



**Science, Technology, Engineering and
Mathematics (STEM):
Baseline Research in Test bed Schools (Yr 1)**

Summary Report

January 2010

CONTENTS

- 1 INTRODUCTION 3
 - 1.1 Project Background..... 3
- 2 METHODOLOGY 3
 - 2.1 Questionnaire Design and Piloting 3
 - 2.2 Fieldwork 4
 - 2.2.1 *Student Survey*..... 4
 - 2.2.2 *Teacher Survey*..... 4
 - 2.2.3 *Parent and Carer Survey*..... 4
 - 2.3 Research Analysis and Outputs..... 5
- 3 MAIN FINDINGS 6
 - 3.1 Student Survey 6
 - 3.2 Parent and Carer Survey 9
 - 3.3 Teacher Survey..... 11
- 4 REFERENCES 13

1 INTRODUCTION

This reports provides a summary of findings from the Science, Technology, Engineering and Mathematics (STEM) Baseline Survey Research Programme, part of the 'Improving STEM Careers Awareness in Schools and Colleges' project which is being delivered by the Centre for Science Education at Sheffield Hallam University and VT on behalf of the Department for Children, Schools and Families (DCSF).

1.1 Project Background

The Improving STEM Careers Awareness project encompasses various strands of activity focussed around six 'test bed' schools, including the development of resources and of programmes of professional development, specifically: the development of a STEM curriculum-related careers resource; CPD for teachers and trainee teachers; IAG professionals' support resources; an economic well-being resource; work placements, mentors and role model resources.

The primary purpose of the research dimension of the project is to measure the potential impact of the activity and resources mentioned above. Baseline surveys conducted over three years in the six test bed schools will provide ongoing evidence about shifts and changes that are occurring in schools as the project progresses and provide the project team with ongoing feedback to link into the resources and activity that is under development. The six test bed schools are:

- CTC Kingshurst Academy
- Thomas Deacon Academy
- Collingwood College
- Comberton Village College
- Pleckgate High School Mathematics and Computing College
- Ecclesfield School

The research focuses on three key groups – young people in Yr 9, Yr 10 and Yr 11; parents and carers of these young people; STEM teachers and careers-practitioners offering information, advice and guidance in the schools. This report summarises the findings of the 2008/09 baseline surveys.

2 METHODOLOGY

The following section summarises the methodological approach.

2.1 Questionnaire Design and Piloting

Three questionnaires were designed, one for each respondent group. The questionnaires were self-completion in design. The surveys were piloted in one of the test bed schools (CTC Kingshurst Academy) in November 2008 prior to being rolled out to the other test bed schools. Teachers, students and parents were provided with feedback forms to evaluate the pilot surveys. This information resulted in some minor changes and improvements being made to the questionnaires prior to the main fieldwork stage.

2.2 Fieldwork

The three surveys (student, parent and carer, and teacher) were undertaken in five of the six test bed schools in total.

The questionnaires were distributed to a primary contact in each school. This contact took responsibility (with guidance from the researchers) for co-ordinating the dissemination of questionnaires to target groups and (for student and teacher surveys) returning completed forms to the research team.

2.2.1 Student Survey

The school co-ordinator was instructed to arrange for all students in Year 9, Year 10 and Year 11 to complete the survey, either in tutor groups or other appropriate sessions (e.g. PSHE) ensuring that there were no duplicate completions.

Students completed the questionnaires individually, and returned their completed questionnaire to the teacher, sealed in an envelope to ensure confidentiality.

In total 3279 student questionnaires were returned. The response rate across the whole sample was 71%.

2.2.2 Teacher Survey

Only teachers of STEM subjects and careers teachers/PAs were included in the sample.

A paper self-completion questionnaire was given to relevant members of staff who were given the option to either return the completed questionnaire to a central co-ordinator (in a sealed envelope) or return the questionnaire directly to the researchers via Freepost.

