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Royal Society Vision Project

Report on Leadership and Workforce Issues within UK Science and Mathematics Education

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Executive summary

Recent studies have raised serious concerns about the ability of the education system in the UK to meet the challenge of increasing the numbers of school-leavers with the science and mathematics qualifications required by industry, business and the research community to assure future economic competitiveness and our ability to answer new questions. The Royal Society's Vision project aims to determine what needs to be done to make science and mathematics education in the UK as inspiring and effective as possible. The present report is the result of research which examines the contribution of teacher training and professional development, school/college leadership and ethos. This research was designed to answer five key questions:

1. What factors are associated with better and poorer school or college performance in science and mathematics education?

2. What contribution to outcome is made by the initial teacher education (ITE) and continuing professional development (CPD) received by teaching staff?

3. What role does school or college leadership play in the development of innovative and best practice?

4. What are the characteristics of effective leaders in science and mathematics education?

5. How far do any of these vary according to nation, phase and student characteristics?

The research consisted of two principal stages. The ***mapping stage*** focused on synthesising the main conclusions of other researchers regarding these questions by comprehensively reviewing existing literature and research data. The ***inquiry stage*** was designed to dig down into conclusions identified during the mapping stage in order to better understand the factors that drive variation in performance. A layered approach was adopted, in which a mixture of site visits and telephone interviews was used to build up a systematic set of illustrative case studies involving schools and colleges across the four home nations. Both concentrated in particular on the activity of subject leaders, since the mapping stage indicated that they had a crucial influence on outcome. We were especially concerned to identify factors which were associated with performance that was out of step with the trend for demographically similar schools or colleges. The case studies were supplemented by a large-scale online survey of teachers, designed to collect data on their perceptions of the training and leadership factors that affect school or college performance in mathematics and science.

There was striking unanimity across the literature review, the case studies and the online survey that schools and colleges which are successful in science and mathematics provision are *collaborative* and *inclusive*.

With regard to **collaboration**:

- Subject leaders are collegiate, lead by example and develop teams with high levels of open exchange, mutual support, shared values and shared goals.
- Subject leaders value good subject knowledge, and deploy and develop it in coordinated fashion through appropriate CPD.
- Subject teams work collaboratively with those in other departments, exchanging information and sharing practice via in-house CPD.
- Subject leaders and their teams work collaboratively with other schools and colleges, sharing CPD and working together to ensure consistent approaches within phases and coordination across them, especially at points of transition.
- Subject leaders have good relationships with their senior managers, and are trusted by them to take responsibility for their area of provision.
- Good teaching skills are seen as crucial, and are valued and respected by senior managers and subject leaders, who grant good teachers autonomy and flexibility over methods of delivery.
- Pupils and students are encouraged by staff at all levels to be open about their strengths and weaknesses and to seek support when they have difficulties.

Successful schools and colleges are **inclusive** in the way they view their students and set up opportunities which cater for different levels of ability:

- Teachers value engagement and enthusiasm as much as achievement, and they promote these by their own example.
- Senior managers and subject leaders have high expectations of their students and set challenging goals, but frame these in terms of individual objectives, not absolute standards.
- Pupils who want to progress to higher levels of study and qualification are encouraged to do so even if the outcome is uncertain, and teaching staff work hard to support them.
- Where possible, curricula and qualifications are made available which are aimed at enabling those with lower levels of ability to progress.
- Teachers make systematic use of investigations and extra-curricular activities which connect subject content to pupils' everyday experience and they encourage them to be adventurous in their thinking.
- Extra-curricular activities include a focus on careers, for instance via visits to and from local industry and universities, helping make the possibility of employment involving science and mathematics seem both real and desirable.

Many of these points apply to other areas of teaching, but they have particular significance within the context of science and mathematics:

- Those with a background in science and mathematics tend to be less adept at the people skills which underpin collaborative and inclusive styles of working. Subject leaders in particular are very likely to need specific support in order to develop the range of skills involved in democratic and collegiate management. At present, however, take-up of subject leader training is patchy, and its importance is not widely appreciated. Such training, backed up by systematic support for effective deployment, is a necessity for subject leaders in all phases if science and mathematics provision is to become properly professionalized.

- Science and mathematics teachers are often guilty of seeing their subject knowledge as established fact. This leads to lesson content which is static in character, and to teaching methods aimed simply at imparting knowledge to pupils. Inclusive, pupil-centred approaches to delivery stimulate engagement at all ability levels and provide a key means of moving away from static content. However, these are a radical departure for many science and mathematics teachers, and specific support is necessary to ensure they are adopted. Mathematics and science teachers in all phases need to regularly access the growing information on successful pupil-centred methods within their subject areas, and use it to develop new pedagogical skills. They also need to keep up to date on new and emerging areas of subject knowledge and ideas about how to incorporate these within their teaching, to fuel a sense of novelty and excitement among pupils. Full participation by teachers in CPD is a further key requirement for professionalizing science and mathematics teaching. The importance of this needs to be instilled at an early point, during ITE.

- Effective professional development for both subject leaders and teachers in science and mathematics is ill-supported by the current patchwork quilt approach to provision, particularly as regards its appropriateness to the different curricula in place across the four home nations. Although their provision is open to teachers across the UK, the Science Learning Centres (SLCs) and National Centre for Excellence in Teaching Mathematics (NCETM) are located only in England and are primarily directed at supporting English curricula. Science provision in Scotland is relatively healthy and there is more focused support for professional development than is enjoyed by teachers elsewhere. However, there is no comparable CPD delivery focused on mathematics. The National SLC mounts occasional courses in Wales and Northern Ireland, but these do not amount to a systematic programme of activity, especially in terms of support for the local context. Other Welsh provision is restricted in scope and patchy in coverage. In Northern Ireland, plans for the future direction of teacher professional development have yet to be drawn up.

- Problems of variation in the availability and fit of CPD are compounded by problems of take-up. Given the costs of cover to support release, there is pressure to run CPD courses in twilight mode (i.e., after school working hours), or to release teachers in selective fashion to attend courses relating to areas of immediate need, with subsequent local cascade. Both are poor options. The first leads to diminished ability to concentrate and shorter sessions, and the second to unsystematic engagement and distorted implementation. A more coordinated, thorough and better supported system of providing professional development for both teachers and subject leaders in science and mathematics – and one which takes into account differences in national context – is crucial if genuine professionalization is actually to occur.

- Mathematics and science are ‘difficult’ subjects in which pupil achievement is often lower relative to other areas of the curriculum, despite greater costs. Senior managers must have good understanding of the specific demands of mathematics and science in order to set realistic performance goals, and provide the necessary support in terms of resources and institutional priorities. They also need to be able to make suitable staff and subject leader appointments, promote opportunities to progress for weaker as well as stronger students, and set an agenda for collaboration, within and across schools and colleges. The necessary understanding to underpin effective and innovative approaches is far from commonplace, and without it, opportunities are being missed to extend inclusive progression in mathematics and science, to link to business and industry, and to consider alternative models of engagement with CPD such as vacation provision. Support for the development and dissemination of senior leadership needs to go beyond the generic to focus on successful approaches to mathematics and science, but we were unable to locate any training of this kind.

The introduction of mandatory subject leader training, targets for subject-specific CPD and focused skill development for senior leaders are obvious corollaries of these conclusions, but this will require:

1) a coordinated system for provision of training
2) mechanisms for defining standards and targets
3) some form of overseeing authority to ensure take-up

At present, the four home nations are at markedly different levels of development as far as 1) is concerned. The way forward seems to lie in greater sharing of expertise – and where appropriate, provision – across the four nations, echoing the collaboration that is a hallmark of effective schools and colleges, rather than each attempting to build up their own systems independently. This would make it possible to extend the generalisable aspects of existing National SLC and Scottish provision, whilst at the same time attending to the location of these within the context of the different national curricula, assessment frameworks and administrative systems. This approach would help ensure greater coherence of training standards across the UK as well as guaranteeing sensitivity to local circumstances.

This expanded collaborative provision would necessarily require increases in resourcing, and the most credible means of achieving this is via increased incentives for teachers to fund their own development, including via course attendance during school and college vacations, as is commonplace in the US. This model operates in a variety of other professions, where demonstration of engagement in CPD is frequently a requirement for promotion or even being allowed to continue to practice.

To be effective, this approach would also require the presence of professional organisations or similar structures capable of defining standards and targets both for provision of training and engagement in it, with sufficiently high levels of membership or other forms of control to help enforce these – thereby also helping to address points 2) and 3). Rapid and coherent progress is most likely to be achieved by a single overarching professional organisation, with a broader focus than just science or mathematics, capable of leading an initiative to determine standards and targets in consultation with the SLCs, the Association for Science Education, NCETM, the Advisory Committee on Mathematics Education and other providers of training, including national and local authorities. When finalised, it would then help coordinate or even broker provision that meets these agreed standards. An organisation such as the Royal College of Teaching (RCT) might potentially take on this role.

Once set up, the simplest method of policing adherence would be to routinely require detailed reporting on subject leader training and CPD participation within school and college inspections by Ofsted, Education Scotland, Estyn in Wales and the Education and Training Inspectorate in Northern Ireland. Given the importance attached to inspection outcomes, this would also be the most secure way to achieve compliance. Nevertheless, a system of this kind might still take many years to develop if left to occur in bottom-up fashion, because of the degree of professional consensus required. In order to expedite its growth, there would also need to be some additional and specific incentive to take up membership of the overseeing professional organisation, whether statutory or financial. This represents the most direct path to the professionalization of science and mathematics teaching which we have identified as the key underpinning priority.

On the basis of these points, we make eight specific recommendations, six related to the generic actions needed to develop a genuinely professional system of training at all levels of the mathematics and science workforce, capable of transforming science and mathematics education across the UK; and two regarding crucial follow-up research which will steer future development in an informed fashion:

Generic recommendations

1. **Introduce a systematic and mandatory programme of training and support for subject leaders in mathematics and science.** This programme should consist of initial formal training followed up by a period of individual mentoring by experienced subject leaders from other schools or colleges.

2. **Establish explicit and mandatory targets for teacher involvement in subject-specific CPD.** These must cover both subject knowledge and pedagogical approaches, and ensure that a minimum proportion is delivered by those with recognised expertise, including knowledge of the specific curricular contexts in which teachers are working.

3. **Provide training and development opportunities for senior managers focused on effective learning-centred leadership within mathematics and science.** Given the breadth of concerns for which senior managers have responsibility, it is less appropriate to set mandatory goals here, but training of this kind made a focal part of current efforts to improve leadership standards more generally.

4. **Establish a system of collaborative exchange and development of training activity in order to systematically extend its reach across the whole of the UK, whilst retaining sensitivity to local context**. A wide range of national and local authority organisations are currently involved in CPD and leadership training, and rather than each nation attempting to promote separate growth of full provision, it would be more cost effective to pool this activity by making content readily available for adaptation to local contexts. Resourcing of this system would come from a mixture of school/college and self-funded participation.

