THE STEM DIRECTORIES

PHASE 3 GAP ANALYSIS

FINAL RESEARCH REPORT

This report provides further detail on the methods and research results for the STEM Directories Phase 3 Gap Analysis. It accompanies two other documents: a Summary Report and separate Appendices containing examples of the research tools (coding framework, questionnaire and interview schedule) used.

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THE STEM DIRECTORIES

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1. INTRODUCTION

Three printed STEM Directories were published for the first time in September 2008, outlining the diverse initiatives offered to learning providers in science, mathematics and engineering across the UK. In order to inform the further development of the Directories, a preliminary gap analysis (Phase 1) occurred in March 2009. This initial analysis reviewed various aspects of the STEM Directories content, including subject areas, target age group, activity category, geographical distribution of schemes and type of provider organisation

The resulting report from the preliminary phase of the research was distributed to the Strategic Management Group in May 2009 and succeeded in prompting much discussion and debate. It was agreed that further analysis was worthwhile in order to provide a more in-depth view, especially with regards to gaps in existing provision, and including how teachers perceive those gaps. This document outlines the preliminary results of this work (Phase 3), which sought to map across the schemes and activities provided within the existing STEM Directories, resulting in the identification of key recommendations for consideration by the subject lead organisations and members of the Strategic Management Group (SMG). Note that an updated analysis of the online STEM Directories content, as well as an investigation of teacher, provider and broker feedback to the Directories (Phase 2 of this work) was delivered via an MSc dissertation at UWE, Bristol in November 2009.

Phase 3 of the research:

- Concentrated on identifying key gaps in provision across topic areas and curricula (i.e. more focused than simply which STEM subject is involved as occurred in the prior analysis)
- Be relevant to teachers' requirements
- Involved teachers' perspectives on the identified gaps/overlaps in provision

Note that this work does NOT comment on the quality or otherwise of the schemes involved; it merely maps the existence of provision to the identified topic areas.

2. PURPOSE

The work at Phase 3 focussed on identifying existing gaps and overlaps in provision of national enhancement & enrichment (E&E) activities across KS3 and KS4 STEM subjects.

2.1. OBJECTIVES

The objectives of Phase 3 are:

- To develop a topic categorisation system and associated coding framework
- Pilot the framework against a sample of 21 STEM Directory entries
- Assess all relevant STEM Directory entries using the coding framework by reviewing each provider's website
- Use a questionnaire to assess teachers' perceptions of existing enhancement and enrichment activities and the STEM Directories
- Interview 5-10 teachers to gain deeper insight into the findings from the questionnaire data

3. METHODS

3.1. CODING FRAMEWORK AND TOPIC CATEGORIES

[Delivered December 2009]

The coding framework, incorporating topic categorisations, was informed by information gathered on the various curricula, in addition to analysis of a pilot sample of activities. Comparisons were also made to similar directories such as the British Colombia Science Outreach Directory, Education and Public Outreach Partnership Directory (EPOP) (Space Science Institute), the Learning Grid and Science Live. The coding framework was designed to be iterative, thus allowing for additional topic areas to be identified within the duration of coding. Members of the STEM Enhancement & Enrichment Strategic Management Group (SMG) were provided with an opportunity to comment on the coding framework prior to piloting and the analysis of the full sample. The research team also liaised with other existing initiatives in this area (e.g. the STEM Resource Centre who are developing a meta-data cataloguing system for their e-library) to ensure consistency.

The categorisation was sent to the SMG for comment in December 2009 to discuss the identified topic categories. Feedback from the SMG was incorporated into a second version of the topic categorisation.

3.2. PILOT MAPPING EXERCISE

[Delivered 2010]

The coding framework was then applied to a pilot sample of 21 entries to the STEM Directories at KS3 (see Appendices for more detail). The sample was chosen by searching for all activities for KS3 and working through the first 21 relevant entries. The information analysed was taken from both the relevant entry within the online version of the STEM Directories and analysis of the providers' own website.

This stage was important in defining the inclusive and exclusive criteria for mapping. Of the 21 activities reviewed, six were rejected for the reasons now defined as the exclusive criteria below, resulting in 15 being analysed for the pilot.

Inclusive Criteria

- Activities were clearly for KS3 and/or KS4 STEM subjects
- English and / or Welsh national coverage (due to being funded by DCSF)

- Information on the website was sufficient to assess the curriculum content (for example descriptive text or specific curriculum links)

Note that in line with the DCSF funding remit and also in order to achieve a realistic sample size for data analysis within the time and resource available, other key stages, national curricula and/or data gathering options were not considered appropriate for inclusion. It is also worth acknowledging that the information provided here reflects only the website descriptions of providers' activities – further investigation e.g. through attending events or interviewing the providers may have clarified their offerings however was beyond the scope of this work.

Exclusive Criteria

- Activities were designed for KS1, 2 or 5 with either no mention of KS3 and/or KS4, or stated the activity could be used for KS3 and / or KS4 but with no indication of how the activity would be revised to meet the needs of KS3 and / or KS4 students
- Non-national coverage
- Scottish only coverage
- Information on the website was insufficient to assess the curriculum content
- The website was not available
- The website required a fee-paying registration to view the content
- The activity had not been submitted to, or accepted for inclusion in, the STEM Directories at the time of the mapping exercise

Coding was performed by more than one researcher and the analytical programme SPSS was used to record and analyse data. The pilot exercise highlighted a number of useful issues with regard to the wider mapping exercise, though only a small number of changes were required to the coding framework itself:

- In a high number of cases the self-assessed topic information included in the Directories differed greatly to what was included on the providers' own website. This normally took the form of the Directories entry stating the activity covered several Topic Areas, but according to the providers' own website information the activity was found to cover limited Topic Areas and Curriculum Content. This confirmed that the mapping should use the activity websites directly to code for Topic Area and Curriculum Content, rather than the entries supplied by providers upon registration to the Directories.

- Many providers had stated that their activities were targeted at specific student groups in the Directory entry (e.g. gifted and talented or special needs), but upon examination of the website it was not clear how this was

Methods

the case. Unless activities were directly mentioned as meeting the needs of the specific target group, activities were therefore coded as being for 'All students'.

- All but one of the activities examined in the pilot made no distinction between Key Stages 3 and 4.

- A number of the providers indicated within the STEM Directories registration process that the evaluation of their activities is publicly available. It was rare to find the evaluation report on the provider's website, however this is likely to be due to the evaluation report being in the public domain, but published elsewhere. As we do not have the resources to seek each evaluation report more widely we highlight this point for information and have coded this data on the basis of the scheme's entry specifications in the STEM Directories.

- The decision was taken to migrate the data from SPSS to Excel following the pilot. While this reduces the ability to produce comparative data this was necessary to speed up data collection. The full set of Excel data is also available for direct review.

3.3.   FULL MAPPING EXERCISE

An Excel spreadsheet of the online STEM Directory entries was downloaded at the end of March 2010, corresponding to schemes which had been submitted by providers and accepted for publication in Autumn 2009. An initial sample of 123 entries matched the criteria of being for KS3 and / or KS4 and having national reach. Each of these entries was then assessed in detail using the above Inclusive and Exclusive criteria resulting in 63 entries which could be mapped using the framework[1]. Since many providers offered multiple activities this sample of 63 provider entries corresponds to a total of 203 actual activities offered, according to the data available on providers' websites.

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[1] It is worth noting that the decision to reject specific schemes from the data analysis was not taken lightly. All 123 schemes were thoroughly considered, however in the cases where, despite significant investigation, it was still not possible to compile the necessary data, those schemes were thereby deemed not able to be included. This high proportion of rejections due to lack of information (approximately 30%) is disappointing considering that it is arguably a reflection of how easily teachers would be able to identify the appropriate curriculum links etc. themselves. Note also that multiple schemes offered by one provider were combined into single entries since that was how they tended to be approached on the providers' own websites. The reason for rejection is provided with each excluded entry within the separate Excel data sheet.

Data Sources

As in the pilot exercise the web content of each activity was reviewed for *type of provider*, *type of activity*, *curriculum* and *topic content* and for evidence of *specific audiences* being targeted. On the grounds of efficiency, information on *preparation time*, *cost* and *evaluation* were taken from the information supplied by the providers at the time of their registration to the STEM Directories. It is worth noting that this later data was provided by the activity providers themselves so the research team cannot comment on the reliability of the data. To distinguish between these data sets they have been shaded in different colours in the Excel document accompanying this report.

Coding was performed by more than one researcher and Excel was used to record and analyse data in the final mapping exercise.

Curriculum Links

With regards to assessing curriculum links, the activity was initially assessed to see which subject area it had stated it was addressing (Science, Mathematics, Design and Technology) and which Key Stage.

A small number of activities were also flexible in their content, for example the CREST Awards. These were coded as 'Not relevant' across the curriculum links as they could have been tailored to any, or none, of the curriculum depending on the teachers' and/or students' use of the resource.

Capacity

At a later stage in the mapping process, the SMG requested information on the capacity, or reach, of the activities. By this point most of the activities had been reviewed and there was insufficient time to return to each activity and individually assess capacity. In addition, very few of the providers supplied this sort of information within their websites. Within the current STEM Directories registration process there is no request for information regarding providers' maximum capacity, i.e. how many schools / pupils they *can* reach. However since the development of the online version, providers have been asked:

> To qualify for entry to the directories please confirm that you record the number of schools and teachers involved in your scheme and/or the number of students over a 12 month period? *
> - Yes – if so please provide latest up-to-date figures

A review has been performed of the providers' responses to this question in order to provide a broad-brush indicator of existing reach. This information is supplied in Table 4.

As indicated above, the monitoring question is stated in terms of an open-form response. This method was used in acknowledgement that providers currently capture their data in many different ways, often limited by the type of scheme that they are running – some data in whatever format was considered better than nothing. Unfortunately this does however mean that comparing like for like within this data set is not straightforward.

3.4. TEACHER CONSULTATION - QUESTIONNAIRE

The aims of the teacher consultation were to:

1. Identify gaps in provision of Engagement and Enrichment (E&E) activities according to teachers
2. Identify what techniques or brokers teachers use to identify and recruit E&E providers and activities

The questionnaire was developed with a focus on key areas. Firstly it asked teachers a series of questions about their own professional background, including the subject areas they taught and how long they had been teaching. Next a section asked about their general use of E&E, how frequently they used E&E activities, why and what incentives or deterrents they had experienced. Thirdly teachers were asked about their perceptions of provision in their subject areas, both in terms of availability and quality of activities. Finally teachers were asked about their views on and use of the STEM Directories and invited to participate in an interview. See Appendix B for details of the questionnaire.

The questionnaire was circulated to the SMG for comment and then distributed to appropriate teachers and networks. This was achieved by using existing contacts with Local Authority STEM education advisors from SW, SE and northern England; a link from the front page of the Teachers' section of the STEM Directories website[2]; colleagues and contacts of the SMG; and posting in relevant TES online fora[3].

The questionnaire was initially distributed using Survey Monkey following the Easter break in April 2010. However, due to some travel disruption over this period which we anticipated may have delayed and disrupted its completion we carried out a second distribution in May 2010. The questionnaire closed in June 2010 with 60

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[2] http://www.stemdirectories.org.uk/teachers_&_lecturers.cfm
[3] http://www.tes.co.uk/community.aspx (Science, Mathematics and Design and Technology fora)

respondents completing the questionnaire. This was a smaller number than originally intended however due to the limited duration of the project a further distribution was not possible. Overall the questionnaire worked effectively and indicated future possibilities to embed it more regularly within the STEM Directories for continuous teacher feedback at a later date.

Excel was used to analyse the data from the questionnaire respondents.

3.5.   TEACHER CONSULTATION – INTERVIEWS

Following completion of the questionnaire teachers were asked if they were willing to participate in a further semi-structured interview. Eight teachers indicated that they were willing to be interviewed. From these six interviews were scheduled in June/July 2010. The remaining two individuals were sent further reminders but did not respond to the request to schedule an interview.

The interview questions were designed to further explore a number of issues raised by the mapping and questionnaire data. This included questions on the types of E&E activities they used, why they used them and how they located them. A copy of the interview questions can be found in the appendix to this report. Interviews occurred via telephone and lasted for approximately 30 minutes.

The interview data was then fully transcribed and key themes noted by two researchers. One researcher then analysed the interview data in full drawing out the key issues which are presented in the results section.