In total 98 teachers/careers professionals participated across five schools.

2.2.3 Parent and Carer Survey

Respondents to the parent and carer survey were parents/carers of Year 9, Year 10 and Year 11 students in the specified schools. VT research distributed ready 'stuffed' questionnaire packs directly to schools for onward postage to parents and carers. The questionnaire packs included: a questionnaire; a letter explaining the purpose of the survey and completion instructions, and; a Freepost envelope for return postage.

Schools distributed the packs to parents/carers, who were given a two week period to return their completed forms.

In total 880 parent and carer questionnaires were returned. The response rate for the whole sample was 19%.

2.3 Research Analysis and Outputs

All data were entered into SPSS and the data underwent a series of integrity checks prior to analysis.

Four research reports have been produced:

- Student survey report
- Parent and carer survey report
- Teacher survey report
- Summary report

3 MAIN FINDINGS

The following sub-sections summarise the findings from the three research surveys.

3.1 Student Survey

3279 students participated in the survey. The distribution of responses across schools is: Thomas Deacon Academy 28%; Pleckgate School 19%; CTC Kingshurst Academy 18%; Collingwood College 18%, and; Comberton Village College 17%.

36% of respondents are in Year 9, 37% in Year 10 and 28% in Year 11. Just over half (53%) of respondents are male and 47% female. As might be expected, there is variation in the proportions of different ethnic groups across the sample of schools, reflecting the ethnic diversity of the areas in which schools are located.

Personal Skills and Capabilities

In terms of personal skills and capabilities, students rate themselves most highly on teamwork, social intelligence and creativity. Students rate themselves lowest at critical thinking and for positive self-image. Females rate themselves lower for positive self-image than males.

Enjoyment of Subjects

Students most enjoy PE; Art; English; and Science subjects at school. Enjoyment of STEM and STEM-related subjects varies, with ICT being enjoyed by 32% of students; Maths by 26% of students; and Engineering by only 7% of students.

Subjects enjoyed least by students are: Maths; Religious Studies; Foreign Languages; and English. Again enjoyment of STEM and STEM-related subjects varies, with Science being among the 'least enjoyed' for 31% of students; ICT by 22% of students; and Engineering by 11% of students.

Students' views of subjects vary along traditional gender-specific lines, with significantly more females than males saying they enjoy arts subjects, such as Art, English, Religious Studies and Dance/Drama as well as Food Science and Health and Social Care; while significantly more males than females say they enjoy Engineering, ICT, Maths, Science and PE.

Responses to this baseline survey show that one way to boost participation in STEM subjects is to ensure that female students become more engaged with them, and enjoy them more. Greater enjoyment of STEM subjects is therefore one measure that could be applied to assess progress in encouraging students to continue with these subjects in the test bed schools.

Views on STEM Subjects

When presented with a series of statements about STEM to measure students' views towards the subjects (e.g. 'science will get you a good job'; 'I can get good grades in science'; 'science is interesting' etc) the majority of students display a positive attitude towards Science and Maths subjects. The majority of students also have a positive attitude towards Technology, though slightly less positive than towards Science and maths. There is also a wider gap in perception of the 'suitability of the subject for males and females'. Technology was perceived to be less suitable for girls, with a six percentage point difference between these two figures.

Attitudes towards Engineering are generally less positive than for the other STEM subjects. A larger proportion of students gave a 'don't know' response to all of the statements, compared with other STEM subjects, indicating that awareness around this subject is generally low. There is a strong perception that engineering is more suitable for boys than for girls, with a nineteen percent difference between the 'perceived suitability' figures for each gender.

Beyond this baseline survey, the gap in attitudes between Engineering and the other STEM subjects should be a priority area, and especially the gap in perception related to its suitability for boys and girls.

Progression in STEM

Students' desire to continue or progress in STEM learning is generally promising. Half of the sample wants to continue in science, and for each science subject (Biology; Physics; Chemistry) around a third of students express a desire to continue studying. Nearly half (47%) of students are keen to continue studying Maths, and two in five (39%) Technology; but engineering is less desirable to students (21%).