5. **Identify or establish an overarching professional organisation to take the lead in determining agreed training standards and CPD targets and helping coordinate provision in consultation with existing training providers and subject associations.** The

introduction of mandatory subject leader training and targets for subject-specific CPD requires concerted action to ensure a coherent approach is adopted across the UK. The combination of political differences, lack of public funding and a need for teachers to embrace CPD as part of their profession means that an autonomous organisation of this kind is the best mechanism for ensuring it happens.

6. **Work with the respective inspection bodies in each of the four home nations to secure monitoring of training uptake within routine reporting.** Given the number of teachers involved, the regularity of school and college inspections, and the importance attached to them, monitoring within them of adherence to mandatory training is likely to be the most effective means of policing available.

Research recommendations

7. **The differential effects of alternative modes of ITE provision must be reassessed following the introduction of employment-based routes.** Although there is little past evidence that the ITE route through which science and mathematics teachers receive their training leads to differential outcomes, we need to ascertain whether employment-based schemes have changed this picture by emphasising craft skills at the expense of professionalism.

8. **The defining characteristics of effective collaborative networks need to be examined in detail.** While there was clear evidence that collaboration was an important feature of effective provision in science and mathematics, it was much less clear whether some forms of this are more productive than others.

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Context

This report is the outcome of research on teachers and leadership for the Royal Society's project "Vision for Science and Mathematics Education 5-19". The Royal Society has a longstanding commitment to supporting the development of a world class education system in science and mathematics, one that will increase the numbers of school-leavers with the science and mathematics qualifications required by industry, business and the research community to assure the UK's future economic competitiveness and its ability to answer new questions. Producing new scientists and new mathematicians with the knowledge and understanding to meet these demands will only be possible with an inspirational and high-performing school and college science and mathematics education system. Within the UK Government, the Department for Business, Innovation and Skills is similarly "committed to developing a world class UK research base responsive to users and the economy, with sustainable and financially strong universities and public laboratories and a strong supply of scientists, engineers and technologists." (BIS web site, 2012).

Beyond this, though, mathematics and science are widely regarded, alongside literacy, as pre-eminent and foundational skills among the general population, since each represents a central cognitive resource with importance in both everyday and work contexts. Literacy and communicative ability is the key to participation in pluralist democratic societies, which increasingly rest on the assumption that their populations have access to information in a variety of modes, and are able to use it to inform judgement within work and community settings. Mathematical ability provides these same populations with the more specific capacity to understand and utilise quantitative information in all areas of their lives. Scientific ability in many respects builds on literacy and mathematical ability. However, it goes beyond each to encompass not just a grasp of established understanding about how we and the world around us function, but more crucially a capacity to collect and assess evidence in an objective unbiased fashion and draw from it explicit testable conclusions about causal relationships. Governments and policy organisations have been concerned to promote the acquisition of skills in each of these three areas, not just because of their contribution to national economic competitiveness, but also because of the consequences at an individual level of poor development and the costs associated with managing these.

Unfortunately, recent studies (e.g. Wilson, R, 2009) have raised serious concerns about the ability of the science and mathematics education system in the UK to rise to the challenge it is set. The Royal Society's Vision project aims to determine what needs to be done to transform science and mathematics education in the UK and make it as inspiring and effective as possible. It has identified five priority areas for investigation: teachers and the wider workforce; leadership and ethos; skills, curriculum and assessment; infrastructure; and accountability. The present report is the result of research addressing the first two of these areas with a focus on teacher training and professional development, leadership and school/college ethos.

The quality of the teaching workforce is plainly of paramount importance. As has been stated many times, an education system can only be as good as the teachers within it. The Royal Society has concerns about the recruitment, but also the training and professional development opportunities of the teaching workforce in our schools and colleges. There has been much policy activity to attract new recruits to primary and secondary science and mathematics initial teacher training, but these may have masked the need to address more fundamental and long-standing structural and operational issues. In particular, once they have been recruited, we need to ensure that science and mathematics teachers are supported in developing their knowledge and skills to improve the quality of the learning they promote. Creative and challenging subject-specific continuing professional development (CPD) is also likely to help in the retention of talented and inspirational teachers. However, there are concerns that CPD aimed at developing teaching skills is not valued highly enough among schools and that its value in helping teachers teach better and improve their career development prospects is unrecognised. Relatedly, although we know that leadership matters, we have insufficient knowledge regarding the leadership characteristics of those who innovate in science and mathematics teaching, what constitutes effective practice among senior and subject leaders, and how their activities impact on the performance of those around them.

It is these issues which form the focus of this report.

The IOE team

In order to identify more specific research questions related to these issues, to deliver answers to these questions and to provide the Royal Society with appropriate evidence to inform the Vision project, we drew on a broad and complementary range of expertise. Central to the shaping and conceptualisation of the project was the Expert Reference Group (ERG), formed of nine respected figures in the world of science and mathematics education and educational leadership:

- Professor Michael Reiss (Lead on Science Education)
- Dr Esmé Glauert (Lead on Primary Science)
- Dr Ralph Levinson (Lead on Secondary Science)
- Sally Johnson (Lead on Science CPD)
- Professor Celia Hoyles (Lead on Mathematics Education)
- Professor Dave Pratt (Lead on Secondary Mathematics)
- Professor Peter Earley (Lead on Leadership)
- Professor Matthew Harrison (Lead on wider STEM, workforce and FE)

The ERG was led by the project director, Professor Andrew Tolmie, and its activity focused on a) steering the mapping and critical review of past research outputs, and identifying internal/external sources to ensure comprehensive coverage; b) reviewing the results of the literature survey and providing further commentary on these; c) informing the specification and design of the inquiry stage of the research; d) assisting in the promulgation of the online survey that formed part of the inquiry methodology via a range of specialist networks; and e) reviewing the contents of this final report. A small group of experienced education research officers, led by the project manager, Brian Creese, carried out the literature review work, instrument design, fieldwork and data analysis for the inquiry stage. The principal contributors were Rebecca Nelson, Jonathan Block, Dr Jon Swain and Dr Olga Cara.

The five core research questions

As noted above, the Vision project identified a range of priority areas for action with respect to current science and mathematics education in the UK, but targeted this initial phase of research at two of these as crucial potential levers for change: 1) teachers and the wider workforce, including initial teacher training (ITT) and CPD provision and uptake; and 2) leadership and school/college ethos. Our research questions were drawn up to reflect this remit while keeping the broader range of priority areas in view, in order to ensure the work was also capable of addressing the *relative* impact of workforce and leadership factors and could therefore contribute to the framing of focal issues for the next phase of the project. The emphasis of the Vision project on the 5 to 19 age range entailed a focus on mathematics and science education within the primary, secondary and further education phases, but it was decided in addition that it was crucial to examine the influences on both better *and* poorer performing schools or colleges, since poorer performance might not be attributable simply to the absence of positive factors. We also adopted as far as possible a focus on all four of the home nations, not least because of the distinctive features of the provision within each, and for the literature review we considered wider international evidence.

Our research questions were designed to steer our activity towards a layered build up of evidence, starting with school and college performance itself, then focusing in on the specific influences on this of workforce and leadership characteristics, and systemic variation. The five core questions were these, therefore:

1. What factors are associated with the incidence of better and poorer performance in science and mathematics education?
2. What contribution to outcome is made by the characteristics of teaching staff, especially their ITT and CPD experiences?
3. What role does school or college leadership play in the perception and take-up of CPD and in the identification and deployment of innovative and best practice?
4. What are the characteristics of effective leaders in science and mathematics education, especially as regards their background and training?
5. How far do identified patterns of influence vary according to nation, phase/sector and student characteristics?

Research design

As indicated above, the research consisted of two principal stages of activity. The ***mapping stage*** focused on identification of existing literature and research data. The object was to synthesise the main ideas, approaches and debates regarding teaching and leadership of mathematics and science education in schools and colleges in the UK and wider; and to address each of our research questions by generating new analysis of 1) the relationship between teacher characteristics, ITT/CPD and school/college performance; 2) factors associated with CPD uptake and impact; and 3) school/college performance in relation to teacher retention and leadership profiles. During the course of these analyses, we also considered apparent associations between performance and phase, location of provision and socio-economic status.

The ***inquiry stage*** was designed to dig down into the patterns of association identified during the mapping stage, with the object of generating a better understanding of the dynamics that tie associated factors together and drive variation in performance. A layered approach was adopted, in which a mixture of site visits and telephone interviews (plus garnering of context-specific quantitative data where these were available) was used to build up a set of illustrative case studies from a systematically selected sample of schools and colleges. Both site visits and interviews concentrated on the activity of subject leaders, since the mapping stage had indicated these might have a particularly important influence. The size of sample that could be achieved within the time available meant that stratification was inevitably restricted (see below for detail), but it was possible to set up comparisons across phase, nation, focus of teaching (mathematics or science) and school/college performance level. School and college profiles for socio-economic status (as measured by percentage of students in receipt of free school meals) were also taken into account. We were especially concerned to identify any factors which were associated with performance that was out of step, whether positively or negatively, with the trend for demographically similar schools or colleges, since these would evidently be especially important parameters. The case studies were supplemented by a larger scale online survey of teachers, designed to address issues of perceived school or college performance in relation to national context, socio-economic status of students, teacher qualifications and experience, subject leadership and CPD, as well as canvassing views on the critical factors affecting outcomes.

The methodology employed at each stage is described in detail in the following section, but it is important to note that the synthesis of past research and the analysis of new data both made use of a combination of qualitative and quantitative techniques. We believe that this mixed methods approach used has enabled us to provide the necessary breadth and depth of data analysis for meaningful and valid conclusions to be derived without sacrificing investigative rigour.

Methodology

Mapping stage

The review drew on a wide range of publications and other data, including inspection reports; policy documents based on directly commissioned research and calls for evidence (such as reports to the House of Commons Education Committee); evaluation reports; and research literature. Given the wide variety of potential sources of material, and the fact that much of it consists of a) grey literature with restricted circulation, and b) other resources that are unlikely to surface in response to standard online search procedures, the first stage of the exercise involved extensive consultation with members of the ERG to garner their views on important sources of evidence and to obtain their assistance in retrieving these.

A number of existing syntheses of research on effective teaching in mathematics and science, teacher education, professional development and leadership were identified as part of this process, both from within the UK and internationally. Based on usage within the more authoritative of these syntheses, as determined by international citation and the opinion of ERG members, a variety of search terms were then used to identify more specific mainstream sources of evidence relevant to each of the five core research questions. These additional publications were inspected in order to check the consistency of the points already identified and to obtain illustrations of their relevance to mathematics and science education in the UK context. Since many of these publications (particularly those selected as illustrations) were small-scale qualitative studies or summaries of inspectorate reports, their replicability is uncertain; their value derives from the fact that they do echo wider findings. The search for publications continued iteratively until no new relevant points were identified. In this way, a comprehensive – and coherent – literature set was obtained, though it cannot be claimed to be completely exhaustive; this would be extremely difficult to achieve with any degree of certainty.