4. RESULTS

4.1.   MAPPING OF STEM DIRECTORY ENTRIES

Subject Focus

63 providers to the STEM Directory matched the inclusive criteria. Nearly half (n=25) of these initiatives were providing support for Science only. Maths and Engineering and Technology had 10 and two providers respectively that supported these single subjects. The remaining providers offered support for combinations of subjects, or all STEM subjects (see Figure 1). Activities counted as being in the 'All' category included those providers who made explicit links to all subject areas (for example BP Educational Service), and those which could be adapted for any subject area (for example CREST Awards).
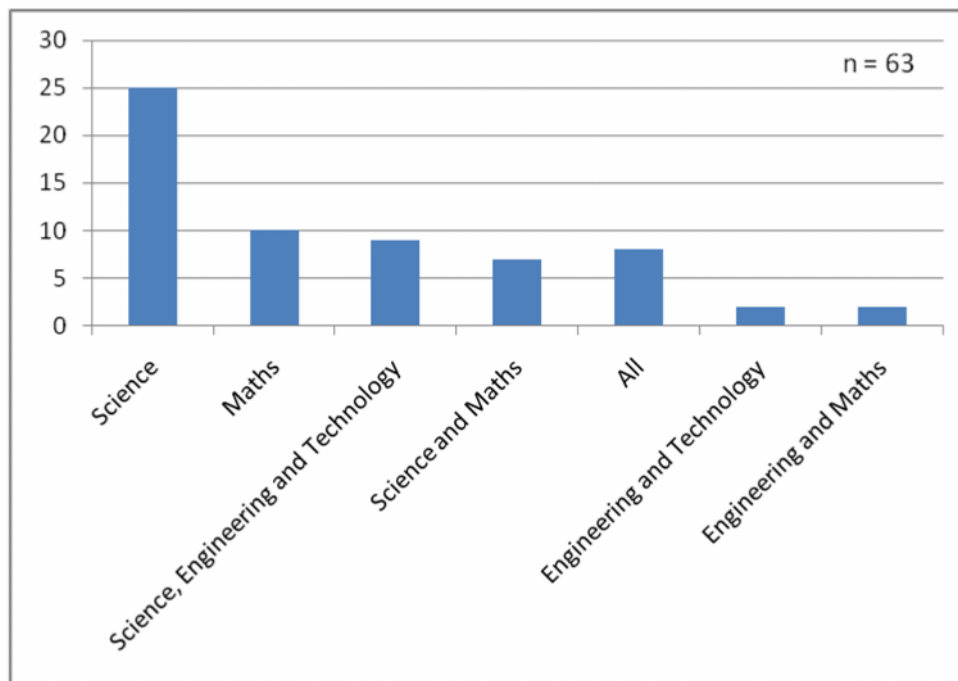
FIGURE 1 NUMBER OF ENRICHMENT AND ENHANCEMENT PROVIDERS FOR SEPARATE AND COMBINED STEM SUBJECTS

Curriculum Links

Table 1 provides a breakdown of the STEM subjects according to whether they applied to Key Stage 3 or Key Stage 4. Looking at E&E support for the three curriculum areas (Science, Mathematics and Design and Technology) the sciences have the greatest level of provision, with 43 providers at both KS3 and KS4. There is little difference between the Key Stages as few providers made any specific distinction between KS3 and KS4.

| Key Stage 3 Subject	Number of providers	Key Stage 4 Subject	Number of providers
Science	43	Science	43
Mathematics	23	Mathematics	22
Design and Technology	17	Design and Technology	16

TABLE 1 THE NUMBERS OF PROVIDERS FOR KEY STAGES 3 AND 4 FOR SCIENCE, MATHEMATICS AND DESIGN AND TECHNOLOGY. SOME ACTIVITIES CATER FOR MORE THAN ONE SUBJECT.

Of the 43 providers that targeted Science at KS3 a high number could make links to specific areas of the current curriculum, including 'Practical and Enquiry Skills' (n=27), 'Applications and Implications of Science' (n=27) and 'Scientific Thinking' (n=26). However, 'Chemical and Material Behaviour' (n=13) and 'Communication' (n=13) were far less apparent, with 'Organisms, Behaviour and Health' (n=12) being covered by the least number of providers. These are illustrated in Figure 2. It is also worth noting that even across this fairly limited sample size all of the curricula areas were covered by at least 12 existing providers.
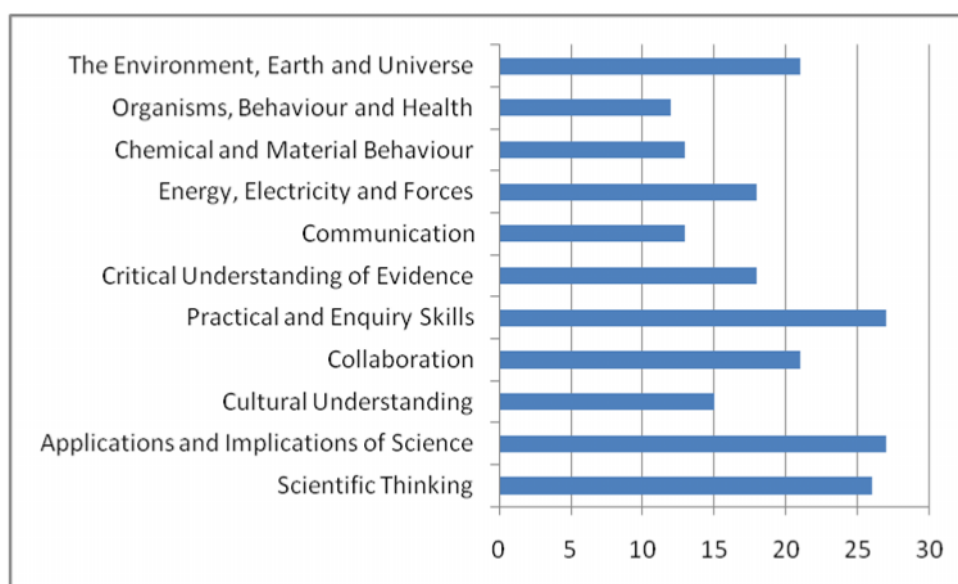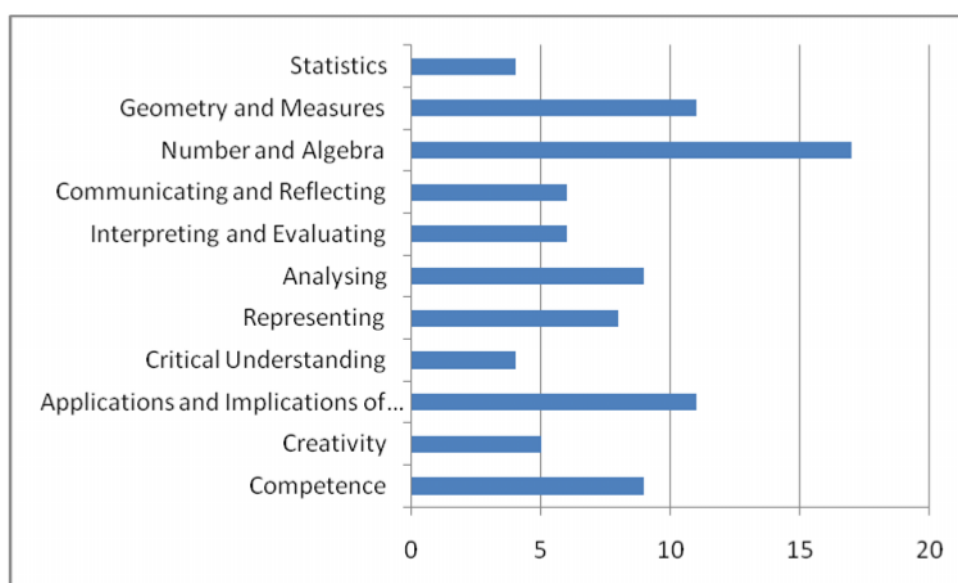

FIGURE 2 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS3 SCIENCE

Results

The 43 Science providers at KS4 showed a similar pattern (see Figure 3), whereby 'Applications and Implications of Science' (n=26) and 'Practical and Enquiry Skills' (n=25) were popular. In this context 'Energy, Electricity and Radiations' (n=11) was less prominent although in comparison with KS3 there was an increase in 'Communication Skills' (n=18) covered within activities.
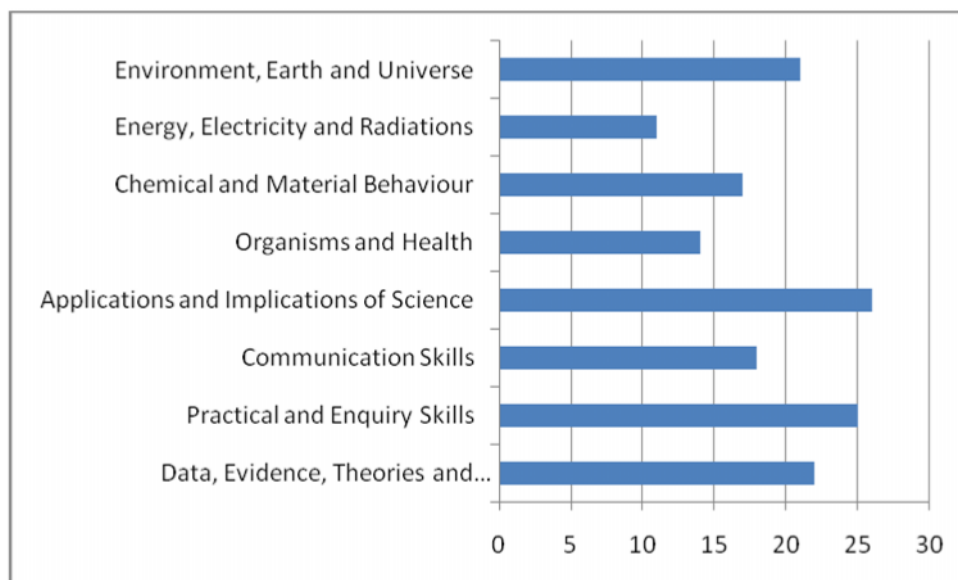
FIGURE 3 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS4 SCIENCE

In terms of Mathematics 23 providers came under this area at KS3 (see Figure 4). The most popular curriculum links for activities here included 'Number and Algebra' (n=17), 'Applicants and Implications of Mathematics' (n=11) and 'Geometry and Measures' (n=11). 'Statistics' and 'Critical Understanding' are the least popular areas covered (n=4 for each).

FIGURE 4 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS3 MATHEMATICS

Results

At KS4 'Number and Algebra' (n=14) remains the most common and 'Statistics' (n=3) the least popular categories however 'Competence (n=14) and 'Analysing' (n=11) have both increased in popularity compared to KS3 (see Figure 5).
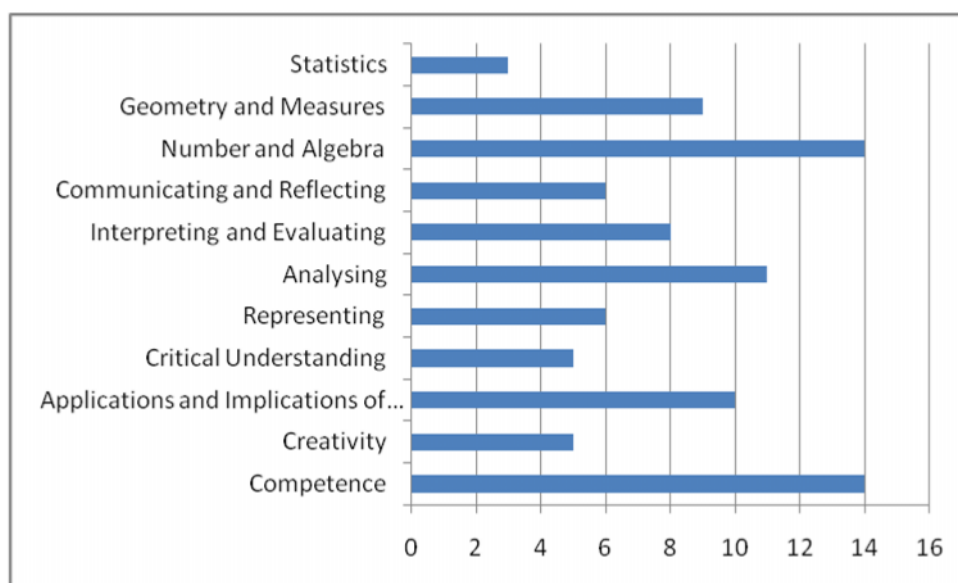
FIGURE 5 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS4 MATHEMATICS

Compared to Science and Mathematics there were a smaller number of providers linking to the Design and Technology Curriculum. 'Creativity' (n=10) and 'Solve Technical Problems' (n=10) were most apparent however no specific links were made to 'Textiles' or 'Food' (see Figure 6).
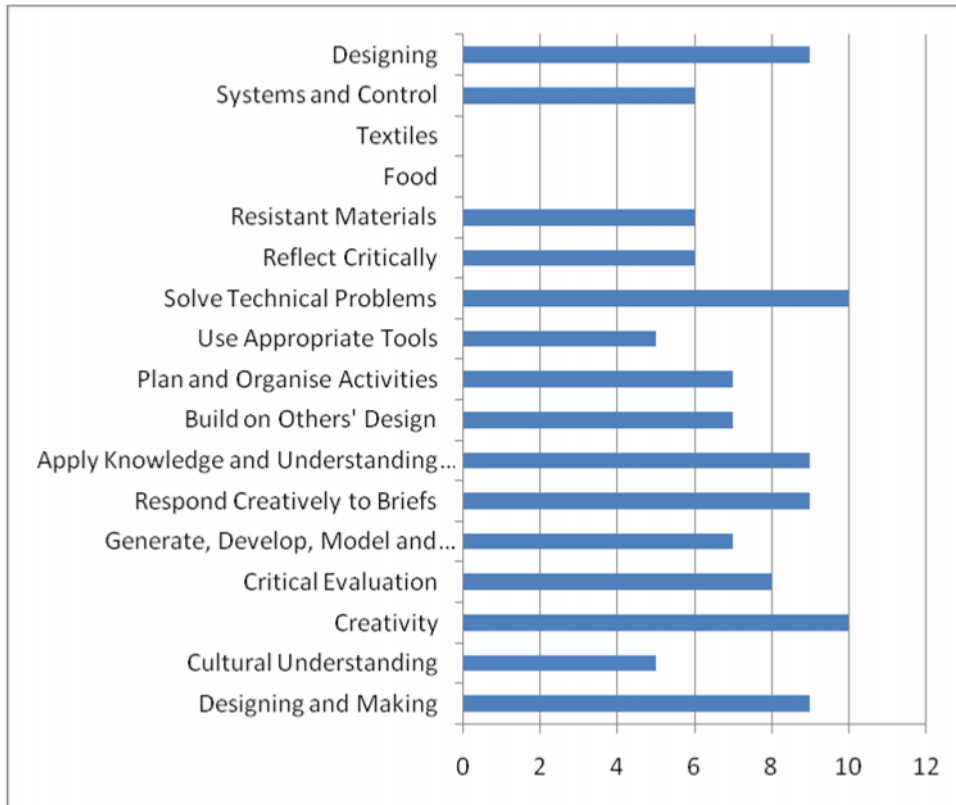
FIGURE 6 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS3 DESIGN AND TECHNOLOGY