There are, again, some significant gender differences. Except for Biology, males are more likely than females to want to continue studying STEM subjects – particularly in Engineering where there is a twenty six percentage point difference between males and females.

Interest in further study of STEM decreases between Year 9 and Year 11. This is not entirely surprising since, in Year 11, students will be making choices to study a smaller number of subjects post-16 and some may choose not to continue studying at all. However, previous studies of different age groups have also shown that interest and enjoyment in Science tends to decline with age. There is also significant variation by school in terms of students' desire to continue studying STEM subjects, showing that school practice/school culture may have an impact upon students' desire to continue in STEM. In addition, a relatively large proportion of students say they are 'not sure' whether they want to continue studying STEM subjects (between 18% and 25%). This means that there may be an opportunity in the test bed schools for these undecided pupils to become more engaged with STEM subjects.

Choices and STEM Careers

Nearly half (49%) of respondents agree or strongly agree that STEM careers are highly paid; are enjoyable (48%), have prospects (46%), and require people to be more highly qualified (45%). Over a third of respondents agree or strongly agree that STEM careers are more stable than other (39%) and make a real difference to environmental issues (36%), while 29% see STEM careers as being no better than other careers; not as prestigious as other careers (21%) and 'for boys' (20%). Only 15% of students agree or strongly agree that STEM careers are easy. The large proportion of Don't Knows across all categories (from 49% to 34%) indicates that students may benefit from further information and guidance about STEM careers. There is some variation of student perceptions about STEM careers across the test bed schools.

Role models and the Internet are important sources of support in finding out about STEM careers. 70% of respondents specified the Internet; 61% talking to parents; and 58% talking to a teacher as a means of support.

Overall, between a fifth and over a third of students want to find out more about STEM careers, which affirms the need of students in the schools for more information about this area. Across all STEM subjects, females exhibit less interest in finding out more, with a much larger proportion of females than males (44% compared with 28%) saying they do not want to find out more about any STEM subjects, revealing the challenge required to encourage greater interest in STEM among females. The widest gap (22 percentage points) between males and females for desire to find out about STEM careers is in Engineering.

A majority of students believe that qualifications in Science are useful for careers in Health (63%), Sciences, Maths and Statistics (61%) and Environment, Plants and Animals (54%). Likewise, half or more than half of respondents see Technology or Engineering as useful for careers in Engineering (68%), Technology (63%), Building and Construction (56%) and Computers and IT (50%). A majority of respondents also see Maths as useful for careers in Administration, Business and Office Work (58%), Sciences, Maths and Statistics (58%) and Financial Services (57%).

In job areas that students would prefer to enter, there are statistically significant differences between males and females. Males are significantly more likely to prefer careers in Building and Construction, Computers and IT and Engineering. There is also a larger proportion of males showing an interest in careers in Sciences, Maths and Statistics, though these differences are not statistically significant. Females are statistically more likely than males to prefer career areas such as Design and Technology, Education and Training, and Health.

Work placements or experience related to STEM may also relate to the choice of STEM careers, with those who had done a STEM work placement significantly more likely to specify Engineering and Sciences, Maths and Statistics as a preferred career.

3.2 Parent and Carer Survey

880 parents across five schools responded to the survey. This constitutes a 19% response rate.

Nearly all respondents are parents, as opposed to carers/grandparents etc. Parents/carers have children evenly distributed throughout Year 9, Year 10 and Year 11. Over three-quarters of the responses are from mothers.

Family Background in STEM

Previous research suggests parents/carers' level of education may affect the advice and guidance they give to their children. Those with higher educational qualifications may feel better equipped to give effective educational support.

