Club sessions

There seemed to be a “science is for the science department” attitude from senior management, based on discussion with club staff. The science department is physically removed from the main school in a separate building and this must contribute a little to this attitude. This seems to conflict with the expected situation in a school applying for science specialist status. However, the club is raising the profile of science in the school in some ways: exhibiting their solar cells at the upper school during science week was extremely successful and praised by parents.

School I

School I is a large, mixed 11-18 comprehensive in a small city in a county LA area. There are over 1200 pupils on role, including a large 6th form. Around 10% of pupils have SEN (supported at School Action). There are fewer than the national average of pupils from ethnic minorities, or receiving free school meals. Key stage 3 results are above both national and LA levels, and in 2007 54% of pupils achieved level 6 or above in science, and 61% in mathematics. Results at GCSE are significantly above LA and national averages for pupils achieving 5 A*-C grades, with or without mathematics and English being counted. In 2007 62 % of pupils achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school has a science specialism, and is a Training School.

The club meets on Tuesdays after school, from 3.30 and 4.30, and it has over 30 members from years 7, 8 and 9. Membership was by invitation and consists of students who were identified as likely to achieve level 7 in KS3 tests. However some students who did not meet the academic criteria but showed particular enthusiasm were also admitted. There are a number of well attended after school clubs and students often have difficulty attending all their commitments.

The ASSEC programme implemented in the school.

The club is run by two experienced teachers, one from the maths department and the other from science. They are very enthusiastic about the club and pupils have already completed a number of practical activities, received several guest speakers and have made and will make visits including a planned trip to CERN.

The club has received tangible support from the senior management team, from other members of staff and from the technicians. Support from the senior management team was described as unequivocal and the club leaders have regular update meetings with the Deputy Head. The Head-teacher is on the national board of STEMNET and is very keen that STEM subjects should have a high profile. When setting up the club, the leaders were given both time and advice. Advice came from members of the school senior management and from the regional STEMNET Director, who have provided both the initial inspiration for the club as well as continuing practical support in the form of contacts, speakers and new ideas. The initial training was very useful, offering fresh ideas as well as tried and tested activities, Particularly helpful was the feedback on what worked and what did not.

The club members will be tracked and success will be judged on the number of level 7 science SAT results and the take up of GCSE and A level. Although too soon to have firm data, teachers are encouraged by the level of enthusiasm and by the number of pupils considering science as a possible career. They definitely plan to carry on the club after the current funding period and believe that the improved results and high STEM subject profile will allow them to bid for funding from the SMT to supplement any ongoing support for the ASSEC programme.

Club activities

The aim of the club is to provide interest and stimulation outside of the normal curriculum. The themes for the year were rockets, cars, plants, the environment, forensics and healthy eating and have included a talk and demonstration by an engineer from Lotus cars, a fireworks display, exploding balloons and a visit from a rocket specialist. Some curriculum extension activities have been included where appropriate as students enjoyed activities normally covered at a later academic stage. There is some evidence that ASSEC members have taken their new knowledge back into lessons. There are two club visits planned, one to London and the other to CERN.

From discussions with pupils and staff it was apparent take the club activities were well planned and had a clearly defined purpose. On the day of the observation the session took place in a science laboratory and concerned the design of a vehicle crumple zone. This was linked to the next project, the construction of a *Greenpower* car. After an introduction to the whole group on

the whiteboard, pupils split into friendship groups of 2/3 to design and build their models. There was a lively and enthusiastic atmosphere with teachers helping individual groups with advice when needed. Towards the end of the session the models were tested, involving a great deal of cheering, and a short discussion was held to consider why some models were more successful than others.

As yet there has been little consultation with the pupils on the direction of the club. Planning for the year was done by the teachers before September and was presented to the pupils. The pupils confirmed that they have very little choice of activities but would definitely like more. The club leaders may consult more next year when both teachers and pupils have had some experience of the club.

At a more practical level, they would like to see resource packages for cross curricular multi-session projects. Ideally such packages should contain session materials that could stand alone or be linked to form one or more projects.

Collaborations

Within the school there are already strong links between the science, maths and technology departments, they hope to involve the English department and club leaders are very open to the prospect of other departments becoming involved in the future.

One of the club leaders has a community-based role within the science department and the club leaders are well aware of opportunities for collaboration between the school and the wider community but are somewhat restricted by the apparent lack of local industry. However the club has been visited by a SEA from the international engineering company based in the area. He talked to the club about how he became a chemical engineer, what his job entailed and even how much engineers could earn. There have also been talks and demonstrations from a cars manufacturer and a firework company. However, the possible role of agricultural contexts seems to have been missed. Good links with the regional STEMNET Director have been developed, and the school was planning to make use of CREST Awards.

Impact on pupils

The response of pupils towards club activities has been very positive. Although the club is at an early stage, there is some indication that it has had an effect on club members' interest in science and on pupils outside the club who now want to join. When pupils were asked whether the club had changed their ideas of STEM subjects, the Year 7 pupil said that it had, while the others felt that they were already interested.

Although most of the club activities had not been explicitly presented as engineering, the visits of two practicing, professional engineers helped pupils towards an understanding of engineers and engineering. That understanding will be practically reinforced with the construction of Greenpower cars in the near future. Pupils enjoyed the visiting speakers and felt they had gained a better understanding of engineering. They also said that the club had helped them to see that engineering was a much wider subject than they had realised.