At KS4 'Creative Product Brief' (n=11) and 'Make Decisions, Consider Sustainability and Develop Skills' (n=11) were most frequently noted (see Figure 7).
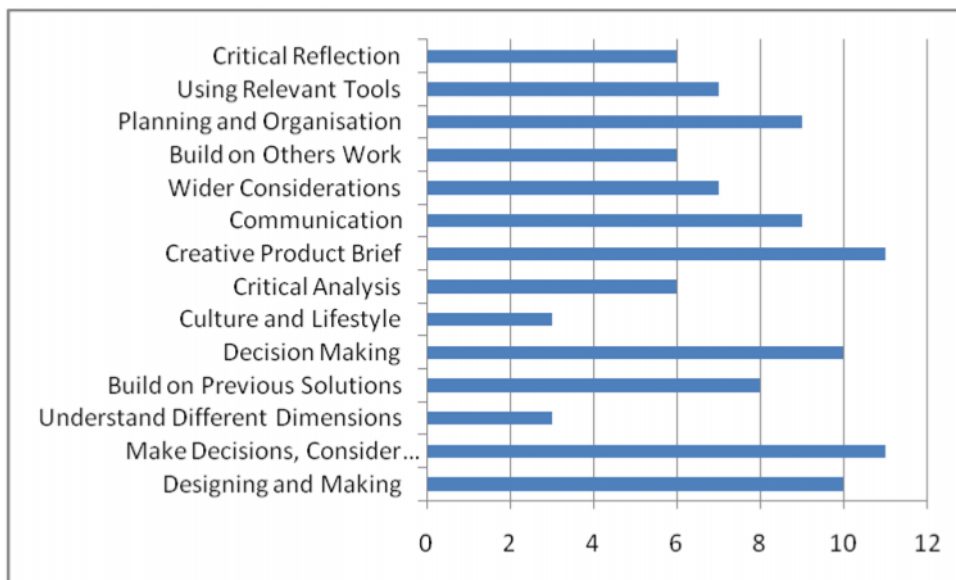
FIGURE 7 CURRICULUM RELEVANCE OF E&E ACTIVITIES FOR KS4 DESIGN AND TECHNOLOGY

Topic Areas

Activities offered by the providers were also coded for the topic areas they encompassed as broken down in Table 2.

Topic	Number of Engagement and Enrichment activities
Mathematics	23
Engineering: Electrical and Mechanical	20
Earth and Planetary Sciences	19
Energy and Transport	17
Physics and Astronomy	16
Design and Technology	14
Engineering: Materials and Bioengineering	14
Chemistry	12
Environmental Sciences	12
Biochemistry	11
Environmental Management	11
Cellular and Molecular Biology	9
Microbiology	8
Computer Science	7
Medicine and Health Sciences	6
Animal Sciences	5
Behavioural and Social Sciences	2
Plant Sciences	1

TABLE 2 TOPIC COVERAGE OF ENRICHMENT AND ENHANCEMENT ACTIVITIES AT KS3&4

'Mathematics' (n=23) was most popular in this regard, though it should be noted that this subject area was not split into as many categories as areas impinging science, design and technology. Following this, 'Engineering: Electrical and Mechanical' (n=20), 'Earth and Planetary Sciences (n=19)' and 'Energy and Transport' (n=17) proved popular. Less prominent were activities offered by providers that

included 'Plant Sciences' (n=1), 'Behavioural and Social Sciences' (n=2) and 'Animal Sciences' (n=5).

Target Student Group

All but three of the providers reviewed did not deliberately target a specific group, despite frequently checking 'Gifted or Talented' or 'Special Educational Needs/Access for All' within their registration information for the STEM Directories. All three who had developed materials for a specialised group rather than a general school audience provided activities for 'Gifted and Talented' students. It was not apparent in our analysis that any providers had material specifically tailored for 'Gender', 'Engaging the Wider Community', or for 'Ethnic Groups' based on their web content. This is in contrast to the information provided in the registration process for the STEM Directories where providers could input their own information. In this later case over two thirds (n=46) stated they targeted at least one specific audience, with many stating they targeted multiple specific groups.

Figure 8 shows that many of the activities analysed were provided by four types of provider: Science Communication Companies (n=16), Industry (n=11), University / Educational Establishment (n=10) or Research Council / Learned Institutions (n=10).
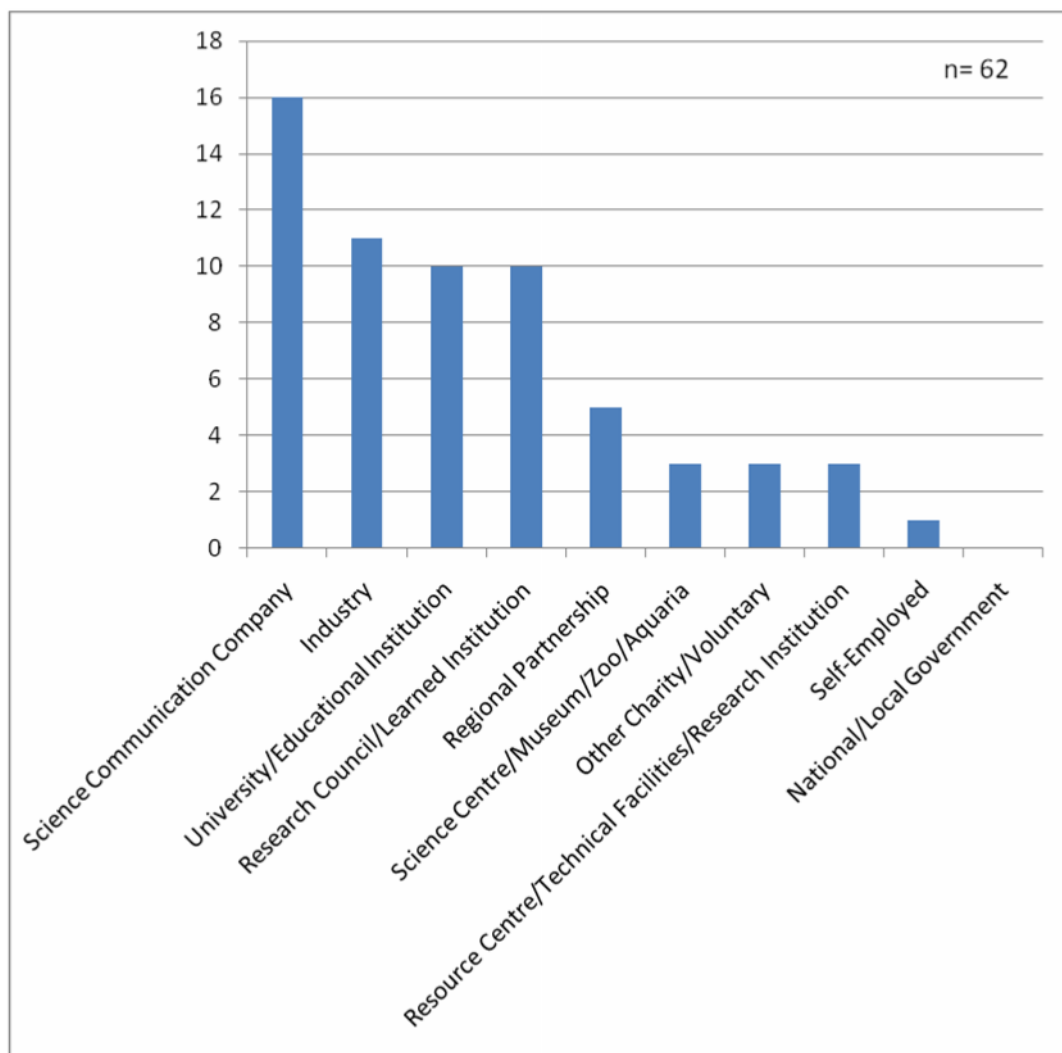
FIGURE 8 TYPE OF ORGANISATION PROVIDING ENRICHMENT & ENHANCEMENT ACTIVITIES

Cost [data supplied by providers directly at time of registration]

Just under half (n=30) of the E&E providers reviewed offered activities that were free to teachers. The other providers used a variety of pricing models which makes it difficult to compare like-with-like. For example some activities, such as Crest awards, charged a cost per head. Others had a registration fee (for example competitions) while activities that involved shows or workshops tended to have a daily rate. Most of the non-free activities charged from £300-£900 (n=16) per activity. The most expensive activity was £2400 for a four-day residential course for 12 students and a teacher.

Results

Frequency of Activity   [data supplied by providers directly at time of registration]

Frequency of activity	Number
One-off event	35
Continuous	20
One-off and two stage events	5
Two stage Event	3

TABLE 3 ENRICHMENT AND ENHANCEMENT ACTIVITIES CATEGORISED ACCORDING TO FREQUENCY OF INTERACTION (N=63)

Just over half (n=35) of the activities reviewed were one-off events as Table 3 illustrates. One-off events (n=35)[4] were largely shows (n=21) and lectures (n=5), or CPD sessions (n=19). Continuous events (n=20) were largely ongoing activities undertaken as part of a national competition or award scheme.

Evaluation   [data supplied by providers directly at time of registration]

In response to the question "do you undertake regular evaluation?" within the STEM Directories registration process, 59 of the 63 providers investigated within this work stated they did, 26 of which were conducted independently. Nearly half (n=28) of the providers indicated they were willing to make their evaluation public.

Types of Activity   [data supplied by providers directly at time of registration]

Although 63 providers were reviewed for this work, this constituted a total of 203 actual activities, since many providers offered more than one type of activity. The types of activities available in this sample were mostly 'In school' (n=71) or for 'Teachers' (n=66). The remaining third was split almost evenly between 'Out of school' (n=32) and 'Student' (n=31) as indicated in Figure 9.[5]

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[4] The total number of one-off events (n=35) is less than the sum of the *types* of one-off events (shows, CPD etc.) since many activities offered multiple types of one-off events.

[5] A number of providers offered activities in a number of categories. As such this data was collected via four separate non-overlapping categories. Further details are presented in the coding framework in Appendix A.

Results
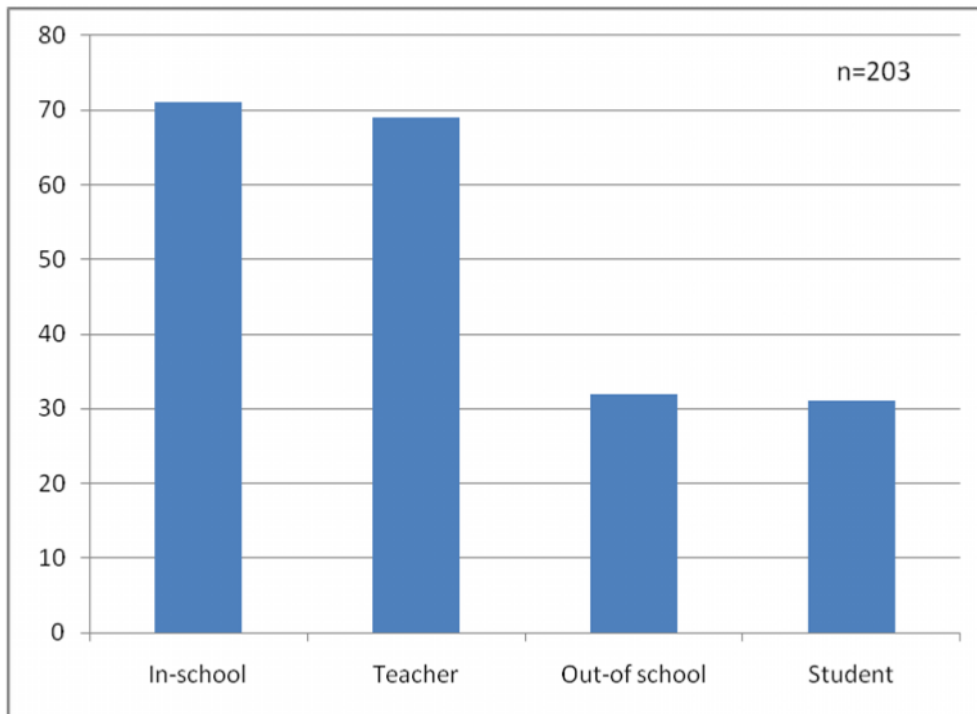
FIGURE 9 TYPE OF ENRICHMENT AND ENHANCEMENT ACTIVITIES