The majority of parents/carers (around four-fifths) indicate someone in the child's immediate family has a formal qualification in Maths or Science. Far fewer families hold a qualification in Technology and Engineering. Families' Degree Level qualifications, however, are most likely to be in Science and Engineering. Just over one tenth of respondents (11%) state that no one in the child's family has any STEM qualification.

Fathers proportionally hold more qualifications in all STEM subjects at all levels: the difference is particularly striking in Technology and Engineering. Of our test bed schools, families from Comberton generally hold the most STEM qualifications; followed by Collingwood; Thomas Deacon; Pleckgate; and families from CTC Kingshurst hold the least.

Respondents (or someone in the child's immediate family) are most likely to have an engineering-related job/career, despite the proportion of respondents/family members that have a qualification in Engineering being the lowest of any STEM subject. Science and Maths are the areas in which respondents / their families are most likely to have a qualification.

The gender distribution of parents/close family member working in Science and Maths-related jobs/careers is fairly equal. However, there are significantly more fathers in technology and engineering fields than mothers.

Views on STEM Subjects and Progression

Previous research has shown that young people often make choices that concur with their parents' preferences. Parental education and occupation affects the probability of a young person's remaining in post-16 education. Where school offers strong careers guidance and general support, students are less influenced by family (DfES, 2003; 2004; 2006).

Nearly all (95%) of parents/carers in the sample state that they want their children to stay on in learning post-16. Parents/carers are generally positive about STEM subjects offering a route to a good career. Respondents believe that Maths and Science are the most useful of any subjects in leading to a good career: Engineering and Design & Technology are the joint fifth most useful.

Fathers are significantly more likely to think that Engineering will lead to a good career than mothers.

A very small minority (2%) of parents/carers believe that Maths will not be useful to their child in their future career, whilst nearly a third (31%) have that opinion about Engineering. Technology is thought to be more useful to children than any of the individual science disciplines (Biology, Chemistry, and Physics).

A family with no formal qualifications in Science and Technology sees less value in those subjects. The same is true to a lesser extent in Engineering and Maths. Within the three Science subjects there is a gradual decrease in the value parents/carers place on each one as the levels of qualification in the subject decrease.

Almost no (1%) parents/carers would actively discourage their child from pursuing a career in STEM, though quarter feel that they do not have enough knowledge to offer effective guidance. Fathers are considerably more likely to feel confident that they have enough knowledge than mothers.

Results suggest that parents/carers are more confident in discussing progression in different subjects than the subject/course content or related careers. Fathers are more confident in discussing STEM subjects with their child (particularly Technology and Engineering); whilst there are few gender differences in confidence in discussing English and Languages courses.

Generally, the higher the level of the qualification that is held within the family in a particular STEM subject, the greater respondent's confidence in discussing the subject. The greatest difference in parent/carer's confidence is between those with no qualifications within the family and those with a GCSE.

Views on STEM Careers

Parents/carers think that STEM careers are challenging, but enjoyable. Though most feel that higher qualifications are required for STEM careers, the majority also acknowledge that this results in better prospects and the chance to make a real difference to environmental issues. Very few respondents believe that STEM careers are gender-specific.

On average, Pakistani parents/carers think that STEM careers offer better prospects and stability than their White British counterparts. They also see STEM careers as offering better rewards, both in monetary and enjoyment terms. However, though there is some indication that attitudes towards STEM careers differ slightly according to ethnicity (reflecting other research) the sample of participants does not mirror a representative spread of ethnic groups nationally, meaning these data cannot be applied to the general population. Because of the sample of schools, other ethnic groups (e.g. black parents/carers) are under-represented.

Careers Education and Guidance

Parents/carers feel that the three most useful activities to support their child in their pursuit of a STEM career are work experience, STEM-related activity days, and visits to STEM employers.

Less than a fifth of parents/carers say they have seen something in the media or their child's school promoting STEM subjects or careers. Those from Pleckgate are most likely to have seen STEM promotional material, while Kingshurst parents/carers are least likely to have seen anything.