Impact beyond club sessions

In the local community, the school already has a high profile and it is hoped that in future the ASSEC will help to promote science and engineering. The club leaders believe that this year they should concentrate on firmly establishing the club within the school, in future it may be possible to liaise with local primary schools in order to collaborate with their Year 6 pupils and a transition project could identify potential club members. Although there is no evidence as yet of the effect of the club on conversion of SATs Level 6 to Level 7, teachers believe that it will have a positive effect.

School J

School J is a small 11-18 comprehensive school in rural LA area. There are around 600 pupils on roll, and with just over 6% having SEN (supported at School Action), and with fewer than average receiving free school meals. Almost all pupils are of white British ethnic origin. Key stage 3 results were above LA and national averages in 2007, with 49% of pupils reaching level 6 or above in science, and 56% in maths. Results at GCSE have improved greatly over the past three years, and it is significantly above LA and national averages for 5 A*-C grades, with and without including maths and English. Around 84% of pupils in Y11 achieved the equivalent of 2 GCSE A*-C grades in Science in 2007. The school is part of a rural academy of nine schools and has specialist technology school status.

The club meets at lunchtime once per week, but the day chosen varies. However, the school does not class the programme as a club *per se*, but as part of a suite of 'clubs' within a progressive enrichment programme covering all year groups. The whole programme has been 'branded' within the school with a motivational name to remove possible negative stereotypes caused by a club-style title. A large number of pupils have been involved in this more broadly defined 'club' activity so far, with around 100 pupils having attended. Membership is open and not aimed specifically at higher achieving pupils, although this particular 'club' has targeted Y7 and 8.

The ASEC programme implemented in school.

The club has been designed to fit in with other activities creating a coherent enhancement and STEM enrichment programme across the years 7-13 with a particular emphasis on engineering. In effect, the funding has been used to augment existing spending, to create a more stimulating set of activities for Y7 and Y8. This was set out in the school's application form. The science department are responsible for the programme. The broader programme existed prior to the current funded pilot scheme, and the school intend to continue post-funding period, making use of the investment in equipment the pilot has allowed.

Club activities

- The club has delivered a number of activities based on several themes:
- Rockets
- Electronics
- Go karts
- Mechanical engineering

Although themes for activity are essentially driven by teachers, members are encouraged to voice opinions and to contribute to planning of potential topics/themes. A 'Cafe Science' has been established which is aiming to become completely pupil-led and will be a forum for debate and discussion between pupils and teachers about STEM topics. A key aim of the club is to distance the club from a typical pupil perception of STEM activity as 'Geeky'. This has been an influencing factor when planning topics/themes and purchasing equipment and resources. As a result, effective use of funding has been made with two examples of particular note:
Recording equipment used to deliver pod casts within the school regarding STEM topics
Model rockets which include data loggers - data concerning trajectory and height can be downloaded onto the Google Earth website which will then produce a Google Earth image of the school location showing the trajectory and height of the launched rocket.

A Science and Engineering Ambassador (SEA) is responsible for a large proportion of activity delivery and club management with strong support from the head of science and science department staff. Delivery of club activities differs from normal classroom learning and teaching through a sustained use of practical approaches and through the creation of a more informal atmosphere. Some activities that have been developed within the club have been used to support curriculum delivery: an astronomy-based intervention has now been embedded within the curriculum.

Collaborations

The club is run entirely by the science department, and no significant collaboration has occurred with maths or D&T. A strong relationship with the sub-regional SETPOINT has enhanced the range of activities delivered through the club and strengthened links with the wider STEM agenda. Good use of SEAs have been made while members are supported to undertake Crest Awards at Bronze and Gold levels. The club leader has been able to establish good contacts with businesses in the region. British Gypsom, UK Atomic Energy Authority and United Utilities have all contributed to the club either through financial support for competition awards, provision of SEAs or accommodating visits.

Impact on pupils

A high proportion of pupils go on to study science post 16, although there is no formal evidence to indicate that this is a direct result of establishing the enrichment and enhancement programme. An increased interest from pupils in engineering has been observed by club staff. While no formal evaluation of the impact upon members has taken place, club staff are encouraged by the level of enthusiasm demonstrated by members during club activity. The club leader hopes to learn from a wider evaluation being conducted by the Regional Development Agency that will include club activity.

Pupils are responding well to ASSEC activity and spoke freely about that interest in science and being a member of the club. Members suggested that they appreciate the clubs aim of attempting to move away from a perceived 'geeky' image but registered strong doubt as to whether this will actually be achieved. However, all members agreed that they are realistic about the stereotypical image attached to STEM and do not suffer any inadvertent effects.

Members demonstrated a limited understanding of career choice within science and engineering and stated that they are not yet considering career options. However, they did explain that science and engineering based occupations are realistic options for them to consider.

Impact beyond the club sessions

The funded ‘club’ activities form part of a broader range of enhancement and enrichment opportunities provided by the school. There is some evidence of teachers using ASSEC ideas in their normal teaching through the embedding of an astronomy-based activity within the curriculum. The club has contributed to the profile of the school through local business links and local press coverage of events.

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