The approach taken to synthesising points from across the identified literature was similarly iterative. Where conclusions directly bearing on the core research questions had already been made, these were noted along with their supporting evidence, and built up into a composite mapping relating to each question. This mapping was then augmented by relevant points of evidence identified from other sources, and finally worked up into a coherent text, acknowledging and addressing any apparent conflicts or tensions that had surfaced. The resulting narrative was then reviewed by members of the ERG, revised in the light of their comments, and updated at several points since (see below). The full document is presented in Appendix A and the references cited in Appendix F; the main pertinent points are outlined in Section 6 below.

There are three particular issues noted during the preparation of the mapping document that merit highlighting here:

1) It had been hoped during the planning of the mapping stage that it would be possible to identify existing datasets that might be subjected to further interrogation in order to address the research questions. In the event, the scope for doing this proved extremely limited. With respect to England, the National Pupil Database (NPD) did make it possible to compare school performance in terms of GCSE, AS and A2 results and also percentage progression rates to higher levels of study. However, this depended on a lengthy wait for Department for Education release of school code data. Moreover, the information contained in the NPD cannot be triangulated with any of the workforce census data, so it served no purpose for tracking of school performance (in these restricted terms) in relation to any of the key variables of interest. Ultimately, the main use we made of the NPD data was therefore to identify secondary schools for potential inclusion in the case study sample for the inquiry stage. The Individualised Learner Record (ILR) data, obtained from the Royal Academy of Engineering's STEM Data Project, is similarly restricted, and was used essentially to identify target FE colleges in England. The position in the remaining three countries is worse: no comparable data even exists. One consequence of this paucity was that it left us (perhaps in common with others before us) more reliant on inspectorate data and reporting than we would have cared to be – these are by some margin the most comprehensive resources available, but may contain many inherent biases. The plaint has been made before, not least by the Royal Society, but it bears reiteration: the standard of integrated quantitative data on student and

school/college profiles available across the UK is parlous, and it greatly hampers impartial secondary analysis.

2) The existing literature on workforce and leadership issues in relation to mathematics and science education is very uneven. General analysis of factors affecting school and college performance is fairly common, for instance, and some of this does address workforce and training issues to a reasonable extent. Analysis of leadership factors, especially at subject level is sparse by contrast, and this has some bearing on the weight that can be attached to the conclusions that we have drawn regarding these, although the follow-up inquiry stage built into the design of the research mitigates this.

3) A particular issue for the review itself is the sheer number of new publications relevant to its scope that appeared within the timeframe for the research. Admittedly relatively little of this has materially altered the picture that began to emerge at an earlier point, but the almost daily release of new journal and website links attests to the scale of activity whilst continuing to underline its variable quality. Updating of the review has continued during the period up to preparation of this final report.

Inquiry stage

The inquiry stage was designed to probe the school and college actions which facilitate successful outcomes for students in mathematics and science. A key issue that needed to be resolved before we could progress to data collection was therefore how better and poorer performance should be defined, especially bearing in mind the wider value of mathematics and science skills identified in Section 1 above. Since ultimately we wanted to examine what schools do that helps promote engagement and enthusiasm as well as understanding of mathematics and science, we decided to use multiple criteria. In broad terms, therefore, we sought to identify schools and colleges where students reach high levels of attainment in tests and examinations *and* where high proportions of students are eager and confident in continuing their studies at more advanced levels. We also sought to identify schools which are effective in improving, as well as sustaining, successful practice, especially where they include higher proportions of students from groups that tend to under-achieve at national level, such as those from poor socio-economic circumstances. For the 'poorer-performing' category, we selected schools which are not as good in science and mathematics as might be expected given their general context and profile in other subjects, but are showing signs of improvement which might provide an indication of key factors to be targeted elsewhere. We did not expect to gain much from collecting data from 'poor' schools as such, since the factors leading to general failure would be likely to be dominant to the point of obscuring any more specific considerations with respect to mathematics and science.

Because the literature had indicated that the conditions for good teaching are at least in part secured by good leadership, we sought in particular to identify those things that school and subject leaders do that make a difference. Similarly, in view of issues identified by the review of the literature regarding variations in the quality of teaching and the importance of school leadership for the effectiveness of continuing professional development, we sought to identify those actions that successful school leaders were using to develop and retain their mathematics and science teachers, particularly those without degree-level qualification in the subject taught or an initial teacher education specialism in mathematics or science. Because little is known from the literature about the preparation, development and support for subject leaders in mathematics and science, we also sought to identify those actions that school use to recruit develop and sustain good subject leadership.

The methodology used needed to enable us to gain detailed insight into the features that constitute a good ethos for learning mathematics and science and those things that school and subject leaders do, on a day to day basis, that contribute to this. Since a considerable literature attests to the fact that many aspects of leadership behaviour actually rest on tacit knowledge and ways of doing things that are generally not very amenable to being talked about, this led us to conceive of the layered approach referred to in Section 4, comprising:

1) A limited number of shadowing visits focused on mainstream settings where there was clear evidence of notable performance or else an upturn in science and mathematics grades and progression over the past three years, in order to provide data on explicit and tacit processes that had led to this outcome, which would serve as the basis of more refined research and recommendations for other schools.

2) A larger number of telephone interviews with both better and poorer performing schools and colleges, in order to help us determine how far the explicit structures and processes identified by shadowing extended to other settings that produce good outcomes, and how poorer performers differed from these.

3) A larger scale online survey covering a range of contexts and levels of outcome, with content of questions driven by 1) and 2), in order to ascertain prevalence of productive and unproductive features from both teacher and leadership perspectives, and their quantitative strength of association with outcome.

Procedure

Identification of schools and colleges for the telephone interviews and shadowing visits. It was decided at an early stage to weight the sample towards secondary schools, since this is where the great majority of students will have their most extensive contact with science teaching, where provision in science and mathematics carries most impact in terms of qualifications, and where this impact is therefore easiest to discern. For these reasons, analysis of differences between better and poorer performing schools also focused on this phase. The secondary sample was supplemented by primary schools and FE colleges which were identified in one way or another (including in England the ILR) as being successful.

Because of differences in the information available in the public domain and the role of local authorities in relation to mathematics and science education, strategies for identification of schools or colleges for initial contact differed across the UK nations. School performance tables in England and for secondary schools in Scotland were used to identify schools with a range of performance when judged by examination or test outcomes. Performance tables in both nations provided additional information about the number of pupils in the school, the proportion eligible for free school meals and of the type of school (for example, whether schools were selective grammar schools or denominational schools.)

In England, secondary school performance tables for 2011 provided information about the progress of pupils in both English and mathematics between the end of key stage 2, at age 11, and the end of key stage 4, at age 16, and the progress of disadvantaged pupils may be compared with that of all pupils in the school. Tables also give attainment at GCSE and at A level, over all subjects. The performance tables enabled schools with both high attainment and progress for all pupils to be identified, as well as some with lower attainment but good progress and schools where progress in English differed notably from that in mathematics. For schools with sixth forms, the National Pupil Database was used to identify those with relatively high or low progression to AS and then to A level. Information from school websites was then used to see if performance had been sustained, had risen or had fallen in 2012. The most recent Ofsted report was used to determine if leadership had been judged to be 'good' or 'outstanding'. Schools with leadership that had been judged at the most recent inspection to be either 'satisfactory' or 'inadequate' were not contacted as previous research evidence was convincing in identifying the importance of good leadership for high performance across all subjects. A final stage of the identification process for secondary schools in England was to include 'Lead Teaching Schools[1]' for mathematics. The primary school selected in England was also a lead teaching school.

In Scotland, Northern Ireland and Wales for all phases and for colleges in England, inspectorate reports from the last two years were scanned for information regarding both performance and quality of provision in mathematics and science. In England, this information was supplemented by data from the Royal Academy of Engineering STEM data project (2011). In the other UK nations, local authority advisors provided further suggestions of schools with good and/or improving practice in mathematics and science. This was particularly helpful in identifying schools for visits in Scotland. Contact continued to be made directly with additional schools and colleges in order to ensure that a range of school types was included in the interview/shadowing stage. Although performance in external examinations varied widely, all of the schools and colleges approached were either sustaining high examination performance or improving and, in this sense, might be classed as successful.

Telephone interviews. A total of 42 schools and colleges were identified, and asked by e-mail if they would be willing to participate in semi-structured telephone interviews involving subject leaders of mathematics and/or science. From these, a total of 25 interviews were conducted during the period September to December 2012, broken down as follows:

- 3 primary schools, 1 in England and 2 in Scotland
- 12 secondary schools, 7 in England, 3 in Scotland, 1 in Wales and 1 in Northern Ireland
- 9 FE colleges, 3 in England, 5 in Scotland and 1 in Wales
- 1 English Trust Group (including FE, Secondary and Primary schools)

[1] Lead teaching schools are 'lead' in relation to 'Teaching School Alliances', established by the National College as research and development networks around three themes of pedagogy, CPD and leadership of learning networks. Each alliance further refines the theme to provide an area of focus http://www.nationalcollege.org.uk/index/resources/leadingschools/national-research-and-development-network/research-and-development-network-themes.htm

Consistency in questioning and in interpretation was secured by the use of one senior researcher with expertise in the secondary school and college sector for all but one of the telephone interviews relating to these, and by the use of another senior researcher for the telephone interviews with primary schools. The initial interview schedule (cf. Appendix C for content) was modified slightly to ensure that time was allowed in later interviews for those questions which were found to be most fruitful in providing data for our research questions. Interviews were audio-recorded for subsequent analysis.

Shadowing visits. During the telephone interviews, respondents were asked if they would be willing to host a visit to their school. A sub-set of suitable and willing schools in England and in Scotland was selected for visits. Evidence from the visits, the preceding telephone interview and inspection of documentary evidence about the school, such as inspection reports and the school website, informed 9 case studies, as follows:

- 1 better-performing primary school in England
- 1 better-performing secondary school in England
- 2 poorer-performing secondary schools in England
- 1 Trust group in England comprising 1 primary school, 3 secondary schools, 1 14-19 skills centre and 1 FE college
- 2 better-performing primary schools in Scotland
- 1 better-performing secondary school in Scotland
- 1 poorer-performing secondary school in Scotland

Visits to FE colleges per se were not conducted, as their diffuse structure meant meaningful shadowing was not feasible. In secondary schools, the visits were conducted by one of two senior research officers with experience and expertise in the secondary school sector. These were different officers from the telephone interviewers for the schools visited. The primary school visits and telephone interviews were all conducted by a senior researcher with experience and expertise in the primary sector.

The selected method for the visits was loosely based on a shadowing method described by Earley (2012) and used in a study for the National College on newly appointed head teachers (Earley and Budd (2012)). The original design consisted of a shadowing exercise of the subject leader, supported by semi-structured, reflective interviews before and at the end of the visit. This model was adapted, so that as well as providing information about the subject leader's relationships and observed activities in relation to the leadership role, there were also opportunities to talk to subject teachers, a senior leader and to observe some teaching. Data was gathered in field note form, using common pro-formas.