3.3 Teacher Survey

A total of 98 teachers/careers professionals provided responses to this survey. The number of respondents per school varied from 12, at Comberton Village College, to 31, at Collingwood College.

Background of Respondents

Just under half (47%) of respondents teach combined science. Biology and chemistry are taught by around a quarter of respondents (24% and 25% respectively); physics is taught by just over one sixth (17%) of respondents; a quarter (26%) teach technology; one fifth (21%) maths; and one in twenty (5%) teach engineering.

Around three-quarters of respondents teach students in Years 8 to 11, slightly fewer (66%) teach Year 7. One third (34%) teach Post-16 students, which reflects the fact that only three of the participating schools (Collingwood; Thomas Deacon, and; CTC Kingshurst) have a post-16 function.

More than three quarters (78%) of respondents teach their subjects to four year groups or more, demonstrating the sustained involvement/impact teachers are able to have as students move through secondary schooling.

Just under half (46%) of teachers have had STEM-related careers prior to teaching. Therefore, 54% of STEM teachers/careers professionals in our sample have no prior experience of using STEM subjects in other careers. Those who indicated that they had become teachers after a prior STEM career do not always teach the subject directly related to their previous STEM career.

Almost two fifths (38%) of teachers/professionals have been practising for less than 5 years; one fifth (20%) for six to ten years; and just over two fifths (42%) have 11 years or more experience. This means that three in five (62%) respondents could be considered 'more experienced', having six or more years in teaching.

Progression in STEM

Teachers/professionals were asked to identify (from a list of characteristics) the kinds of students that they consider will do well in STEM. The results reveal perceptions that students who do well in STEM subjects are 'focused' and 'hard workers' whilst students who tend not to progress to further STEM learning or careers may have more personal, behavioural or learning difficulties like a 'lack of support from parents'.

Teachers provided estimates for the approximate proportion (percentage) of a typical Year 11 group that go on to do post-GCSE learning in each of the STEM subjects. Teachers generally say that a higher proportion of learners will progress in science and mathematics than in technology and engineering. There are also significant differences between perceived (median) percentages of males and females expected to progress, in all STEM subjects except science (teachers estimate two fifths of both males and females (20% and 18% respectively) will continue with the subject).

STEM Activity Beyond the Classroom

Just over one tenth (11%) of respondents are actively involved in placing students in work experience/placements/tasters. This relatively small proportion of teachers/professionals could be influenced by the school's systems and processes. However, it would be worthwhile exploring the extent to which teachers/professionals

in these roles feel that they could positively influence/contribute to the successful and relevant organisation of placement of students who have a keen interest in STEM careers/subjects.

Just under half (49%) of teachers say their students have been involved in STEM careers exploration beyond the classroom. The activity teachers/professionals most frequently mentioned was work experience. Problem solving days and taster sessions are the next most frequently cited activities for students, closely followed by FE/HE open days and employer visits.

One third (31%) of respondents say that they have used STEM careers-focused information, resources or publications with their students within the last year. Most frequently used were posters, the Careers Advice website and Connexions information and PAs. Most say they use the resources in class group or small group settings and via information displays.

Barriers to Participation in STEM

Teachers/professionals see the perception that STEM subjects are male-dominated as a barrier to participation in each of the subjects. This barrier was most frequently cited in relation to engineering and science; more than half of all respondents feel that the barrier exists in each of these subjects. Fewer teachers/professionals express concern that it affects participation in technology and maths (42% and 30% of respondents respectively say that it is a barrier to continuation with each of these subjects).

Teachers/professionals say that the limited exposure students get in school to the range of jobs and careers related to STEM subjects, and their subsequently poor understanding of the range of careers available are also barriers to participation in these subjects.

4 REFERENCES

DfES (2006a) *How Do Young People Make Choices at 14 and 16?*

DfES (2004) *The influence of the School in the Decision to Participate in Learning Post-16*

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