Breaking down the activities further by each type there are a number of trends. In terms of the 71 'In-school' Activities, 'Competitions, Quizzes and Challenges' (n=24) and 'Shows, Interactives and Demos' (n=21) made up the majority of this type of activity. The least well catered for were 'Lectures and Talks' (n=9), 'After School Clubs' (n=9) and 'Debates and Discussions' (n=5). There were only three instances of the 'STEM Ambassadors' being advertised as taking part in an activity as Figure 10 indicates.
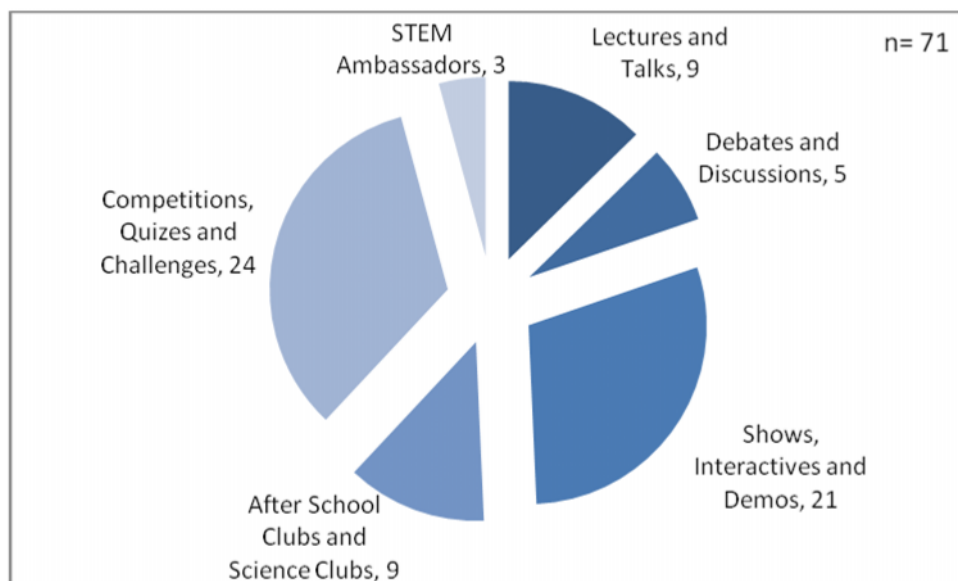
FIGURE 10 NUMBER OF IN-SCHOOL ACTIVITIES AVAILABLE

Results

Figure 11 shows the number of resources available for teachers as part of a wider STEM Directory entry[6]. Most of the activities provided for teachers take the form of materials and resources for delivering lessons in the classroom: 'Teaching Packs, Classroom Resources or Lesson Plans' (n=26) and 'Websites and Downloads' (n=23)[6]. Just under one third (n=19) of the activities reviewed included opportunities for 'CPD or Training'[6], however this differs to the information inputted by the providers which shows 26 instances of CPD being available. There was only one specific mention of resources being provided for 'Interactive Whiteboards'[6].
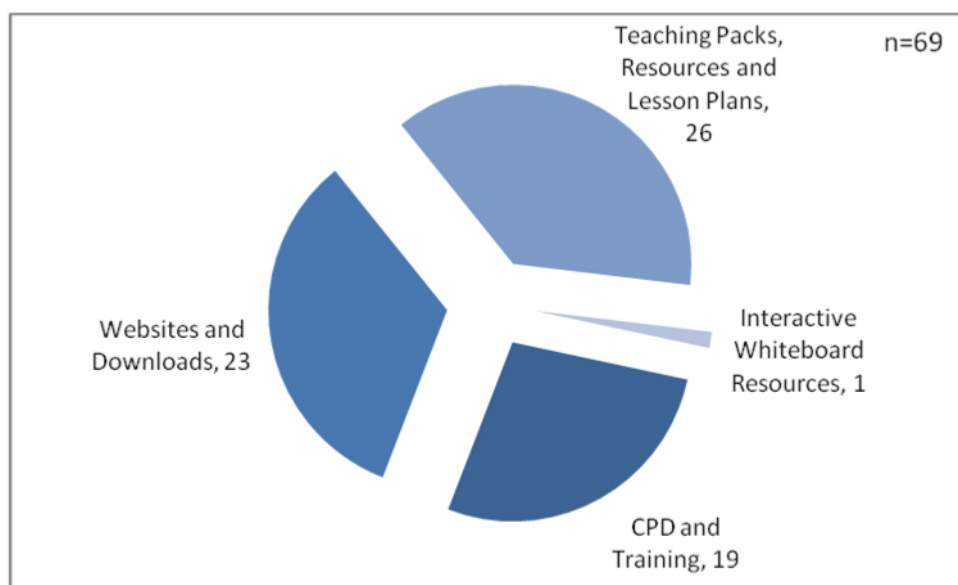
FIGURE 11 NUMBER OF TEACHER RESOURCES AVAILABLE

'Out-of-school' activities were far fewer in number with 32 in total. Of these 'Trips and Visits' (n=16) made up half the 'Out-of-School' Activities, followed by 'Partnerships with Universities and Industry' (n=11) as shown in Figure 12.

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[6] It should be noted that for activities to qualify for entry into the STEM Directories there must be an element of direct interaction between the provider and the school. The STEM Directories do not cater for activities that consist only of resources for teachers or interactive whiteboards, teacher CPD, or are purely web-based. Entries described here therefore combined an interactive element with these other factors described in Figure 11 and Figure 13.
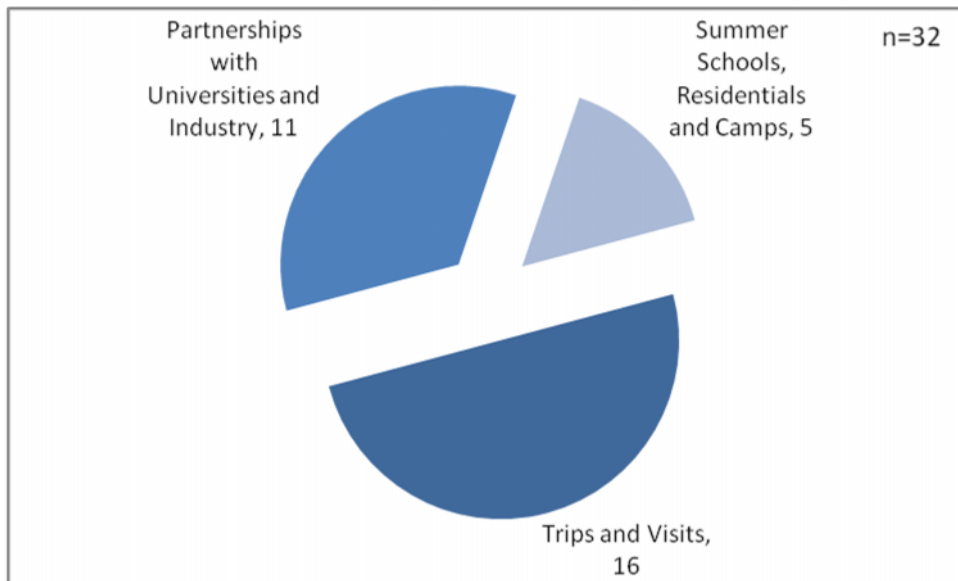
FIGURE 12 NUMBER OF OUT-OF-SCHOOL ACTIVITIES AVAILABLE

There were similar numbers of activities (n=31) developed for school students themselves. The most readily available were 'Websites and Downloads'[6] (n=18) demonstrated in Figure 13, with there being only one example of a 'Work Experience or Placement' opportunity.
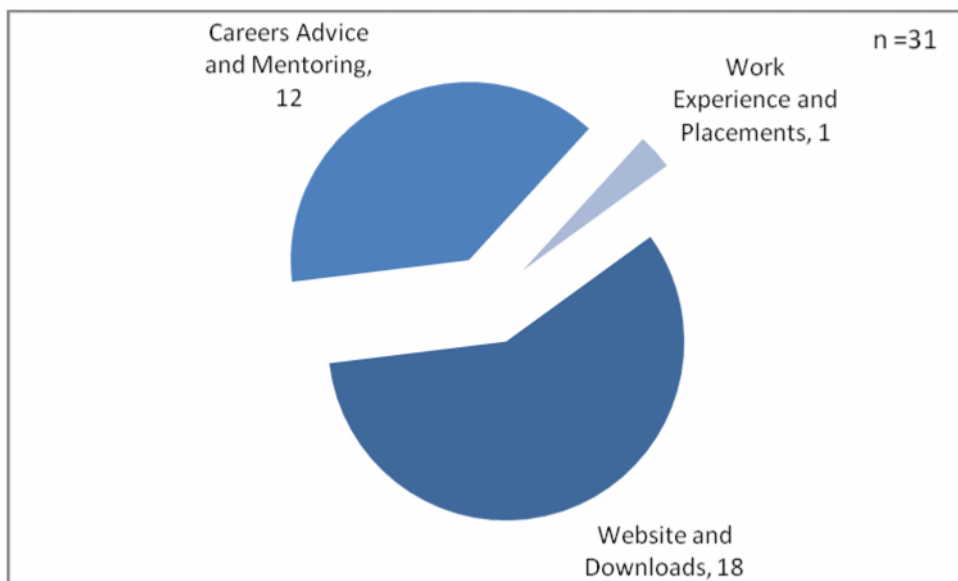
FIGURE 13 NUMBER OF STUDENT RESOURCES AVAILABLE

Results

Reach [data supplied by providers directly at time of registration]

Providers quoted their information in a variety of ways, some on an annual basis, some 'to date', some within specific time frames etc. Where possible the timescales were adjusted to consistent 12-month periods however the totals given should be considered an under-representation.

The data has been coded into a series of categories as indicated below, based on how the providers themselves described their metrics. Note that the categories are orthogonal, i.e. providers each specified only ONE data type indicated below (except in the case of separate numbers for students AND teachers). The self-reported data from six providers is not included in the table below due to lack of clarity.

Of the 63 schemes in the Phase 3 Gap Analysis, the specified reach was:

Type of audience	Number
Students (all ages)	157204
Students (secondary)	77404

Type of audience	Number
Schools (secondary)	7501
Schools (all)	15767

Type of audience	Number
Groups (all)	498

Type of audience	Number
Teachers (secondary)	490
Teachers (all)	14960

Type of audience	Number
Unclassified[7]	10879296

TABLE 4 REACH ACHIEVED BY DIFFERENT AUDIENCE TYPES

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[7] This category is considered to contain unreliable/incomparable data, corresponding mainly to websites who quoted a range of different metrics ('hits', 'unique visitors', 'users', 'page loads' etc.). In addition, some activities delivered outside the formal school environment (e.g. at festival events) provided total audience numbers. Although some schools and/or individual school pupils may be within that count, wider public and even trade representatives were also included so it is not a true indication of reach for educational purposes. For this reason these elements were grouped together into a single 'unclassified' category.

When considering the data in Table 4 it is worth noting the following:

- For the reasons outlined in section 3 regarding the methods involved, **this analysis is purely indicative and should not be taken as a reliable comparison**. The data has been coded into a series of categories as indicated in the tables above, based on how the providers themselves described their metrics.

- Many schemes were offered to multiple age groups but did not distinguish between the different age groups of the pupils involved when reporting their data. If the scheme in question was offered only to a particular key stage then it was allocated accordingly; if it was offered across ages 12 – 19 then the data was allocated to 'secondary pupils'; if the scheme was offered across all age groups with no distinction when reporting numbers then it was allocated to 'pupils (both primary and secondary)'.

- Some providers chose to report in terms of the number of 'groups' their activity was delivered to, i.e. it was possible that multiple groups per school were involved but the breakdown of school (or pupil) numbers was not given. The categories within the 'groups' type were allocated as per the breakdown mentioned above.
- Again, where providers offered their scheme to both primary and secondary schools, the reporting data was often not broken down, therefore a combined total has been indicated in some cases.
- Teachers were often specifically noted as a category by providers, although again not always distinguished in terms of the year group or even primary/secondary school type.
- Three of the 63 schemes provided no data about their monitoring figures. In some cases this was because the schemes were new, however there were some existing schemes who did not complete this section. At least two of these latter schemes indicated that as a result of this question they would now capture this information for future years.

4.2. TEACHER QUESTIONNAIRE

Note: Response numbers to questions varied across the questionnaire. For clarity, any percentages quoted are based on responses to individual questions.

Teacher Background

88% (n=52) of teachers completing the questionnaire taught Key Stage 3 and 93% (n=55) taught Key Stage 4, the majority of teachers were thus teaching both Key Stages. Teachers had a variety of levels of experience with 20% (n=12) teaching for 'under 5 years', 31% (n=18) '6-10 years', 27% (n=16) '11-15 years' and finally 22% (n=13) teachers for 'over 15 years'.
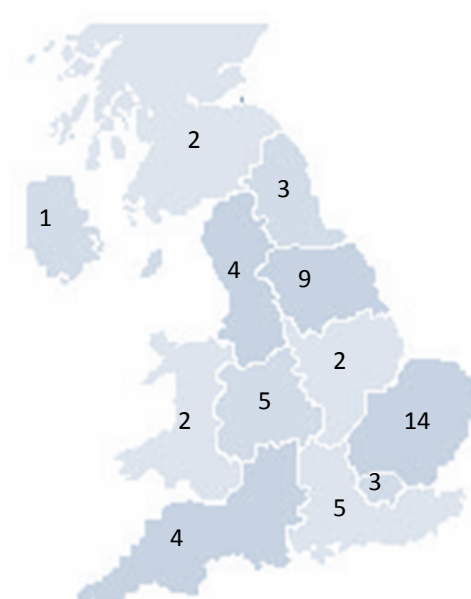
FIGURE 14 TEACHERS' LOCATION

As shown in Figure 14 respondents came from across the UK, with the highest number of responses from teachers in Eastern England (n=14), followed by Yorkshire and Humberside (n=9), West Midlands (n=5) and the South East (n=5).

Teachers were asked to select a maximum of 3 subjects by Key Stage that they taught most regularly. For the purpose of clarity here these responses have been separated by Key Stage but it is important to highlight that respondents could select a maximum of 3 over both Key Stages. Reponses to this question showed that the most popular subject areas for respondents to this survey were science-based. Breaking it down by key stage, at Key Stage 3 there were higher amounts of teachers involved in 'Science' (53%/n=31), 'Physics' (32%/n=19), 'Biology' (22%/n=13) and 'Design and Technology' (22%/n=13) but other areas also featured as indicated in Figure 15.