Online survey. Insights from the literature review, the interviews and the case studies were used to formulate an online survey consisting of 28 questions, designed to provide information about the relevance of issues identified at earlier stages to teachers in a wider range of schools. The questions addressed respondents' job titles, the subjects they taught, their degree and ITE qualifications, influences on their decision to become a teacher, and the time they had spent in teaching; the type of school or college they taught in, where it was located, and the percentage of students in their school receiving free school meals; their ratings of mathematics and science teaching in their school, and their ratings of the respective subject leaders; their perception of and contact with CPD, and the type of CPD they regarded as most effective; and the factors they perceived as impacting most on quality of provision in mathematics and science. The full set of questions and response options is presented in Appendix D.

Once compiled, the online survey was made accessible using a link provided by Survey Gizmo, which was promulgated across a variety of networks, including:

- the Science Learning Centres network
- the Nuffield Foundation
- the Association of Science Education
- the National Centre for Excellence in the Teaching of Mathematics
- the Advanced Skills Teachers National Network, hosted by the National College for School Leadership
- The Royal Academy of Engineering's network of schools
- Schools in partnership with IOE in PGCE and Teach First provision in science and mathematics
- An individual list of mathematics educationalists

The survey link was initially live between 6th and 27th November 2012 and attracted 414 responses during this time. However, only one response each was identifiably from a teacher in Wales and Northern Ireland (see the earlier point about participation from these countries in the interviews). As a result, a further Wales-specific network was identified, and the survey was re-opened to these respondents between 30th November and 6th December 2012. The final figures were a total of 430 responses, 332 from England, 64 from Scotland, 15 from Wales, 1 from Northern Ireland and 18 unidentified. Of these, 42 respondents (10%) reported themselves as working in the primary sector, 355 (84.5%) in the secondary sector, and 23 (5.5%) in FE colleges. Teachers (190) and advanced skills teachers (21) made up more than half of the sample (54%), subject leads (121) nearly a third (30.9%), and senior managers and HE staff the remainder (52, 13.3%). The sample was more or less evenly split between those teaching mathematics (200, 46.4%) and science (218, 53.1%). There were no marked national differences in the characteristics of respondents.

The reasons for the apparent lack of engagement among teachers in Northern Ireland and to a lesser extent Wales are not entirely clear. One possibility is that the emergence of new national structures has created a sense of detachment from wider UK issues, without (unlike Scotland) these having bedded down sufficiently to lead to confident responding with respect to those structures. However, it must be acknowledged that it may simply be that we failed to identify the appropriate networks to promulgate the survey. It should also be noted that few differences were discernible between English and Scottish teachers at any level in the factors they considered promoted good performance, so it may be the case that even if greater numbers of respondents had been obtained within Wales and Northern Ireland this would have had little material impact on our conclusions.

Ethics. The research raised potential ethical issues relating to the sensitivity of information obtained and to anonymity/confidentiality. With regard to the first, participating staff were likely to be sensitive to their school or college being explicitly labelled as underperforming, and this term was therefore avoided during recruitment. The emphasis was instead on selection being driven by an interest in sampling schools and colleges that exhibit a range of outcomes in science and mathematics according to publicly accessible data. A further potential issue of sensitivity related to the possibility that negative statements might be made about other staff during data collection. The content of such statements was likely to have material bearing on the focus of the research, and it was decided that they would therefore not be expunged. However, care has been taken to ensure that any reporting that uses this content has suitably anonymised. As far as wider issues of anonymity and confidentiality are concerned, reporting of the case study data, interview responses, survey responses and focus group content has all been anonymised. Data from the present research which could be tied to detail in publicly available reports have been maintained primarily in electronic form on password protected servers only accessible to members of the project team. Any paper-based data records are kept in locked filing cabinets in locked rooms, and accessed solely for the purposes of analysis. Records will be retained for the duration of the Royal Society's Vision Project, since later phases may need to make further use of them, but will be destroyed at the end of the Project. Informed consent has been obtained from all participants in the shadowing, interview and survey elements of the research. The processes outlined above received ethical approval from the Faculty of Policy and Society Research Ethics Committee at the Institute of Education prior to the commencement of the research.

Data analysis. The approach taken to analysis of data from the shadowing cases studies and the interviews was similar to that adopted for the synthesis of points from the literature review. First of all, the audio records of telephone interviews were used to build up notes of the main points of content in a format similar to that used for the field notes generated by the shadowing visits. The fuller case study and interview data records were essentially the same in nature, therefore, albeit different in scale. Once these records had been compiled, points relating to each of the core research questions were identified, and built up into a composite mapping of recurrent themes and relevant evidence bearing on these. As with the literature review, this mapping was worked up into a coherent text, noting points of tension and correspondence with past research reports. The resulting narratives were then reviewed and revised accordingly, firstly by other members of the research team, checking back against the case study and interview records for both accuracy and completeness; and then by members of the ERG, checking for coherence and interconnection of points. As with the literature review, the main points that emerged are outlined in Section 6 below. The case study and interview records are presented in Appendix C to enable readers to check further the basis for the claims made.

Analysis of the survey data employed quantitative techniques. Since virtually all questions had fixed response options, the primary focus was on the relative frequency with which these had been chosen, and this information was extractable directly from the Survey Gizmo resource into spreadsheet format. Once in this format, the data were then used to check for associations between patterns of response to the substantive questions about performance and reported demographic/school leadership characteristics or CPD experience. Where free text responses were available, principally in relation to job titles and perceived factors that affected quality of provision, these were categorised according to simple coding schemes and treated in the same fashion. The raw response frequencies are presented in Appendix B.

Results

For the sake of clarity and brevity of reporting, the sections below present a digest of the main points which emerged in relation to each of the five core research questions from the mapping stage, the shadowing visits, the telephone interviews and the online survey. The full mapping report (including referencing), the summarised visit and interview notes and the survey response data are available for inspection in Appendices A, D and F respectively.

Factors associated with better and poorer performance in science and mathematics education

Good teaching

There is high consensus, among researchers, policy makers and practitioners about the importance of good teaching and good teachers (see Appendix A, Section 3.1). One SLT member interviewed said 'Schools should love their teachers'. There is similarly high consensus about the characteristics of good teaching which apply to all subjects and about those which are specific to mathematics and to science. There is agreement in the literature that good teaching in general is adapted to the context of the school, with teachers selecting from a range of strategies to meet the best needs of a particular group of pupils. There is a calm, well-disciplined, orderly environment, an ethos of aspiration and achievement for all, a positive emotional climate, and purposeful, stimulating activity. There is also a focus on promoting engagement and enthusiasm for the subject, as well as high examination performance. This could be summed up in a phrase often used in interviews, that teachers should 'go the extra mile'. In terms of subject-specific characteristics, in science the literature emphasises the importance of pupils learning to do science as well as learning about science, helping them to recognise that science theories are tested against evidence that has been systematically collected. The availability of opportunities for inquiry, in which students formulate and test their own ideas, and of resources to support practical work are both seen as central. In mathematics, skilful teaching enables learners to develop both procedural and conceptual understanding by providing them with opportunities to use their mathematics in meaningful contexts and to make links to other concepts. Learners are given sufficient time to develop understanding and confidence in their own abilities to do mathematics, and misconceptions are treated as a subject for discussion, promotion of reasoning and problem solving over 'answer getting'.

Data from telephone interviews also showed that, in successful schools, high performance was defined not only in terms of attainment in external tests but also in terms of inquiry, problem solving and transferable skills, participation after school leaving age, pupil/student engagement, enjoyment and passion for the subject. Good results in external tests and examinations were important to these schools, but this was refined to mean individual pupils/students achieving at or above their potential. There was frequent mention of the need to get them into the correct course, and the importance of having the right choice of courses to promote attainment across the board, not just at the higher level, encouraging all who want to, to progress. Some schools made use of mentors for under-achievers in order to support this goal.

School visits showed that there was a high degree of consistency in responses from subject teachers, subject leaders and school/college leaders in relation to their understanding of 'high performance', indicating coherence in the vision for mathematics and science learning at all levels in the school. Trust, respect and a high quality of relationships in relation to pupils/students were particularly noticeable during visits to successful schools. Teachers demonstrated respect for their pupils in the way in which they attended to pupils' thinking during the lessons observed. Mistakes were accepted as a necessary part of learning, by both teachers and pupils/students, and used as an opportunity to provide useful feedback, to explore misconceptions and to build understanding (Swan, (2006)). This was evident for all pupils, irrespective of their attainment. The use of feedback from the pupils/students about what helps them learn was frequently mentioned in interviews and visits, for example the regular use of pupil surveys at a secondary school in Scotland.

Considerable importance was also attached to team work as underpinning good teaching, and the need to build stable, cohesive, energetic and enthusiastic teams with shared values and vision. Regular meetings with good two-way communication, and the use of peer observation systems and shadowing for NQTs made it possible to share innovation and exchange information, creating a climate of respect and support not fear, especially fear of failure. Where this was in place for staff, it tended to flow on naturally to the treatment of pupils.

As in the research literature, interviewees often touched on the value of being able to implement a wide variety of approaches to teaching, adapted to context, with light touch planning and a measure of autonomy over delivery. Here too there was an emphasis on promoting transferable investigative, problem-solving and higher-order thinking skills in both maths and science, with children being able to take risks in the sense of exercising creativity in devising experiments. For older students in particular, this involved placing them in a position of responsibility with respect to development of their own skills.

The importance of good teaching and agreement about its features was noticeable in responses to the survey question 'What factors do you think are most important in effective maths or science teaching?', where good relationships with pupils was selected by 89% (n = 352). For the question, 'Finally, what single change do you think would improve maths and/or science teaching in your school/college?, the terms 'enthusiasm', 'enthusiastic', 'passion' and 'passionate' featured frequently in responses. An 'engaging curriculum that relates to its realistic uses in society/life', and 'follow children's interests' are representative of comments related to pupil engagement. Other representative suggestions indicating a shared understanding among the profession of the features of good mathematics and science teaching were 'too much of the science is knowledge/fact based and not about the process of science', 'developing their (the students) thinking and questioning strategies', 'the importance in maths of solving problems', 'making pupils independent learners', and 'teaching for understanding and enjoyment'.

This final question was revealing in suggesting why teachers believe that teaching is not always good, and perhaps what is intended by the point 'giving teachers freedom and the time to act as professionals and do the job they have been trained to do'. The largest category of responses to this question mentioned time or other resources. 'More time to plan and deliver good lessons and formative assessment' and 'having more time to properly prepare and plan lessons' were comments representative of those in relation to workload barriers. 'More funding for equipment', 'use of technology – we cannot afford anything current' suggest a lack of physical resources for teaching as does 'more specialist rooms'. Curriculum constraints to good teaching were frequently mentioned, with examples such as 'moving away from a content-driven curriculum with overly prescriptive behavioural objectives, to a concepts and skills driven. A more integrated curriculum (such as IB MYP) where concepts are taught and life-long skills are developed, associated strongly with cross-curricular planning, is much more relevant to today's children where so much about the future is uncertain'. External accountability and testing were also frequently mentioned with, as examples, 'less pressure through league tables, less government and Ofsted intervention', 'Get rid of 5 A to C including maths. We teach with the exam in mind a lot of the time rather than understanding'. Several comments here also identified issues related to externally driven changes, such as 'A bit of stability in terms of curriculum and assessment. Constant changes (e.g. to GCSEs) … is the biggest problem in school science at the moment'.

Survey answers suggested that some teachers may hold simplistic beliefs that some factors are important for good teaching in mathematics and science despite the more complex picture presented by research evidence. 'Smaller class sizes' was mentioned by several respondents as the single factor that would improve mathematics and/or science teaching, as was use of setting, whereas research indicates that the benefits are primarily restricted to young pupils. These comments were not supported by the interview data, however, and though a variety of setting practices were reported, these were not obviously linked to outcomes.

Despite the concerns expressed, respondents to the survey were positive about mathematics and science teaching in their schools. When asked 'How would you personally rate the teaching of maths in your school/college?, 85% (n = 346) thought that teaching was good or excellent. For the question 'How would you personally rate the teaching of science in your school/college', 85% (n = 324) thought that this was good or excellent.

Planning for progression

The importance of teaching that builds on secure prior knowledge and understanding is recognised in the research literature. In particular, issues of progress at transition when students move from class to class, from school to school and from one level of study to another (such as from primary to secondary or from GCSE to A level) are identified sources of concern. Transition points require planning and communication between teaching staff if progress in learning is to be maintained, and lack of teacher knowledge about the curriculum in other phases may be a major barrier.

Telephone interviews and visits provided examples of highly effective communication and collaboration at transition points in many of the successful schools and colleges. Contact between primary and secondary science teachers, and between secondary schools and colleges was widespread, and included peer visits to other schools, joint science fairs, taster sessions for pupils/students and staff exchange for the teaching of lessons One FE college has a dedicated team for transition. College staff meet regularly with about nine feeder schools and college staff attend school events. Subject days allow for an interchange of students and staff during the summer term. Another FE college uses subject taster days and a 'girls only' science day. All of the schools in Scotland and some of the schools in England were part of a cluster group of schools, which met regularly. These schools reported that the good relationships and communication within the cluster supported good transition. However, some schools in England were constrained by the number of schools involved. For example, pupils from a primary school in England attend ten different secondary schools and one of the English secondary schools takes pupils from approximately 30 feeder primary schools. This makes liaison and transition difficult. Liaison is also difficult when the secondary school is not one that most pupils will want to go on to. One interviewee suggested that the issue was in trusting the data coming from the primary school. If that trust existed then there was no need for the re-assessing which causes such discontinuity on transition.

All schools and colleges interviewed used data to track the progress of their pupils/students throughout their time at the institution. Many organisations could be aware within days of a student failing to attend lessons, not doing homework or failing to meet targets in an assessment. Rapid intervention was seen as a key strategy in preventing students from falling behind. After school clubs and extra support lessons were the strategies for intervention most commonly reported. One FE College in Scotland provides thirty-minute slots for one-to-one support, which may be booked by students. These are very popular and used by students from all programmes of study.

Secondary school teachers were asked in interviews and visits about what, in their view, is most important in encouraging voluntary study of mathematics and science post-16. Enjoying the subject, achieving well and the good reputation of the department were frequently mentioned. One of the secondary schools in England uses early entry for GCSE in Year 10 and an early start on A level content in Year 11 so that students are 'ahead of the game when they join Year 12'. It should be noted that the pupils in this school were high achievers, however, most of whom would be going on to do Mathematics AS level, and this was seen as an opportunity to get them off the exam treadmill with no stress. The applicability of this approach elsewhere might therefore be limited. The subject leader in another English secondary school serving an area of high disadvantage works hard to encourage students to stay with science, through small group talks, one-to-one conversations, an emphasis on employment opportunities for scientists and talks from external speakers.

The survey also asked the question 'What factors encourage pupils to study maths/science at a higher level after GCSE, Standard or equivalent level? Answers were consistent with comments made in interviews, with enthusiastic teachers (who may be inferred to promote enjoyment) and success in age- 16 examinations each being cited by more than 80% (n = 339) of respondents.

The mismatch between expectations in qualifications pre- and post- 16 was mentioned in interviews as a barrier to progression at this transition point. Two secondary schools visited, one in England and one in Scotland, reported increased staying on rates as one of their measures of success in relation to mathematics. However, the courses available at Higher or A level were too demanding for some students who had been enthused by their experiences of learning the subject pre-16, and 'they are not really up to it'. More rarely, some colleges were ready to accept any students at any level, having an ethos of never putting up barriers to learning. Students with Grade C in mathematics were accepted by some organisations for AS and (conditionally) A2, but staff would be constantly monitoring their progress and be ready to offer alternatives if necessary.

Guidance was provided by subject teachers so that some students chose alternative courses. In the English school, some pupils changed to other A level subjects when they realised at an early stage how demanding the mathematics course would be. The senior leader interviewed at this English school, a mathematics subject specialist, believes that preparation and revision for the GCSE examination means that higher-ability students spend time on 'revising things they can do' rather than in building firm foundations and confidence with the algebra required for A level success. A questionnaire respondent similarly noted 'current A level specs seem to assume knowledge that students do not have from GCSE, hence overload'. In another Scottish school interviewed, the subject leader reassesses the progress of students half- way through the first year of the Higher course and may advise what are termed 'moderate' students to do the course over two years rather than one. A Scottish college believes that 'getting them [students] on the right level of course' is very important. In an attempt to get ahead of the requirements arising from the Wolf Review of Vocational Education[2], two English colleges have a policy that all students do Functional Mathematics if they do not have at least a Grade C GCSE. However, in one of these colleges, the subject leader believes that level 2 is too high a hurdle for many on vocational programmes, such as hairdressing. This teacher commented that 'employers have been taught the mantra of the need for five GCSEs A* to C even when the work they are offering does not demand that level'. In Scotland, catering appropriately for students who have not attained a GCSE grade C equivalent was not raised as an issue. It was believed by the subject leader in one Scottish college that this is because there is no demand for mathematics or English at a set grade, with thresholds being more complex and nuanced. Lower achievers work on the SL4 Foundation programmes, which are more geared to work skills than parallel English programmes.

Some science subject leaders had introduced a wider range of courses post- 16 to provide a progression route for a wider range of students. For example, at one secondary school in England, where many of the highest attaining pupils leave for other institutions at age 16, a level 3 BTEC in Science or Forensic Science has been successful.

In response to the last question in the survey, 'Finally, what single change do you think would improve maths and/or science teaching in your school/college?, a few secondary teachers mentioned issues for primary education here, for example 'more rigorous approach to the basics in primary'. What cannot be determined from the survey is whether these comments are based on firm evidence or if they are a consequence of lack of awareness of what, and how, mathematics and science are taught in primary schools, as was noted in the Northern Ireland inspectorate report discussed in the literature review.

[2] https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-00031-2011

Staff qualifications and deployment
The Royal Society 2007 State of the Nation report, The UK's science and mathematics teaching workforce, drew on detailed research on staff deployment in England. More recent detailed and comprehensive data have not been identified. However, evidence from School Census data in England suggests that teachers in mathematics and science subjects, physics especially, do not all have degree- level qualifications in the subject taught, and our interviews supported this finding. Ofsted evidence further suggests that the least qualified teachers continue to be deployed to teach lower sets. This was not something we found in the schools interviewed, though there was a tendency to restrict teachers with lesser qualifications to the lower school within secondaries. There was general agreement from interviewees however that successful mathematics and science teachers have both good subject knowledge and good teaching skills.

FE Colleges often have distinct teaching staff for 'mathematics' and 'numeracy', but the major differential here is on teaching style and pedagogy rather than teacher skills or qualification.

In Scotland, secondary teachers at the higher levels are required to hold degrees in their subject, so a teacher with a physics degree would not be able to teach mathematics. This is not the case in Scottish FE Colleges, however, where experience in industry appeared to be more important than academic qualification.

There is limited evidence about the deployment and impact of support staff in either mathematics or science, though trained technician support is considered to be essential in enabling students in secondary schools and colleges to undertake practical work. There are also advocates of the use of specialist secondary mathematics and science Higher Level Teaching Assistants, provided these too receive appropriate training.

The sample size for interviews and visits was insufficient to provide additional evidence in relation to this factor. Interviews with science subject leaders showed that, in their schools, technicians were considered an integral part of the subject team with a similar entitlement to appraisal and continuing professional development. One school also mentioned the value of graduate coaches – university graduates or postgraduate students with an interest in supporting pupils' learning – though they noted that the availability of these was to some extent a function of the current lack of other employment. Staff retention and the stability of teaching teams was also mentioned as a crucial means of ensuring consistency of teaching.

Careers education and the image of science and mathematics
There is evidence from the literature to suggest that careers education and enrichment activities can contribute to enthusiasm for mathematics and science and for continued study of the subject. Case-control comparison shows that schools that are more successful in encouraging pupils to study physics and/or chemistry post-16 have: careers advice including extra-curricular careers- related activity; well-organised work experience; extra-curricular careers promotion such as visits to local industry and universities; opportunities to take Nuffield scholarships; participation in science weeks; and careers days with external speakers. Recent increases in A-level participation are argued to be at least partly due to

greater awareness of the lifetime economic benefits of qualifications in mathematics. In general, though, evaluations have tended to consider the impact of isolated short-term interventions, rather than assessing their benefits as part of an overall strategy to raise performance in mathematics and science.

Successful schools interviewed often reported the use of enrichment opportunities such as field trips, cross – curricula STEM clubs, participation in competitions such as the UK Team Maths Challenge and visits from external speakers, including university graduates who had previously attended the school. A secondary school in England reported a partnership with a local pharmaceutical company which provided twenty work placements in 2011-12. A secondary school in Scotland, through the Engineering Development Trust, is able to offer opportunities for physics students to go to local companies to do design or other realistic projects for business. The importance of STEM activity in the schools as a whole was evident in two secondary schools visited, one in England and one in Scotland. Display work around the school showed pupils engaged in enrichment activities. For example, in the English school this included photographs from a 'Mathalympics' with partner primary schools that had taken place in the preceding term. The display work for mathematics and science in this exemplar school reinforced a vision of the importance and relevance of these subject disciplines both within the school curriculum and outside and beyond the school context.

The survey findings were consistent with the literature and with interview data about the importance of enrichment and careers activities. 60% of respondents (n = 339) believe that a focus on career opportunities in maths/science is a factor in encouraging pupils to study mathematics and science at a higher level, 22% that extra- curricular activities in maths/science is a factor and 20% that science or maths in the media is a factor.

Summary of key factors associated with performance

- Good teaching. There is general consensus on the importance of good teaching; on the characteristics of good teaching which apply to all subjects; and on those that are specific to mathematics and to science. Crucial features include:
    - an ethos of aspiration and emphasis on attainment and engagement across the board, not just at the higher levels
    - the freedom, time and resources to tailor teaching approaches to context
    - getting pupils into the right course, setting individual goals and supporting them to achieve these
    - pushing everyone to achieve their maximum
    - enthusiastic staff prepared to go the extra mile, who have good relationships with pupils/students
    - staff being part of stable, cohesive teams with shared values and vision
    - a general climate of respect and support, promoting reflective practices and avoiding a blame culture
    - an emphasis on transferable investigative, problem-solving and higher-order thinking skills in both mathematics and science
- Planning for progression. There is also consensus on the importance of teaching that builds in planned fashion on secure prior knowledge and understanding, especially at points of transition from class to class, from school to school and from one level of study to another. Key features here include:

- effective transition arrangements, involving collaboration both between schools and between levels within schools to prevent dips in performance
- tracking of progress and early identification and intervention for support needs
- providing an appropriate range of courses where possible

- Staff qualifications and deployment. There was less systematic data on how far subject-specific qualifications are critical (see further below), but clear importance was attached to the availability of suitably trained support staff.
- Careers education and the image of science and mathematics. There is clear evidence that careers education and enrichment activities contribute to both enthusiasm for mathematics and science and for continued study of the subject.