Results
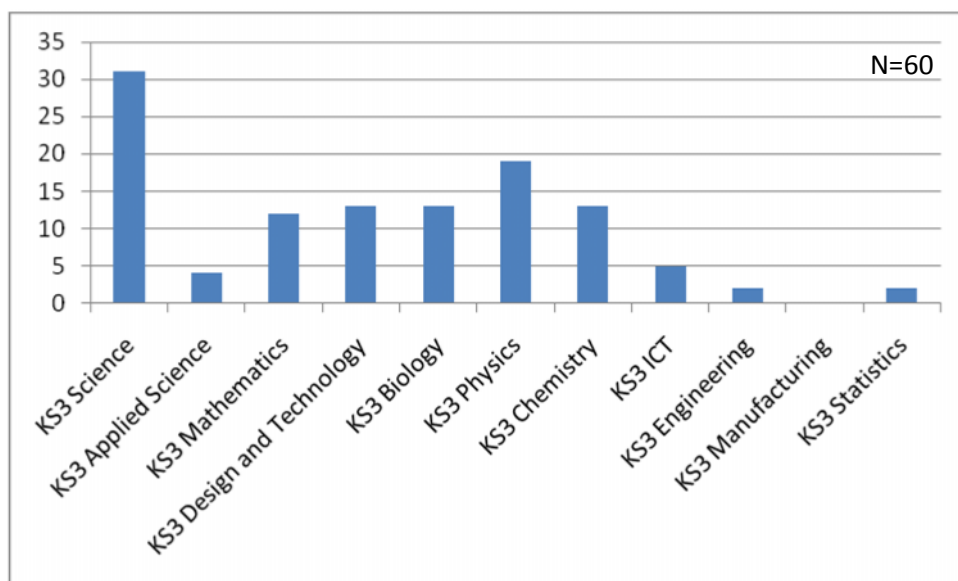
FIGURE 15 TEACHER QUESTIONNAIRE RESPONDENTS CATEGORISED BY KEY STAGE 3 SUBJECT AREA

At Key Stage 4 science areas remained popular and here teachers were most commonly teaching 'Science' (39%/n=23), 'Physics' (34%/n=20), and 'Biology '(25%/n=15) as indicated in Figure 16. The least popular areas for teachers across both Key Stages were Key Stage 3 'Manufacturing' and Key Stage 4 'ICT', which no teachers that responded to the survey taught at that time.

Teachers were also asked which subjects they spent the majority of their time teaching. Here the most popular response was by far 'Key Stage 4 Physics' which 20% (n=12) teachers spent the majority of their time teaching, followed by 'Key Stage 4 Science' (19%/n=11), and 'Key Stage 3 Design and Technology' (12%/n=7). 'Key Stage 4 Mathematics' (10%/n=6), 'Key Stage 4 Design and Technology' (10%/n=6), 'Key Stage 3 Science' (7%/n=4), 'Key Stage 3 Mathematics' (7%/n=4), 'Key Stage 4 Chemistry' (7%/n=4), 'Key Stage 4 Biology' (5%/n=3), 'Key Stage 4 Applied Science' (2%/n=1) and 'Key Stage 4 ICT' (2%/n=1) also received small responses with few teachers saying they spent the majority of their time teaching these subjects. However no teachers within this survey taught for the majority of their time on 'Applied Science', 'Biology', 'Physics', 'Chemistry', 'ICT', 'Engineering', 'Manufacturing' or 'Statistics' at Key Stage 3 or 'Engineering', 'Manufacturing' or 'Statistics' at Key Stage 4.
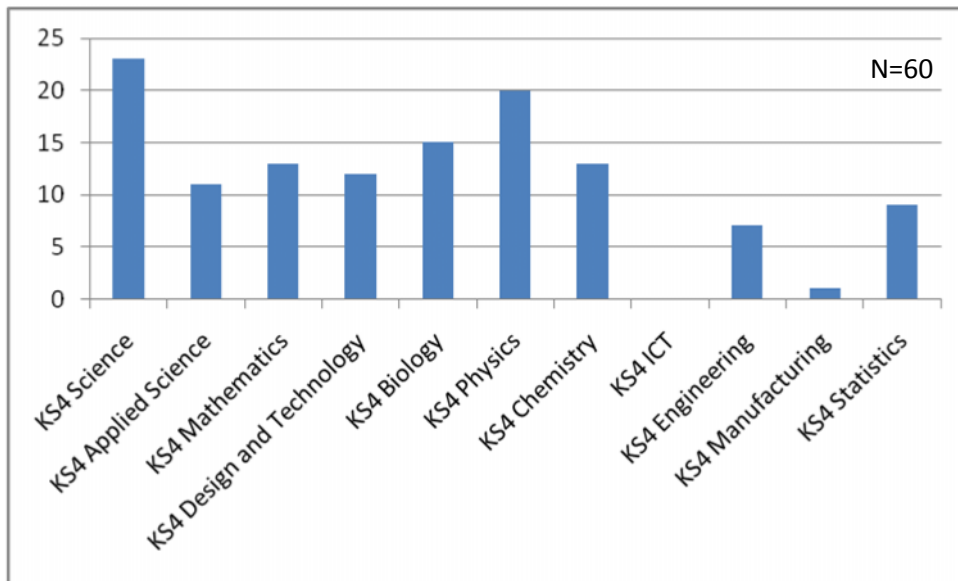
FIGURE 16 TEACHER QUESTIONNAIRE RESPONDENTS CATEGORISED BY KEY STAGE 4 SUBJECT AREA

Use of Enhancement and Enrichment Activities

Teachers responding to the questionnaire most commonly used an E&E activity once a term. 38% (n=16) on average used one 'once a term', closely followed by 'once a year' at 26% (n=11), as indicated in Figure 17. Interestingly 19% (n=8) said that on average they used one 'once a week', suggesting for a small number of teachers these activities play a considerable role in their present teaching. It was notable that 18 respondents (of 60 in total) did not complete this question and related questions despite it being the focus of the questionnaire. The subject distribution of teachers who completed the questionnaire was compared to the distributions shown in Figure 15 and Figure 16, with no noticeable trends observed.
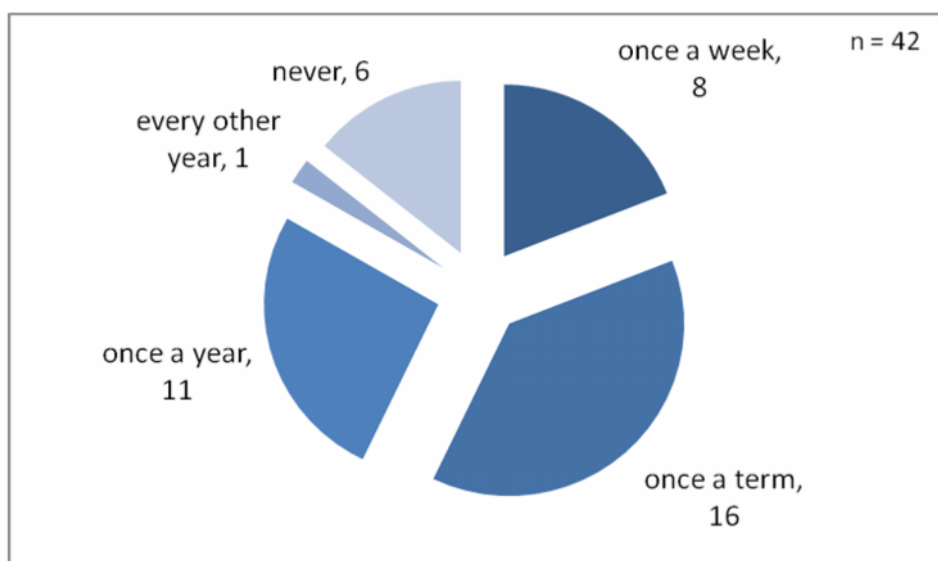
FIGURE 17 AVERAGE USE OF ENHANCEMENT AND ENRICHMENT ACTIVITIES

Examining the teachers who used E&E more and less frequently there are some small points of note. Those using E&E on a weekly basis were often fairly experienced, two had taught for '6-10 years', five for '11-15 years' and one for '15 years plus'. Those who never used E&E activities were also experienced, with 2 teaching for '15 years plus', but we also saw those who were newer to the career as two teachers who never used them had taught for 'under five years'.

Teachers were then asked about why they used E&E activities and responses to this question demonstrated some clearer trends as indicated in Table 5.

For the subject and key stage you teach most, why do you include E&E activities in your teaching?	
To have a change of teacher	6% (2)
To have a change of environment	17% (6)
E&E is readily available for this subject	14% (5)
To access specialist equipment	9% (3)
To access specialist expertise	29% (10)
To get experience of a workplace environment	11% (4)
To consider wider issues (e.g. careers, attitudes and values) around STEM subjects	54% (19)
To introduce a topic	14% (5)
To summarise / conclude a topic	17% (6)

TABLE 5 MOTIVATIONS TO INCLUDE E&E IN TEACHING

The most popular reasons to include E&E in teaching are 'to consider wider issues around a subject area', such as careers, attitudes and values and 'to access specialist expertise'. Both suggest that teachers are using E&E to supplement aspects they may not readily provide themselves.

In addition to the above motivations a small number of teachers provided further suggestions within open comments. Here comments included that they were used to 'add depth and variety in addition to that required to pass the exam', for 'fun', to 'encourage pupils to continue with STEM subjects post-16', 'extend thinking and to engage pupils in new way' and to 'increase employment'.

With regards to how teachers decided on which activities to use a number of factors came into play. Figure 18 illustrates those which teachers suggested to be of highest priority. This includes a number of features which are content related such as

'subject' (87%/n=34) and 'skills' (81%/n=31) but also more practical aspects such as 'price' (74%/n=29).
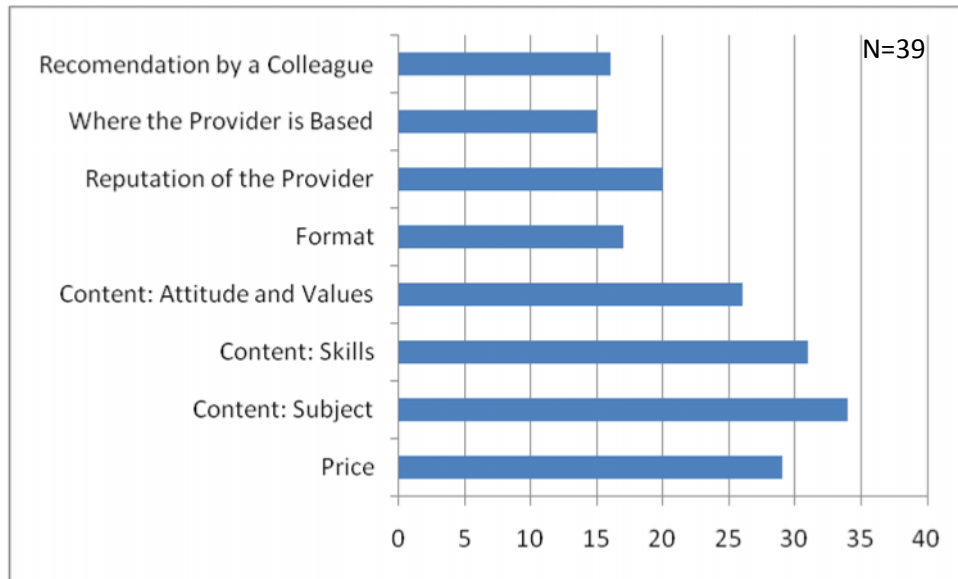
FIGURE 18 TEACHER CONSIDERATIONS WHEN DECIDING ON E&E

Teachers were also asked about factors to which they paid 'no consideration' and here it was interesting to note that a small number of teachers paid no consideration to 'reputation of the provider' (n=5), 'location of the provider' (n=5), 'format' (n=1) or 'price' (n=1) despite these being important to other teachers in the previous question. Asked if they returned to re-book the same providers there was a mixed response, with 52% (n=17) saying that they did and 48% (n=16) saying they did not. Potentially the disparity between these responses could be linked to the quality of the individual activities received by the teachers involved. Those that did return to providers suggested they did so for their 'ability to engage students' (65%/n=11), 'reliability of the provider' (59%/n=10), as well as 'subject' (41%/n=7) and 'skills relevance' (29%/n=5).

Teachers were also asked why they haven't used E&E activities in the past. Although a lower number of responses were garnered here a 'lack of awareness' was the most popular reason why, with 9 teachers suggesting this had been the case. Additionally, 6 teachers had been deterred by the 'price', 5 due to 'time constraints' and 4 due to a 'lack of availability' of an activity when it was required. This suggests that many of the factors deterring teachers from using E&E activities are of a more practical nature rather than necessarily the content or types of activities that are available. Additionally teachers stated that 'price' (83%/n=19), 'subject area' (39%/n=9) and 'format' (35%/n=8) were the most common reasons that they had decided not to use an activity.

In addition to motivations of use teachers were asked how they searched and identified suitable E&E activities based on these motivations. Teachers were most likely to use search terms from 'the subject area e.g. physics' (67%/n=22), for 'specific activities e.g. solar powered buggies' (49%/n=16) closely followed by 'terminology used by the National Curriculum' (39%/n=13). 21% (n=7) of teachers searched for 'personal, learning and thinking skills', and/or 'subject specific skills such as PCR'. They were less likely to search for 'schemes of work' (18%/n=6) or 'specific providers' (9%/n=3).