Contribution to outcome made by the characteristics of teaching staff, especially their CPD experience

Initial Teacher Education, recruitment and retention

Recent evidence from the literature suggests the specific ITE route that has been followed may make little difference to the quality of teachers (see Appendix A, Section 3.2). For instance, Newly Qualified Teacher (NQT) survey reports show satisfaction ratings at their highest level ever in nearly all categories for teachers completing training in 2010, including in preparation for teaching their subject. Satisfaction with preparation for teaching mathematics in primary schools is notably high. Any differences between training routes which may be evident at the entry into the profession appear to be eliminated within five years of qualifying.

In contrast, retention is an issue. Evidence from the literature shows that approximately 30% of teacher trainees in mathematics and science subjects do not take up a teaching post in the year following their training. Although there is further loss in the early years of teaching, there are no apparent differences in the reasons, or proportions, of mathematics and science teachers when compared to other subject areas. The school-based induction and support provided in the early stages of a teacher's career appear to make a difference to the likelihood that the teacher will stay in the profession once trained. Previous research suggests that mentoring programmes are cost-effective and successful, both in terms of improving the confidence and skills of trainees. However, the induction year often fails to build reflective pedagogy, focusing instead on practical issues such as behaviour management. Induction tutors do not typically use the opportunity to encourage reflection on teaching and learning and see their role as helping mentees to settle in to school routines, which is only part of what they need.

Neither interviewees nor survey respondents made any specific reference to the importance of initial training, confirming the overall picture that this is not a critical concern at this point in time. However, recruitment of suitable staff was identified as difficult in English secondary schools and colleges and in Scottish colleges. English organisations found recruiting Physics teachers particularly difficult. Many of the secondary schools and colleges interviewed preferred 'home grown' teachers, trained within or with the support of the institution, particularly in challenging school environments. Trainees who have adapted to the challenge of turning round a failing school are more likely to stay with that school and to respond to the inevitable challenges. Several emphasised the importance of 'getting the right person to fit the team'. There was also evidence supporting the effective use of TeachFirst as means of driving an agenda of change in a struggling school. In the independent school interviewed, they preferred to recruit teachers with very high subject qualifications who had not attended teacher training, so that they could set their own high expectations of what these teachers would contribute to the subject department. In the Scottish and English primary schools visited, there was a preference for recruiting newly qualified teachers so that they could be 'moulded' to fit the team.

Some of the teachers interviewed at school visits mentioned exposure to work in schools, either as a voluntary opportunity during their degree course or when in employment, as a key factor in influencing their decision to undertake teacher training. The survey question Were any of the following influential in your decision to become a teacher of mathematics and/or science?' showed that 26% (n = 396) of respondents had been influenced in this way.

Subject knowledge

Although it is agreed in the literature that subject knowledge is important, the distinctions and relationships between domain subject knowledge, pedagogic knowledge and pedagogic content knowledge are blurred. However, there is consensus that teachers need a deep understanding of key concepts and the skills to teach these for understanding. They also need to have sufficient depth of knowledge to understand the significance of fundamental concepts and where these will lead at later stages of study. Evidence suggests that subject qualifications alone are not necessarily sufficient to ensure teachers have all the required subject knowledge and understanding, and that CPD in subject knowledge is needed, whether or not teachers have relevant subject qualifications.

In Scotland, secondary teachers must have a degree in the subject they teach, although this is not necessary for employment in colleges. Subject teams in successful secondary schools in England and in colleges reported in interviews that a majority of staff had degree-level expertise, though the extent of this was variable. Deficiencies in subject knowledge did not appear to be an issue in practice reported in interviews and seen during visits, though, and good collaborative working and professional development opportunities allowed for individualised learning to improve subject knowledge where necessary. Interviews confirmed that subject knowledge at recruitment stage was important to successful schools, but that its complex nature was recognised. Thus, the subject leader in a secondary school in England said that first class science and mathematics teachers 'need to have absolute mastery of the subject and know how to relate to pupils'. However, a secondary school subject leader in England said, in relation recruiting the right person for the team, 'I can teach (new teachers) the maths but I can't turn a non- teacher into a teacher'.

Subject knowledge was not seen simply as an issue for recruitment. Improving domain knowledge is an integral part of the way of working in successful schools and is tailored to the needs of individuals. Audit is used in the science department of one English secondary school and staff have attended a Science Learning Centre course for non-specialist physics teachers. Self-study is also used. For example, in a Scottish secondary school, a teacher was preparing herself for teaching a course at Higher level in the following year and, in an English secondary school, a mathematics teacher trainee with a first degree in economics was working with an NQT to improve her mathematics. The self-evaluation tool developed by the NCETM to assess one's own mathematical content knowledge and mathematical pedagogical content knowledge, and receive guidance on how to move forward has had over 25,000 users.

In England, all primary school entrants are required to have at least a grade C in GCSE mathematics, and there is now a requirement for all new entrants to pass a numeracy test before they gain QTS. In Scotland primary school teachers must have Standard Grade Maths at a 1 or 2 (or equivalent) while in both Northern Ireland and Wales primary school teachers are required to have a grade C in Science GCSE as well as Mathematics. There is a continuing debate in England as to whether these requirements are sufficient to ensure teachers have enough knowledge and understanding to start pupils mathematics education at a sufficiently high level.

Primary schools in Scotland reported on a new scheme for the appointment of mathematics and science 'champions'. One newly-appointed science champion was interviewed during a school visit. She had recently returned from a 'very good and useful' three-day residential course, which had given her 'lots of ideas and resources' as well as covering coaching and mentoring. Through the scheme she has a budget of £4,000 to spend on resources before June 2013. The primary school visited in England uses 'lesson study' as a very successful means of improving subject pedagogy. This approach was introduced to the school following participation by the subject leader in a project with the NCETM. Three teachers work together and meet, first of all, to decide a focus. This is usually decided by the teachers themselves, but sometimes a focus is suggested by the subject leader. An example of a focus is 'better use of mathematical language'. A lesson is then planned and taught by one of the teachers and observed by the other two. The three teachers then meet again and reflect together on what went well and what might be improved. The same, or a different teacher, then teaches to the improved plan and this is again observed by the other two teachers in the triad and followed by a meeting for reflection and evaluation. In the view of the subject leader, this is extremely valuable and has been effective in helping teachers see, not only how important it is to teach for understanding, but also how this can be achieved.' The cycle is repeated annually.

Although several of the schools interviewed mentioned newly qualified teachers as part of their subject teams, it was apparent that their needs were considered as part of the development of the team as a whole, through ongoing informal as well as formal monitoring and observation, and recognition that they needed good support. An example of the way in which support for early career development was provided was seen during a secondary school visit in Scotland. A teacher in her third year of teaching had been recruited to the school from a local authority 'pool', following an induction year in another school in the same authority (all teachers trained in Scotland are guaranteed employment for an induction year). She shared her CPD portfolio, which all Scottish teachers are required to maintain, which showed how individualised targets set during appraisal were met through tailored development opportunities, which were varied to include activities such as peer observation, development of resources for use by the whole team, participation in a school-wide ICT group as well as attendance at internal and external courses. This teacher remarked that she 'just loved teaching'.

The complex relationship between subject knowledge, pedagogical knowledge and approaches to teaching also emerged in survey responses to the question ‘What factors do you think are most important in effective maths or science teaching’, 94% (n = 352) noted enthusiastic teachers and 63% well-qualified teachers. Responses to the question ‘Finally, what single change do you think would improve maths and/or science teaching in your school/college’ included ‘ability to recruit and retain subject specialists who have chosen teaching as a career because they care about their subject and want pupils to study it’, and a need for ‘teachers that are passionate in these areas and that are skilled’. ‘Subject knowledge’ was mentioned in responses, but these did not specify if the respondents saw this as a recruitment or as a development issue. Only one of the survey responses to this question identified initial teacher education as the single change needed, and even here the focus reflected the same essential mix: ‘ensuring that new teachers coming into the profession are extremely enthusiastic and have exceptional confidence in their behaviour management strategies regardless of their degree classification’.

Continuing Professional Development (CPD)

There is a high degree of consensus in the literature of the ongoing need for high quality CPD for teachers of mathematics and science at all stages of their career. CPD is necessary for keeping all good teachers up-to-date with developments in their subject area and with research evidence on teaching and learning. The importance of mathematics-specific pedagogical knowledge for teaching for the understanding of underpinning concepts in mathematics appears to be at least as important as qualification within the discipline. CPD is also essential for improving the quality of teaching for those who lack the skills and subject expertise to ensure that their students have the best opportunity to learn. This may be particularly important for those responsible for teaching lower sets, who are least likely to be specialists, so unlikely to have received initial training on relevant pedagogy. A one-year course of teacher training provided by a PGCE secondary science course should, in any case, be seen merely as a starting point in a long journey of acquiring the necessary subject knowledge and subject-specific pedagogy. CPD which begins in the induction year and continues through the early years of teaching is essential for confident and skilled teaching of science. Similar points have been made for mathematics. CPD has been identified as being more efficient in improving the quality of teaching than investing further in initial teacher training.

There is similarly agreement about the features of high quality CPD that are effective in improving the quality of teaching. Effective CPD is characterised by some key contextual features: providing sufficient time for extended opportunities to learn and using the time effectively; engaging external expertise; focusing on engaging teachers in the learning process rather than being concerned about whether they volunteered or not; challenging problematic discourses; providing opportunities to interact in a community of professionals; ensuring content was consistent with wider policy trends; and, in school-based initiatives, having leaders actively leading the professional learning opportunities. CPD that integrates theory and practice, builds links between teaching and learning, utilises a variety of content, and where understandings are discussed and negotiated produces better outcomes. Effective professional development is strongly enhanced through collaborative learning and joint practice development, and by creating professional learning communities within and between schools – there is a strong consensus on the importance of this. Effective CPD in general focuses on pupil outcomes and learner needs, and needs the support of leaders. In mathematics and science, strong effects of professional development on practice are found where it recognises the teacher's context , is sustained over time, is focused on how to teach specific kinds of content, how to use specific pedagogical skills and on analysis of learning, including conceptual understanding and skills. Involvement in research as part of CPD in science has also been demonstrated to be effective. Teachers are highly engaged by action research approaches and have been found to become more reflective about their teaching strategies.