Although specifically asked about search terms, teachers were also questioned on the wider methods they used to identify activities, though this confirmed 'internet searching' to be amongst the most popular (66%/n=21) as illustrated in Figure 19. Following internet searching teachers were most likely to 'speak to colleagues in school' (50%/n=16) and 'repeat a provider' that they had previously used (34%/n=11). 31% (n=10) of teachers said that they would 'use the STEM Directories', in comparison to no teachers indicating that they were likely to contact 'FutureMorph' or 'the Learning Grid'. Two open responses to this question suggested the TES Forum and that individual research could identify suitable experts, presumably to bring in to school and talk to students. Teachers were most likely to look for activities at 'the beginning of the year '(42%/n=11) or 'the start of term' (35%/n=9), though 4 teachers agreed that they sometimes looked for things 'the week before teaching them'.
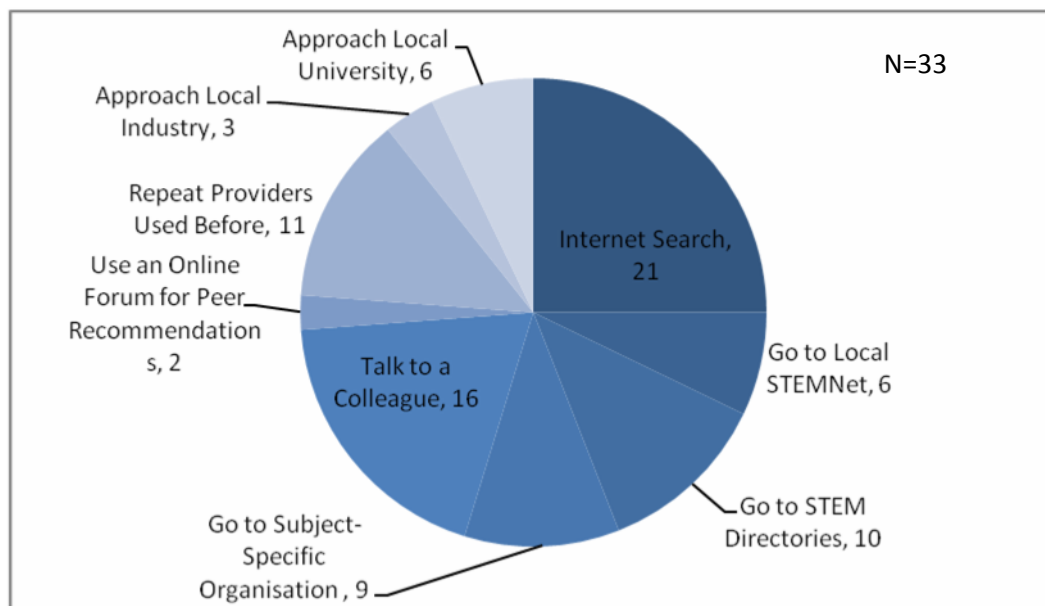
FIGURE 19 HOW TEACHERS LOOK FOR AN E&E PROVIDER

Existing Enhancement and Enrichment Provision

When asked which subject areas they would like to see more E&E activities for the most popular responses were 'Science' 73% (n=16), followed by 'Physics' 67% (n=14), and 'Chemistry' 55% (n=11). Although a limited response was provided when asked to estimate the subject areas for which there was 'plenty available', a small number of respondents (9%/n=2) suggested this was the case for 'Biology' and 'Physics'. Full details are provided in Table 6.

Which subject areas would you like to see more E&E available for?			
	Like more E&E for this	Plenty of this is available	Don't need E&E for this
Science	73% (16)	0% (0)	23% (5)
Applied Science	32% (6)	5% (1)	0% (0)
Mathematics	53% (9)	0% (0)	0% (0)
Design and Technology	37% (7)	0% (0)	5% (1)
Biology	54% (12)	9% (2)	0% (0)
Physics	67% (14)	9% (2)	0% (0)
Chemistry	55% (11)	5% (1)	0% (0)
ICT	8% (1)	0% (0)	8% (1)
Engineering	26% (5)	5% (1)	0% (0)
Manufacturing	29% (5)	0% (0)	0% (0)
Statistics	23% (3)	0% (0)	0% (0)

TABLE 6 TEACHERS' PREFERENCES OF SUBJECT AREAS FOR INCREASED E&E

This slightly higher preference for increased availability in science areas can be explained in part by the greater response rate from teachers amongst this community. 53% (n=31) of teachers that completed the survey currently taught KS3 Science and 39% (n=23) currently taught KS4 Science. In comparison 20% (n=12) and 22% (n=13) of respondents taught KS3 Mathematics and KS4 Mathematics respectively.

When asked about the types of skills they would like to see more E&E activities for 'problem solving' was by far the most popular choice, with 90% (n=28) of people who completed the question agreeing to this option. Other popular choices included 'creativity' at 82% (n=23) and 'group work and collaboration' 80% (n=20) despite these being the skills that teachers suggested already had plenty of provision. It was

also notable that the area which most teachers suggested did not require E&E coverage was 'career development such as CV writing', suggesting activities in these areas are likely to be most relevant to teachers or support staff in other fields but also that curriculum links are a key driver. Further details of responses to the question are detailed in Table 7.

Which skills would you like to see more E&E activities for?			
	Like more E&E for this	Plenty of this is available	Don't need E&E for this
Laboratory Techniques (e.g. aseptic technique)	62% (17)	4% (1)	4% (1)
Scientific enquiry/ How science works	64% (18)	7% (2)	7% (2)
Career Development (e.g. CV writing)	17% (4)	9% (2)	30% (7)
Verbal communication skills	60% (15)	12% (3)	24% (6)
Creativity	82% (23)	4% (1)	11% (3)
Group work and collaboration	80% (20)	16% (4)	4% (1)
Problem solving	90% (28)	10% (3)	0% (0)
Written communication skills	67% (18)	11% (3)	15% (4)
Confidence Building	65% (15)	4% (1)	17% (4)

TABLE 7 TEACHERS' PERCEPTIONS OF THE AMOUNT OF SKILLS-BASED E&E PROVISION

Teachers regarded the *quality* of provision in certain areas such as 'Teaching Packs, Resources and Lesson Plans', 'Websites and Downloads', 'Lectures and Talks', 'Science Shows, Interactives and Demonstrations' as comparatively high. Full details are provided in Table 8. However some areas demonstrated less favourable results, including the quality of activities such as 'Interactive Whiteboard Resources' and 'Work Experience and Placements'. However resources which teachers indicated they 'Don't Use' tended to also be ones that were rated relatively poorly, indicating that these judgements could be associated with teacher familiarity with the activity as well as their judgement of value. For example it was also noted that far fewer teachers used, or were as familiar with activities such as 'Debates and Discussions', 'After School Clubs and Science Clubs', Summer Schools, Residentials and Camps' and 'STEM Ambassadors'.

For the subject you mostly teach please rate the <u>quality</u> of...	Very Good	Good	Okay	Poor	Very Poor	Don't Use
Teachers Resources						
Continuing Professional Development and Training	3% (1)	43% (13)	27% (8)	20% (6)	0% (0)	7% (2)
Websites and Downloads	20% (6)	40% (12)	27% (8)	7% (2)	0% (0)	7% (2)
Teaching Packs, Resources and Lesson Plans	7% (2)	47% (14)	27% (8)	13% (4)	0% (0)	7% (2)
Interactive Whiteboard Resources	17% (5)	17% (5)	37% (11)	10% (3)	7% (2)	13% (4)
Student Resources						
Websites and Downloads	10% (3)	50% (15)	27% (8)	7% (2)	0% (0)	7% (2)
Careers Advice and Mentoring	3% (1)	27% (8)	33% (10)	20% (6)	0% (0)	17% (5)
Work Experience and Placements	0% (0)	17% (5)	27% (8)	27% (8)	0% (0)	30% (9)
Out-of-School Events						
Trips and Visits	3% (1)	37% (11)	27% (8)	20% (6)	0% (0)	13% (4)
Partnerships with Universities and Industry	3% (1)	30% (9)	20% (6)	27% (8)	0% (0)	20% (6)
Summer Schools, Residentials and Camps	0% (0)	17% (5)	28% (8)	24% (7)	0% (0)	31% (9)
In-School Events						
Lectures and Talks	3% (1)	52% (15)	17% (5)	10% (3)	3% (1)	14% (4)
Debates and Discussions	0% (0)	17% (5)	24% (7)	14% (4)	3% (1)	41% (12)
Science Shows, Interactives and Demonstrations	3% (1)	45% (13)	35% (10)	7% (2)	0% (0)	10% (3)
After School Clubs and Science Clubs	10% (3)	21% (6)	31% (9)	7% (2)	0% (0)	31% (9)
Competitions, Quizzes and Challenges	17% (5)	31% (9)	24% (7)	14% (4)	0% (0)	14% (4)
STEM Ambassadors	4% (1)	11% (3)	29% (8)	14% (4)	4% (1)	39% (11)

TABLE 8 TEACHERS' PERCEPTIONS OF QUALITY OF DIFFERENT TYPES OF ACTIVITY

Linked to the question of quality is the perception of how many activities are *available* in certain areas and teachers were similarly asked to rate the number of resources available in the areas they mainly taught in as shown in Table 9.

For the subject you mostly teach please rate the number of... that are available						
	Very Good	Good	Okay	Poor	Very Poor	Don't Use
Teachers Resources						
Continuing Professional Development and Training	7% (2)	23% (7)	30% (9)	23% (7)	0% (0)	17% (5)
Websites and Downloads	20% (6)	33% (10)	27% (8)	10% (3)	0% (0)	10% (3)
Teaching Packs, Resources and Lesson Plans	13% (4)	23% (7)	30% (9)	20% (6)	3% (1)	10% (3)
Interactive Whiteboard Resources	13% (4)	13% (4)	23% (7)	23% (7)	10% (3)	17% (5)
Student Resources						
Websites and Downloads	23% (7)	20% (6)	33% (10)	7% (2)	7% (2)	10% (3)
Careers Advice and Mentoring	3% (1)	17% (5)	28% (8)	24% (7)	10% (3)	17% (5)
Work Experience and Placements	7% (2)	3% (1)	24% (7)	31% (9)	10% (3)	24% (7)
Out-of-School Events						
Trips and Visits	7% (2)	17% (5)	23% (7)	30% (9)	10% (3)	13% (4)
Partnerships with Universities and Industry	0% (0)	20% (6)	23% (7)	27% (8)	7% (2)	23% (7)
Summer Schools, Residentials and Camps	0% (0)	17% (5)	27% (8)	20% (6)	7% (2)	30% (9)
In-School Events						
Lectures and Talks	7% (2)	30% (9)	23% (7)	23% (7)	3% (1)	13% (4)
Debates and Discussions	3% (1)	13% (4)	27% (8)	33% (10)	3% (1)	20% (6)
Science Shows, Interactives and Demonstrations	7% (2)	23% (7)	23% (7)	27% (8)	7% (2)	13% (4)
After School Clubs and Science Clubs	3% (1)	17% (5)	33% (10)	23% (7)	0% (0)	23% (7)
Competitions, Quizzes and Challenges	13% (4)	17% (5)	30% (9)	23% (7)	3% (1)	13% (4)
STEM Ambassadors	0% (0)	7% (2)	28% (8)	24% (7)	0% (0)	41% (12)

TABLE 9 TEACHERS' PERCEPTIONS OF AVAILABILITY OF DIFFERENT STYLES OF ACTIVITY

Once again teachers appear to less frequently utilise activities such as 'STEM Ambassadors', 'Summer Schools, Residentials and Camps', 'Work Experience and Placements'. Certain areas have also been highlighted where teachers feel there is poor availability of provision, as indicated in Table 9. This includes 'Interactive Whiteboard Resources', 'Work Experience and Placements', 'Trips and Visits', 'Partnerships with Universities and Industry', 'Debates and Discussions', 'Science Shows, Interactives and Demonstrations'. The findings suggest that in the impression of the teachers surveyed there are already fairly good numbers of activities like 'Lectures and Talks' and 'Websites and Downloads' available. 65% (n=17) also agreed that in the subject and key stage that they mainly taught more E&E could be provided.

Use of the STEM Directories

Unfortunately of the 60 survey respondents only a small number answered that they had used the STEM Directories before. This totalled 8 respondents. Due to the smaller numbers within this section percentages will not be presented.

Despite the small numbers these respondents came from a range of subject areas. Two teachers taught Key Stage 3 and 4 'Design and Technology', four teachers taught Key Stage 3 and 4 'Mathematics and Statistics' and two teachers taught Key Stage 3 and 4 'Science', as well as specific subjects within that such as 'Biology' and 'Physics'. They had also used the Directories on a regular and more occasional basis, with four using them once, one teacher using them twice and the remainder utilising the STEM Directories on more than three occasions.

Their use garnered some interesting responses as illustrated in Figure 20 below. The most common use when using the STEM Directories was to 'browse', which 5 teachers said they did, and following this they were most likely to be 'looking for a specific activity' or 'provider' or to be 'focussed on a particular key stage'. Amongst this small group of respondents both casual browsing and more specific use of the Directories was noted.
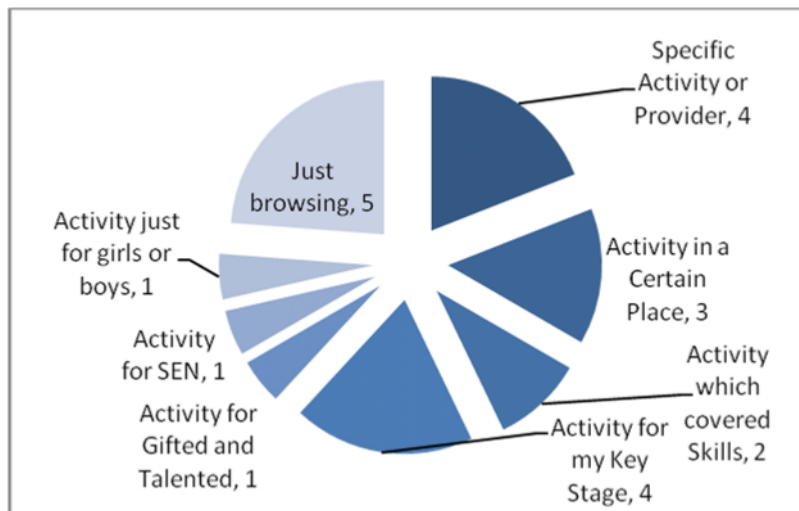
FIGURE 20 MOST LIKELY PURPOSE WHEN USING THE STEM DIRECTORIES

With this mix of focused and more casual searching, responses to a question on the success of their searching were mirrored. Three teachers said that they 'had found what they were looking for' when using the Directories with four suggesting that they 'had not'. Asked which aspects of the STEM Directories they found useful the most popular response was that 'everything was in one place', which seven teachers agreed with. Illustrated in Figure 21, the 'choice offered' (n=6) and awareness that 'evaluation had occurred' (n=6) were also popular. Only one respondent suggested there was an unhelpful aspect and that was the design and layout, though this appeared popular with others. In an open question asking what else would be useful one person commented that images of the activities would be a useful addition.
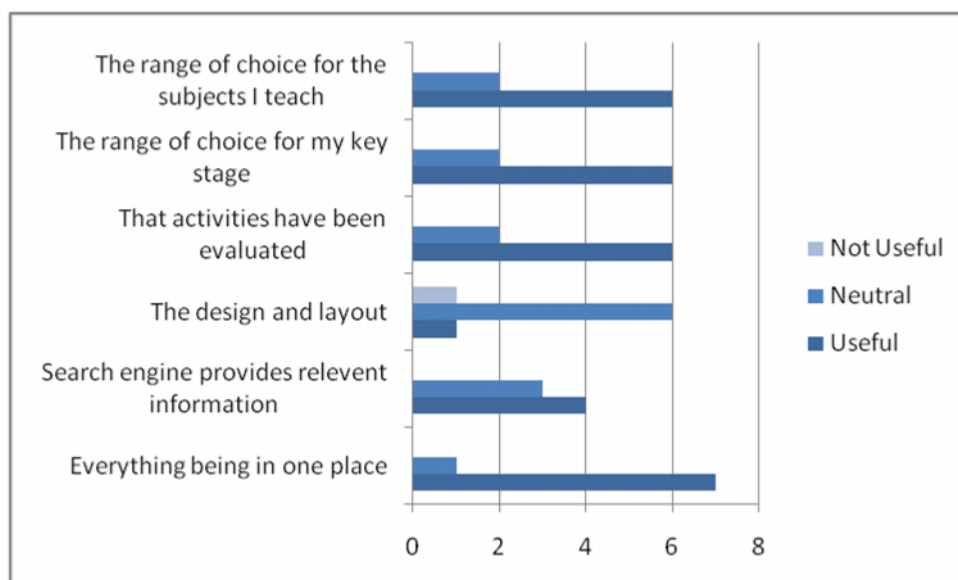
FIGURE 21 ASPECTS OF THE STEM DIRECTORIES THAT ARE USEFUL

Respondents were also fairly positive with regards to what the STEM Directories offer in comparison to other methods of locating activities. Five felt that 'the number of activities offered', how 'innovative' they are and how 'searchable and browsable' they found the Directories meant that it is better than other sources that they might use. Four also felt it was better than other sources in respect to the 'variety' and 'geographical spread'. The remaining respondents agreed that it was 'about the same' as other sources in these respects, and no respondents suggested it was worse than other sources in any of the above categories.

4.3.   TEACHER INTERVIEWS

Six teachers in total participated in interviews, representing a range of subject areas and key stages. One teacher taught Science at KS3 and 4, and a further teacher taught Science at KS3 to 5, as well as Health and Social Care at KS5. Three teachers taught Design and Technology at KS3, 4 and 5, and one teacher taught Mathematics at KS3, 4 and 5.

Motivations

A number of teachers we spoke to suggested they used E&E activities as a means of attracting students to their subject areas, either in terms of choosing to study an optional subject at school or encouraging them to continue in a subject area in higher education or for their careers:

> The science engineering link, because I'm an engineer, and I find the link between science and maths especially and engineering, very useful for our top calibre kids who want to be engineers but don't really know what engineers do and the activities give us an opportunity to introduce project work team work where they can think like a team of engineers trying to do problem-solving, critical thinking. (Interviewee 4, Science, KS 3 and 4)

> I'd use the activity at KS3 to try to interest the students to take Design and Technology at GCSE, some of the activities I might do at KS4 might be to encourage the students, to give them ideas for jobs or careers or apprenticeships for when they leave school. (Interviewee 6, D&T, KS 3, 4 and 5)

A number of interviewees discussed how their schools used activities over a full-day to encourage students to see the connections between subjects or the channel through to potential careers. The Maths teacher we spoke with described how his department frequently created activities for other subjects to benefit from and

others also talked about using E&E when there was a need to relate or draw in other subject areas:

> The main thing is to try and encourage them [students] to have a much more scientific interest and to see the use of science across, as a science college, for them to see the use of science across the curriculum...The plan [for E&E] was to try to encourage more children to take up science and see it is a more, as part of their everyday life and then maybe go into scientific careers. (Interviewee 5, Science, KS 3, 4 and 5)

> With the new framework which has the How Science Works part in it...if we can develop in our kids earlier to think that science is not alone, it's with maths, with technology and engineering then we can motivate, especially the girls there is an issue with getting girls motivated with physics, so with these kind of activities they can perhaps ignite their interest and maybe take further some of these sciences like physics. (Interviewee 4, Science, KS 3 and 4)

There were also a number of comments that suggested E&E was used to supplement content provided by the teacher, be it a specific skill, professional environment or particular technology and resources that they could not recreate in a classroom:

> We bought in a juggler, a science juggler who was absolutely brilliant because he just filled in the gaps, particularly with the little ones, KS3 kids, just to get them really, really interested in science. It was something we couldn't provide in school... for example next term I'm bringing in someone to help with my KS5 Textile girls for example a manufacturing business just to give them a different opinion, rather than something from a text book, something that the teacher's told them. So it would be gaps in the knowledge that we can provide them as teachers or gaps in something that we can't provide in school, or we're not as good at providing in school. (Interviewee 1, D&T, KS 3, 4 and 5)

> You've got to captivate the children, going to a different environment helps with that because they've got facilities and resources that we haven't got in school and it can show them what the work place is like as well. (Interviewee 6, D&T, KS 3, 4 and 5)

> It's just something different. What can we not offer, it's just industrial experience I think...I think it's just widening their experience, giving them a bit more of an idea of what they can do and what's available to them. It's so different to say 20 years ago when I was school. (Interviewee 2, D&T, KS 3, 4 and 5)

Thus it was important for the teachers we spoke to that E&E activities offered something extra that the school or teacher could not provide, and this often related to the perceived cost-benefit of an activity as we shall explore later. This perceived benefit however did not necessarily have to be a measurable or specific impact. A number of teachers discussed a sense that activities could influence their students be it in terms of interest in a subject or a career. For interviewee 6, there was a responsibility to this subject but also to his students' engagement:

> I mean I teach GCSE Electronic Products so obviously, I've got a role in this school and in Design Technology, to look at enhancement across all different areas...But for my personal preference, I like them, because it's just something that engages the children and gives them a bit of a wow factor really. (Interviewee 6, D&T, KS 3, 4 and 5)

Deterrents

Despite teachers rating opportunities for E&E highly in terms of the experiences, engagement and opportunities they could encapsulate there were also notable disincentives that emerged in the context of the interviews. Interviewee 2 stressed that using an E&E activity, particularly one which involved a trip out of school or an external person coming in could take a good deal of work on the part of a teacher. This could then be disappointing if an E&E activity did not occur as planned or was of poor quality:

> Bringing students out of the classroom or someone into the classroom is quite difficult, it requires quite a lot of work and sometimes, to give you an example yesterday I had to cancel a trip to [names university] because there wasn't enough student interest there. I don't think the parents realise how much work goes into organising an event like that. (Interviewee 2, D&T, KS 3, 4 and 5)

Interviewee 2 also touched on the costs involved in the activities in terms of both time and money and a number of comments surrounding E&E activities had a particular economic connotation and value to teachers, which was often depicted in a negative manner. Teachers described working in an environment where cost was a considerable factor. As such they would consider using a nearer location if an activity involved a trip out of school or selecting a day when teaching cover might work out cheaper and often their requirements for a particular KS or subject of study has to be balanced with other teachers within a department or school:

> Interviewer: what other things encourage you to make a choice around which activities to use?

If it's cheap! That unfortunately is the case - it's awful isn't it? But that's without a doubt the first thing that counts - how much it costs!... if I were bringing them in from industry, then I'd be expecting them to do it for free and I'll just buy lunch for them along those lines, and we're hoping this'll give them publicity things like that. (Interviewee 1, D&T, KS 3, 4 and 5)

Interestingly this was not always a reflection of the budgets available, as at least two teachers highlighted those in science, maths and technology often had considerable budgets available for E&E compared to colleagues in other subjects, or would tap into those with an overlap to another area (for example gifted and talented). However, teachers' comments often reflected a desire to get good value for money and a professional product:

I had a day where the [names provider] came in and did an activity with the children, which I was a bit disappointed with really, but it was £500 just for the day. Now that might not seem a lot, but for a school and department budget, that's quite a lot of money so I had to apply for additional funding from a special fund to do with business and enterprise from outside of school and I had to do the bid and on the whole I was bit disappointed. That's one of the implications. (Interviewee 6, D&T, KS 3, 4 and 5)

The same interviewee returned to this issue at a later stage of the interview:

Teaching and learning has changed a lot over the last 10 years, and bringing outside agencies in, I sometimes feel that they don't match what goes in schools and some of the activities are quite staid and not as cutting edge, or forward thinking as some of the activities we might do in school. You see some of the activities are the same activities that you saw 10 years ago, like building a plane out of balsa wood and tissue paper...and this person was a post-graduate with no teaching experience so it was, to say it was disappointing was an understatement. When you pay out money like that... our kids see powerpoint on a regular basis and they need something to capture their imagination, something more dynamic more cutting edge, more wow factor. (Interviewee 6, D&T, KS 3, 4 and 5)

Teachers not only had to justify the financial aspects of such E&E but also the time away from other subject areas if it was an extensive activity or the curriculum:

I certainly think that money's a limiting factor because I know that we're always worried about issues of the budget and the capitation for each department and I think sometimes it's a matter of time. These are always the biggest factors in teaching: money and time. Time, perhaps even a bigger constraint than money, when have you got time to run these things, is it a

time when they're available, because the most determining factors when we do external stuff is when we have other important timetabled events like exams and things going on. (Interviewee 3, Mathematics, KS 3, 4 and 5)

Part of it is timetable constraints and curriculum constraints because there's so much on our timetable now. I think in year 9, my tutor group, this year had something like 18 -19 different subject reports when you take into account RE, citizenship, PE you know, so the government has loaded us with various aspects that we have to do and trying to fit all those things in. The other thing is timetabling constraints within the school...Obviously, I could sit here and say that money is our main constraint, but that's not going to alleviate any of those major problems that I've mentioned. (Interviewee 5, Science, KS 3, 4 and 5)

I think there needs to be less barriers to allow, more encouragement to allow staff to get out and more encouragement for students to get out of schools...in year 10 and 11 we're so focussed on getting these kids through the exams that unless the enrichment and enhancement activities are directly related to the syllabus course we're doing then there's no, not no point...It's a big thing that well, I've got to get these kids out of this lesson and of course if you're taking them out for the day then there's one lesson of mine that I'm teaching but then I've got Andrew in science and Richard in English and Jenny in Biology who then have to take these students out of their lessons for the day. (Interviewee 2, D&T, KS 3, 4 and 5)

Organising an E&E activity could turn into a series of responsibilities for a teacher, from identifying and organising, to risk assessing and driving the minibus 'there all those obstacles, they're not big obstacles but they just add up to be one big obstacle' said Interviewee 2.

Needs

The interviews were a prime opportunity to ask teachers about how they currently located E&E, used the STEM Directories and perceived gaps in the field. As well as using the STEM Directories to identify E&E, others used sites such as the TES website, Teachernet and TeachersTV, magazines and periodicals such as Science in Schools, and face-to-face meetings, such as the ASE conference, to learn of opportunities. Many also used standard searches on internet sites such as Google or You Tube, with a combination of keywords such as the 'subject', 'key stage' and 'education'. However for Interviewee 1 and a number of other teachers, the advice and experience of others also proved useful:

Word of mouth, I mean if someone says 'these guys are really good' then they may get passed along. (Interviewee 2, D&T, KS 3, 4 and 5)

I'm afraid I'm one of those typical teachers that is obsessed with her subject, obsessed with teaching so I tend to use chat forums. I don't necessarily participate in them terribly much I'm not terribly good at doing that but I will listen to comments from the pupils. (Interviewee 1, D&T, KS 3, 4 and 5)

A lot of the time what you use tends to relate to what other people have recommended. So that a recommendation would be good but one person's good is another person's horrendous isn't it? (Interviewee 5, Science, KS 3, 4 and 5)

In this context interviewee 5 described how her school always performed an 'internal' evaluation whereby teachers would be drafted in to assess an activity. However, like other interviewees she felt feedback from teachers in other schools would also be useful. Whilst Interviewee 1 joked about being a 'typical teacher', it was clear that those we spoke to had considerable expertise in their subject area and used their own judgement and resources to develop opportunities. Interviewee 2 for example extensively discussed the informal networks he had created with companies in his local area by 'picking up the phone'. Despite this knowledge teachers still identified additional factors that would assist them to better utilise E&E activity:

Time! It's just having the time to do it...