The work of the National and Regional SLCs and, in England, the NCETM, in supporting subject-specific CPD through the variety of approaches which evidence shows to be effective, is recognised as valuable. Ofsted have referred favourably to the work of the Science Learning Centres in the provision of high-quality external training and on its impact on teaching practices and pupils' learning in the schools visited, although it noted that this provision was not sufficiently used by primary schools. Science Learning Centres are also increasingly providing CPD within schools, tailored to their needs. Awareness of and usage of the National and the regional centres have grown steadily, although primary schools lag behind secondary and further education sectors in both awareness and usage. Science CPD provided in primary schools is not sufficient to improve teachers' confidence or understanding, but primary teachers benefit from collaborative approaches to planning. There is a weak positive association between SLC usage and improvement in science attainment. Linked SLC usage and school performance data suggests that SLC-using schools have been improving their science attainment faster than the national average, and faster than wider attainment in the school. For mathematics, NCETM has provided funding to support 'projects'. Teacher Enquiry Projects support development at school level, Mathematics Knowledge Networks bring together teachers from different schools and colleges and Regional Projects encourage regional networks. This type of CPD was found to have the greatest impact on pupils, though many teachers found it difficult to identify impact. Teachers identified practical, stimulating activities; opportunities to network; a focus on mathematics and support for reflection and the change process as features of effective CPD.

Support within the school, provided through good leadership and considered further in the next section, is essential for ensuring that CPD is available and matched to teachers' needs, that learning is shared among colleagues and that impact on teaching is monitored. Evidence suggests that individual factors of identity and confidence, or of resistance to change, affect the level to which CPD affects change in teacher behaviour and it may be concluded that such issues also need to be addressed within the school. The impact of Chartered Teachers in Scotland and Advanced Skills Teachers in England has not been determined from the literature evidence available to this review.

Opportunities for CPD were plentiful in the successful schools interviewed in all four nations. Although only Scotland has both an entitlement to 35 hours of CPD per year and a requirement that teachers maintain a CPD portfolio, this is a requirement for teachers in English FE affiliated with the Institute for Learning (IfL). However, despite this, there was clear evidence from interviews that colleges are much less focused on CPD than schools, perhaps because the casualised workforce (particularly in maths/numeracy) means teaching is seen as less of a career for many in the sector, although it also makes it very difficult for an entire department to have an opportunity to meet together and discuss common issues and approaches. It should be noted that this also makes it very difficult for colleges to create the sort of collegiate spirit we have captured in schools. Welsh and Northern Irish schools generally have five INSET (In Service Educational Training) days each year, which should automatically provide at least that amount of CPD, though interestingly staff often fail to identify INSET days as CPD.

Although CPD was clearly considered to be important, its provision appeared to be an integral part of the way in which the team worked, rather than a separate issue. External provision is used selectively. For example, for a secondary school in Scotland the NQT attends the 'very good' local authority course and a secondary school in England tries to get as many staff to examination specification courses as possible. Sharing practice and collaborative CPD was mentioned very frequently as the most useful form of development and it was reported that most CPD is within the school, possibly because of budgetary restraint. Where CPD involved going out of school, invariably there was a further cascade process to ensure all staff were included. If this trend is set to continue it may be worth schools looking at providing specific training in how to 'cascade' knowledge to their colleagues.

At the Trust federation, CPD was conducted across all members allowing for a wide sharing of skills across the schools. This included primary science teachers working with their secondary counterparts. Also seen as very useful was relevant practical training on the use of resources, such as training in the appropriate use of Smartboards.

Informal professional development was very frequently mentioned in these successful schools. For example, a subject leader in a primary school in England described the following: '… there is a lot of talk in the staffroom about science. Lots of change comes about informally with teachers talking about good ideas and things that have worked in their classes and other teachers want to share these'. The emphasis in interviews on a collaborative, sharing approach and on informal processes for development was seen at school visits to be part of an overall reflective approach to the work of teaching. Teachers were not only open to change, but were actively seeking means by which they could improve. The relationships and trust within these schools and subject teams promoted a culture in which not only pupils, but also teachers, were willing to share weaknesses and were not afraid to make mistakes, because they were confident that in doing so they would have the support and development needed to improve.

Although much mention was made of informal processes, all schools interviewed had underpinning rigorous systems for ensuring quality. Staff appraisals and formal lesson observations (both by peers and SLT) helped to identify and record individual development needs and to monitor progress towards individualised improvement targets.

The survey question 'How important do you think teacher CPD is to actual teacher performance?' showed that 94% (n = 348) of respondents believed that it was very important or quite important. However only 16% (n = 346) reported undertaking more than

30 hours of CPD in the previous academic year in response to the question 'About how many hours of CPD did you do last academic year (2011-12)?'. In response to the question 'Which types of subject specific CPD do you think have an impact on teaching?', there was agreement with findings from the literature and from the interviews and case studies. Collaboration as 'sharing ideas and practice with colleagues in own school' and 'meeting teachers in same subject from different schools/colleges to share ideas and good practice' were the highest regarded features, with each considered to have an impact by more than 75% (n = 347) of respondents and 'being peer observed teaching and getting feedback' by 44%. Practical elements, 'finding out about new resources for learning', 'technical information', 'learning about different teaching approaches' were valued highly. A reflective profession is suggested by survey responses that 35% of these respondents believe 'theoretical/pedagogical (e.g. theories of learning') CPD has an impact and 26% that 'engagement in research' does so. None of the types of CPD suggested in the questionnaire had below 25% of respondents thinking it had an impact. Only 3% suggested other CPD.

The importance of CPD was further reinforced in survey responses to the question 'Finally, what single change do you think would improve maths and/or science teaching in your school/college?' with a large number of comments mentioning professional development or one of its types. The comments also identified CPD as something that needed to be improved and to be given more time. Thus responses were formulated as, for example: 'more extensive sharing of best practice and lesson plans', 'more investment in CPD around the department', 'more collegiate approach to developing the best strategies', 'having CPD sessions off timetable once a term rather than after school when we are all exhausted', 'sent on courses related to the subject being taught, especially if the teacher has not taught science or maths before' 'more time to think about maths' . There were a number of comments about mathematics and science teachers needing to work together more, for example 'peer observation from colleagues in chemistry, biology and maths departments' and 'chance for science and maths to work together … approaches to teaching are often very different, e.g. drawing graphs, working out calculations. Joint CPD would be very beneficial…'.

Summary of key factors associated with characteristics of teaching staff

- There is a general perception that ITE and workforce development is moving in the right direction, and schools increasingly attach importance to training their own teachers
- Staff well qualified in both subject knowledge and teaching skills are crucial
- Many schools recruit staff on the basis of their fit to the staff team and develop both subject and pedagogical skills within the institution
- Ongoing CPD and monitoring of teaching quality are crucial to the development of staff capabilities, but external provision is used selectively and then cascaded down internally

Role of school and college leadership in CPD take-up and the identification and deployment of innovative/best practice

The importance of whole school or college leadership and the ways in which effective leadership is enacted have been confirmed through extensive international research (see

Appendix A, Section 3.3). The impact of good teaching does not depend on the actions of individual teachers alone, but on the culture and context in which they work. Whole school leadership is crucial for promoting school improvement and pupil learning. Values and vision plus personal characteristics such as commitment, passion and resilience have been identified as dimensions of successful school leadership. Systematic reviews identify influence through ensuring teacher learning and development as the most significant factor in improving outcomes, but other important aspects include: strategic leadership and setting a clear and realistic vision; creating the right culture of change and a climate for learning, for both teachers and students; distributive leadership so that agents of change are supported at different levels of the school or college hierarchy; involving and listening to the wider school community; teachers, students, support staff, parents and outside partners; ensuring that resources and systems are in place; encouraging both peer led collaboration between teachers within the school or in different schools, or with researchers, that supports practice development and individual reflective practice; monitoring and evaluation through systematic collection of evidence from and about learners. Conversely, less successful schools are characterised by leaders with an 'inability to analyse their own performance and deal robustly with any shortcomings, and to target relevant professional development where it was most needed. Lack of support from the school and a 'blame' culture in relation to behaviour issues, lack of opportunities for professional development and overwhelming paperwork are cited most frequently as reasons for leaving the profession.

The majority of such research has been generic, however, and it was more challenging to identify any additional features of school leadership that are necessary for high performance in mathematics and science. However, it is clear that commitment to STEM from senior managers is vital in communicating its status among staff, in establishing the right ethos, providing adequate resources and appointing a member of staff with a clearly defined role to coordinate careers activity. Some science leaders interviewed in England were concerned that as the focus on mathematics and English increases, senior managers did not give science sufficient recognition and that this was holding back the development of their departments. Improving schools also have well-targeted professional development. There is evidence which suggests that whole school or college leaders need to understand and support a shared understanding of the factors that promote high performance in mathematics and science learning that extends beyond short-term indicators such as examination results or successful enrichment projects. Head teachers in successful secondary schools recognise and have a clear vision for STEM, and line managers of subject leaders are often specialists within the senior leadership team, enabling them to understand the purpose of changes in classroom practice. In primary schools the leadership of the head teacher is considered vital in ensuring a whole school ethos which supports improvement, a vision for sustainable success through high-quality teaching and learning and appropriate resourcing. These head teachers appoint knowledgeable and enthusiastic subject leaders and support them in influencing practice throughout the school. For colleges, the key factor is identifying a leader with responsibility for all aspects of the subject across the college, providing suitable accommodation and resources, establishing and encouraging collaborative teaching teams, professional development and the sharing of practice.

The role of school leaders in both giving status to and prioritising funding for science and mathematics CPD may be more critical in a period of increasing funding restraints. Conversely, a lack of subject knowledge and understanding of the rationale for particular teaching and learning strategies for mathematics and science teaching among senior leaders may be a barrier and this may be more significant than for other areas of the curriculum. Those schools which use funding to develop changes in schemes of work and to pay for release time and responsibility allowances for coordination of changes have a greater chance of sustaining improvements to practice. The importance of the support of senior leaders, both whole-school and heads of department is crucial; without this, it is unlikely that change will be maintained, however enthusiastic individual members of staff may be.

The importance of whole school leadership, and particularly that of the head teacher, was very evident from comments in all schools, in relation to the crucial importance of ethos and particularly so in those that had improved rapidly. The consistency in language for describing the ethos at these successful schools was noticeable, reflecting the qualities of successful leadership identified in the literature. At a Scottish school, the comment made by a subject leader was that, ‘The new head came in and completely transformed the nature of the school. The head works hard, backs up teachers, sets high standards for discipline, has a clear vision for the school and asks everyone to take responsibility for their actions. This is manifest throughout SLT (Senior Leadership Team), PT (Principal Teacher) and teachers. All sing from the same handbook.’ At an English school, ‘the ethos of the school is very focussed on achievement and aspiration and it is very clear that this comes from the head.’ When the head arrived, fewer than 30% of students at this school achieved 5 or more A* to C grades, whereas this is now over 50% and continuing to improve. ‘Aspiration, achievement and challenge’ were similarly the elements of the ethos as described by a subject leader at a school where all of the students achieved an A or A* grade in mathematics in 2011. At the Trust federation a key requirement is that every teacher should understand what they are aiming to achieve and why. Although challenge and high expectations were clearly considered to be essential to the vision of successful schools, this was also underpinned by good relationships, communication, collaboration, trust, celebration of success and listening to pupils/students. One Scottish college encapsulates these qualities in the phrase ‘we expect respect’.