Interviewer: do you think there is anything that could assist you?

Dunno really, some places we go to they give us risk assessments already done which is brilliant...What would be quite good would be if you go and do an activity is having a pack that you give to the staff who are taking the kids out the school that will cover things like a letter, what we're going to do during the day and stuff like that really. (Interviewee 2, D&T, KS 3, 4 and 5)

A description of the tasks that's actually meaningful and clear. You know, what is going to be done, why it's going to be done, what they're trying to achieve...I quite like things to be in plain English. (Interviewee 3, Mathematics, KS 3, 4 and 5)

At least two teachers therefore talked about practical information and clear details as being useful for E&E providers to supply in generic form. However in some circumstances teachers were more enthusiastic about creating a bespoke activity, something particularly specific to their student needs rather than scanning a

directory of pre-defined activities. Interviewee 2 discusses this process and suggested providers needed to be amenable to their needs:

> First of all, finding out what I want, rather than ringing up the company and asking what they can offer. So 'I'd like to do this, can you help?' rather than 'I've got some students, what can you do for us?' Making sure the staff are directed, otherwise you're wasting their time and you're wasting our time... I know what I want and I know that I want to do this, I want to do that, I know I don't want to drive for more than 40 minutes, I want to be there in the morning, I want to have lunch there, I want the kids to experience this and that and the other and I want to go home. And if you can't offer that, then thanks very much for your time, but I'm going to go somewhere else. (Interviewee 2, D&T, KS 3, 4 and 5)

> It's approaching the companies and asking them if they'd be interested. It's building links with industry and education which has always been something to improve because they want the best candidates and for schools to be interested in technology, from a school point of view we see the benefit of it as well. (Interviewee 6, D&T, KS 3, 4 and 5)

Such negotiation however takes time and it was often difficult for teachers to perceive how an intermediary or web-based interaction could ease this process effectively. One aspect we explored further was how curriculum links might aid teachers in this respect and responses to this question were mixed, with some teachers seeing it entirely as the teacher's role and others seeing it as being advantageous 'politically':

> Waste of time, because teachers should be able to do that. (Interviewee 1, D&T, KS 3, 4 and 5)

> Yes, I think I would [find curriculum links helpful]. If I knew what mathematical topics or key skills things that they were going to cover... [but] it can go in both directions. I think we can become too obsessed in education, with ticking boxes...I think that sometimes it's worth just getting a resource or activity in because you think it's great for the kids regardless of the boxes it ticks. But it's useful to know what they think they are doing, and that's more in terms of how one justifies it I guess to the senior management with the money or how one justifies spending time on it to oneself or to one's colleagues. (Interviewee 3, Mathematics, KS 3, 4 and 5)

> That would be quite useful but most of the time you adapt what you find any way to fit your school or to fit your style of teaching or to fit your delivery

> methods or your resources or whatever. (Interviewee 5, Science, KS 3, 4 and 5)

> Whatever they do we can always shoehorn them into the national curriculum if they're designing and making. It's a challenge - but that's what our job is, to make it as exciting rather than necessarily match it to the curriculum because that's the way to get the children interested. (Interviewee 6, D&T, KS 3, 4 and 5)

From the teachers' perspective curriculum links were not necessarily beneficial in terms of interaction with students but could be in terms of justifying the occurrence of an activity. Specific requests were also made by individual teachers for better lists of other websites offering good resources and more image based searching; 'visual learners, we don't like to read much and photos are just brilliant'. This comment was from Interviewee 1 who also suggested there could be more sharing abilities on websites like the STEM Directories, allowing teachers to signpost useful images or activities for fellow teachers.

Next we explored issues of 'gaps' with teachers, both in terms of topic areas and types of activities. When asked where provision was lacking teachers discussed some specific requirements including the need for more resources at the higher key stages:

> I wish there was a bit more robotics, and KS5 and actually KS4.There's a lot of primary, there's a humungous amount for KS3 but because we don't have the variety or even the ability to do whatever we want at KS4 and 5, teachers don't actually put too much together for them. (Interviewee 1, D&T, KS 3, 4 and 5)

Asked by the interviewer about anything else they struggled to find, Interviewee 1 continued:

> Yes, anything maths related... It's a gap, definitely a gap, because we would love it. Of course we get round the maths by doing it as part of the other lessons anyway. But the whole point of STEM is so you can focus on these four subjects and obviously they go together incredibly well, but it is definitely a gap. (Interviewee 1, D&T, KS 3, 4 and 5)

Interviewee 3, a maths teacher, did not share the same perception of a lack of maths content and suggested there were resources available but he was concerned that these tended to focus on particular areas which were amenable to being engaging:

> ...practical stuff to do with shape... is something that's quite useful because you can't always provide the same engagement experience, a kinaesthetic

experience, perhaps on the equipment you've got in the classroom and how used you are to using it...algebra and the sort of core number work like percentages and things like that, you know fractions and percentages and things like that, I find that's quite easy to teach myself and to engage the kids. But in a sense, though, there is that danger that it is very dry maths and kids that are good at it will get it really easily and kids are struggle with it with struggle with it. It's the shape and handling data that's more engaging and more out there for it, I guess. (Interviewee 3, Mathematics, KS 3, 4 and 5)

Interviewee 3 then raised the concern that certain aspects of the curriculum could have more activities that were amenable to engagement. Similarly, Interviewee 5 suggested she had experienced real problems trying to identify the relatively traditional need for good speakers, relying instead on 'friends of friends or relatives of friends or friends of relatives and colleagues' who worked in particular industries, and Interviewee 6 expressed concern that many activities were now becoming web-based:

It's nice to see cutting edge technology in a work place and some of the videos that organisations provide of new technology are quite helpful but there doesn't seem to be anywhere to take the children to show them... [names provider] used to have roadshows where you'd take them along and you could show the children, but now they've stopped that and they've just got the website with all the resources and the videos and things like that - which is good but it's not as good as taking them out of doors and showing them something, and actually getting hands-on really. (Interviewee 6, D&T, KS 3, 4 and 5)

For these teachers at least, identifying some of the more traditional and common forms of E&E had been superseded in recent years by more innovative developments. In general the teachers we spoke to were very supportive of any attempt to assist in this process of identifying activities (albeit with concerns as to any financial or time constraints involved) but they also raised the issue that the proliferation of sources they could potentially go to may add to confusion, particularly when attempting to identify an activity quickly:

Because we work with DATA (the Design and Technology Association) and we've got STEM and the Institute of Materials, Mining and Minerals which covers the Institute of Wood and the Institute of Plastics. It's knowing where to go to get what you want... It's difficult knowing what everyone does isn't it? (Interviewee 2, D&T, KS 3, 4 and 5)

I think there's a lot more out there than we're using, to be honest, I think a lot of that is restrictions on time and money like I said earlier. They're always the biggest factors. I'm sure there's tonnes of stuff [E&E] out there. (Interviewee 3, Mathematics, KS 3, 4 and 5)

I'm aware of a lot that are going on, but obviously I'm not aware of all of them - but there's no national register or national website I can go to to look at the activities going on in your area. Different organisations have their websites which you can look at the different activities going on in your area, but there's not a central area for all STEM activities. (Interviewee 6, D&T, KS 3, 4 and 5)

The availability of a central focus point for E&E activities was thus important for teachers but equally comments throughout the interviews often suggested a more focussed and bespoke provision for their individual needs would be of use.

Results

5. DISCUSSION

This section brings together the data from the three methods used in phase 3 of the STEM Directories gap analysis – categorisation of providers' website content; an online teacher questionnaire; and qualitative interviews with teachers. The findings are compared and contrasted here in order to provide an indication of overarching conclusions. Further recommendations are included in the separate 'Summary Report' available in addition to this Research Report.

Data gleaned via the interviews suggested that for this small group of motivated teachers E&E activities are used for a number of reasons. This includes **encouraging students to study subjects** at GCSE, A-level and University and to consider potential **career opportunities** but also as they can provide something **additional** that an individual teacher or school may not be able to; the **'wow' factor** and **engagement**.

The mapping exercise delivered within this study concluded that **all the STEM subjects contain provision of E&E activities** at a national level at KS3 and KS4, however it is heavily **biased towards Science and areas such as Biology and Physics**. Provision for Maths, Engineering and Technology, either in conjunction with another subject or in isolation, is much less apparent. Within the teacher questionnaire however the respondents strongly indicated that **Science was the main area that teachers would like to see *more* provision in**, followed by Physics then Chemistry, Biology and Mathematics. It was however notable that **teachers appear likely to suggest the need for more activities around the specific subject that they teach themselves**. 73% of questionnaire respondents wanted to see see more E&E activities for 'Science' and this linked to the larger response rate from teachers in that area.

This mapping exercise has suggested there could be a **lack of targeting of activities both in terms of links to the National Curriculum and to specific key stages**. In very few cases providers included full details on their websites of how their activities linked to the National Curriculum (for example through a matrix or downloadable document), whilst more commonly in the coding process the curriculum links had to be assessed according to the activity description. All but one provider within the sample failed to distinguish between KS3 & KS4. **Teachers themselves had mixed feelings about the necessity of curriculum links**, with some respondents actively expecting curriculum links to be provided, whilst others saw making connections between an external activity and the curriculum as part of their own role. Teachers

were however more consistent in their desire for the easy accessibility of **practical information** relating to potential providers' activities.

Similarly, there was **little detail from the providers as to how the activities met the needs of particular target groups**. The data inputted by the providers for their STEM Directory entry suggested that many providers had activities that were developed with a particular audience in mind, for example gender-specific activities, activities for minority ethnic groups or those with special educational needs. Upon review it was not always clear how the activities were tailored for these specific audiences, and in fact these audiences were rarely mentioned on providers' websites. There are two possible explanations: that providers perceive an advantage in 'ticking' the maximum number of boxes within their STEM Directory entry (thereby selecting some descriptors that are perhaps not entirely appropriate) or that they do tailor their activities but do not document this information via their websites. For teachers requiring such information, website materials need to be more specifically focused.

Teachers are highly motivated by 'subject' and 'skills' but also more practical aspects such as 'price' and many of the factors deterring teachers from using E&E activities are of a more practical nature. Organising an E&E activity, even with a professional and efficient organisation, can have **time** implications and require considerable **justification** on the part of a teacher in a typical school environment. As such they expect to see a good return on these **costs** and for it to fulfil their own **individual** requirements. They and their students have expectations that E&E activities should **contain advanced content**, be **delivered in a professional manner**, and **supplementary** to content that a teacher can deliver themselves.

Teachers could be better supported in these efforts via the recognition of the crucial role of **feedback** from others (both teachers and students). Evaluation reports would also be helpful if available, but were not perceived to be as useful as teachers feedback in more general terms. Whilst directories and mediators have a key role to play here, it is important that they do not neglect the more **routine** needs of teachers (for example for speakers to give lectures as well as more 'trendy' E&E formats) and **overwhelm** teachers who are looking to identify a particular activity. Significantly amongst this small group of teachers involved in the interviews, who it should be noted were perhaps more amenable to E&E activities as indicated by their willingness to participate, there was a perception that activities are out there but it is finding the time to **locate** them that often proves the barrier.

The **provision of E&E activities captured within the STEM Directories is dominated by four types of institution**: 'Science Communication Companies', 'Industry', 'University/Educational Establishment' and 'Research Council/Learned Institutions'. It is perhaps surprising that there so few entries from the 'Science

Centre/Museum/Zoo/Aquaria' (n=3) and 'Resource Centre/Technical Facilities/Research Institution' (n=3) categories within the sample investigated (n=63). School visits and outreach activities play a considerable role in Informal Education establishments such as Science Centres and Zoos so they are notable by their absence from the STEM Directories. Whilst the STEM Directories may not wish to become dominated by entries from such groups, marketing its existence or considering if there are any current barriers which could deter such organisations from registering could be considered.

In terms of 'Teacher Resources' provision and perception of quality broadly align with regards to 'Continuing Professional Development and Training', 'Websites and Downloads' and 'Teaching Packs, Resources and Lesson Plans'. In the case of those activities targeted more specifically at students and in school, 'Websites and Downloads', 'Careers Advice and Mentoring' and 'Lectures and Talks' in schools appeared both well regarded and useful for teachers.

Whilst the quality of some other activities appeared to be satisfactory there was **perceived to be a lower availability of resources such as 'Interactive Whiteboard Resources', 'Trips and Visits' and 'Partnerships with Universities and Industry'**. Only one 'interactive whiteboard resource' was identified within the mapping exercise, thus supporting teachers' perceptions on that front. However 'Trips and Visits' (n=16) and 'Partnerships with Universities and Industry' (n=11) were represented within the mapping data, suggesting that it is perhaps an issue of teachers not being aware of these activities, rather than a lack of provision.

In terms of how teachers locate such activities **'internet searching' was amongst the most popular as well as to 'speak to colleagues in school'**. When using the internet teachers suggested they use search terms from 'the subject area', look for 'specific activities' and use 'terminology used by the National Curriculum'. In contrast to this quite specific searching, the most popular use of the STEM Directories was to 'browse', followed by 'looking for a specific activity' or 'provider' or to be 'focussed on a particular key stage'.