Subject leaders were asked during the interview what senior leaders expected of them and whether they felt supported in their role. Responses, on the whole, provided further indications of both high expectations and trust. In good schools senior leaders do not interfere with the running of a successful department, although they are described as keeping a close overview of outcomes. For example, at an English secondary school the subject leader was expected to ‘do the job and maintain standards – get to outstanding,’ but ‘the head is hands off’. At another English school, ‘they (SLT) will ask questions, make sure all areas are covered… that done, they largely leave you to get on with it unless there are problems. Where departments fail to come up to expectations, SLT will intervene strongly and rapidly with regular monitoring and meetings’.

In a minority of interviews, subject leaders felt that senior leaders could be more supportive, for example by maintaining the amount of teaching time for science in one school, or because there was ‘far too much in the way of data and admin’ in an English college. The subject knowledge of senior leaders was not mentioned in interviews, but at one of the schools visited teachers were of the view that it was very helpful that two members of the senior leadership team were themselves mathematics teachers, with one of these being the former head of the department.

From survey responses, it can be seen that there is agreement about the importance of a positive whole school ethos and leadership. For the question 'What factors do you think are most important in effective maths or science teaching?' 63% (n = 352) said 'whole school ethos', 49% 'effective head teacher', and 19% 'supportive governing body'. In contrast to the positive picture of supportive senior leaders and a shared ethos which contributed to achievement in nearly all of the interviews with successful schools, there were several comments in questionnaire responses about the lack of understanding and support from senior leaders for mathematics and science in the school in response to the question 'Finally, what single change do you think would improve maths and/or science teaching in your school/college?'. Comments in relation to ethos, specifically a few in relation to behaviour, were similar to 'better behaviour support from the senior leadership team'. There were several comments about the way in which the senior leadership applied external accountability measures within the school, such as 'SMT to stop being completely fixated on spurious targets' and '… being told to teach in a formulaic way by SLT who have no experience of good maths teaching and just want to plough as many students as possible through early entry and resit approach to GCSE maths.' Knowledge and understanding of mathematics and science education were reflected in further comments such as 'awareness from SLT that progress in mathematics is not linear, and that mathematics learning often requires repeated practice'. Other respondents believed that a higher profile for mathematics and science within the school was the most importance factor – for example, 'the development of a whole school STEM strategy'.

Summary of key factors associated with school and college leadership

- Good leadership of the whole school or college is crucial for providing an appropriate ethos and necessary resources for learning and achievement
- Central importance of building relationships and viewing staff as individuals to be trusted and respected, encouraging a climate within which weaknesses can be acknowledged and addressed in a supportive fashion
- More specifically, understanding of and support for mathematics and science are critical to the setting of appropriate goals and resourcing of CPD and other aspects of development.

Characteristics of effective leaders in science and mathematics education, including their background and training

The importance of good subject leadership and high performance is established in the literature for all subjects, and the importance of establishing trust and of challenging poor practice is also well established. The importance and influence of subject leadership in raising standards of teaching and learning in the subject area is widely recognised, as is the need for subject leaders who are enthusiastic and knowledgeable about their subject, both in subject knowledge and subject pedagogy (see Appendix A, Section 3.4). In the most successful subject areas, there is trust, collaborative working and sharing of ideas. Data is used effectively and teachers are regularly observed teaching, by their peers as well as for performance management purposes. Barriers to a focus on teaching and learning in all departments are the pressure of administrative requirements and a shortage of time for subject leaders to carry out their role effectively. Successful subject leaders have good support from senior leaders in the school. However, the review identified a gap in the literature specifically on subject leadership for mathematics and science. Although the importance of support for subject leaders by the school or college leadership team is agreed, it also identified a further gap on how effective subject leaders are prepared for and supported in their role. Although senior management activity in supporting career development has been seen as important, Ofsted found only 20% of science subject leaders claimed to have had training for their role, despite finding good or better leadership in 80% of the secondary schools visited between 2007 and 2010 (Ofsted, 2011a). There are a wide range of programmes providing training, but little evaluation of their effectiveness.

In keeping with these findings, only a minority of those interviewed had formal training for subject leadership, though there were signs that those who did may be better at planning for continuity. Actions taken by subject leaders interviewed to sustain success or to lead improvement reflected those identified as good practice in the literature, for example: good communication, team building, efficiency, leading by example, introduction of consistency in schemes of work, conversations based on relationships of trust and being approachable. Most described their leadership style as 'leading by example'. What was noticeable during the interviews and also at school visits was the 'self-effacement' in terms of the leadership role, with leaders tending to ascribe success to good teamwork, with little emphasis on their own role in bringing this about. It may be hypothesised that some aspects of effective leadership may operate in tacit manner, rather than being the result of deliberate behaviours. Good emotional intelligence and the ability to create the conditions for trust and collegiality were not explicitly described, though this may be ascribed to the variable nature of training and preparation for the role of subject leader, with no common vocabulary for articulating their leadership behaviours.

Subject team members were appreciative of the qualities of their leader during visits and it was clear that leaders were highly respected for their willingness to teach more challenging groups, their hard work and for the support they offered to all members of the team. Subject leaders were also described as keeping in touch with developments in the subject area outside the school 'on the ball… she always knows what's coming up and lets you know in advance' and in using external contacts to inform teachers about CPD opportunities 'he'll see what's bring offered on his e-mail or the web and let us know about it'. Some subject leaders had received leadership training either prior to, or in role and had found this useful 'particularly for the work on leading teams'. Others had learned on the job or with the support of senior leaders 'a great deal of support from HT and SLT, especially when new to the school'.

Subject leaders interviewed 'know their team very well – their strengths' and monitor their work closely: 'constant informal monitoring – seeing, observing, talking. Very early intervention.' They have very high expectations of their teams, but are able to provide support if needed: 'the school has a culture where the pupils or the staff do not have a fear of failure … so if you need help or advice … we will provide support and guidance in real, practical terms'.

In response to the survey question '*What factors do you think are most important in effective maths or science teaching',* 72% (n = 353) mentioned '*effective subject leader/coordinator'* and in response to the question '*As a teacher of maths or science, who has the most influence on you?',* 22% (n = 343) said '*your subject leader/coordinator'.* This was below the percentage of teachers who said '*students'* (28%) or '*your peers' (*28%), but well above the response '*your head teacher'* (7%). Encouragingly, 78% (n = 334) of respondents believed that their subject leader in mathematics was excellent or good, and 70% (n = 282) believed that their subject leader in science was excellent or good in response to the questions '*How would you rate your subject leader in maths?'* and '*How would you rate your subject leader in science?'.* In response to the question '*How do you get information about CPD in your area?'* 23% (n = 347) said '*the subject coordinator'* although this figure compares with 40% for '*own research*'. The importance of subject leadership also emerged in response to the question '*Finally, what single change do you think would improve maths and/or science teaching in your school/college?',* with comments such as 'generally, better organisation of the department' , 'department discussing teaching in meetings instead of data', 'ideas from coordinator on how to teach a topic'.

Summary of key factors associated with subject leaders

- Collegiate leadership – good subject leaders operate in open, democratic and supportive fashion, leading by example, and there is little sign that training makes much difference to this
- Being trusted by senior leadership to do what they are able to do
- Deep knowledge of teaching staff from informal observation and conversation

Variation in patterns of influence according to nation, phase/sector and student characteristics

Differences between nations

Data on the availability of suitably qualified staff to teach mathematics and science in England, Wales and Northern Ireland are provided through the PISA 2009 international study, but this is not available for Scotland (see Appendix A, Section 3.5). Results show that it is more difficult to recruit qualified staff in England, though this may be a recent phenomenon, and one which varies according to region. PISA data indicate there is no significant national difference between the mean score in either mathematics or science for England, Scotland and Northern Ireland, although the mean score for Wales was significantly lower in both subjects. Scotland had the greatest proportion of higher-achieving pupils in mathematics in the UK. In science, Northern Ireland had a slightly greater proportion of pupils at higher levels than England and Scotland, with Wales having the lowest proportion.

All four UK nations place high priority on mathematics and science education, evidenced through national policy documents, but there is much diversity between the specific systems in operation and the actual priorities which they set. In England, there are changes underway which affect all stages of workforce development, with greater responsibility at school level for initial teacher education and CPD as well as for other factors which have found to contribute to performance in mathematics and science, such as careers education. However, DfE funding for the NCETM and the Science Learning Centres has been maintained, with amendments to the remit to focus on supporting school-based CPD. DfE funding for subject knowledge enhancement courses for non-specialist teachers and returners to teaching continues to be available, with these courses provided by Universities. The increasing diversity and autonomy of schools in England, caused by the advancing academisation programme and the subsequent reduction in the role of local authorities, may be particularly significant for mathematics and science. Opportunities for variations from national pay scales and the freedom to employ teachers without a teaching qualification together with greater disparities in funding may add to variation in the ability of schools to attract and retain good teachers when these are in short supply. Since monitoring is primarily through success in external tests, there is a risk that the pressure to sustain test success, rather than understanding and enthusiasm for the subject may increase further. However, the negative effects may be offset by core subjects being given status as important subject areas, with priority for resources, support from senior leaders and the power to influence school policies or modify them to the needs of the department.

There is also a significant amount of curriculum change that affects both mathematics and science, including a proposal to ensure that all pupils study mathematics to the age of 18. Changes to GCSE, AS and A2 examinations proposed by the Secretary of State in England may also affect schools in Northern Ireland and Wales which currently use these qualifications. If implemented, replacements for GCSEs will require secondary schools in England to adjust priorities for use of staff training time to preparation for teaching new syllabuses, which has the risk of diverting resources from efforts to improve the quality of teaching overall.

In Scotland too, there are moves to a less centralised structure and some reduction in support from local authorities, though the latter still play a key role in brokering collaboration. It perhaps reflects the extent of such networking and collaboration that we found Scottish schools to be notably less defensive with respect to outside contact. The Scottish Government’s approach to educational reform is based on Curriculum for Excellence (CfE), which became mandatory in 2010-11. Its aims are to support good teaching and cross-curricular themes to support learning, with greater autonomy for teachers and recognition of their professionalism. Evidence on the success of implementation is currently limited and the changes have yet to be worked through. Progress with implementation varies widely, with primary schools further ahead than secondary schools. In the latter, some teachers are concerned about the lack of detail regarding assessment. Workload is considered to have increased for all teachers and morale is low, with funding cuts and staff shortages proving to be barriers.

As already noted, all Scottish secondary teachers have degrees in their subject area and teachers have an entitlement of a minimum of 35 hours CPD each year. The Scottish system recognises the importance of the induction year and all newly qualified teachers who have graduated from a Scottish university are guaranteed a one-year teaching post with a maximum class commitment of 0.7 full-time equivalent, with time set aside for professional development and access to a mentor. The Scottish Government has provided additional funding for CPD provision for science teachers and further CPD funding for primary teachers in delivering science learning.

The Welsh Assembly Government abolished school performance tables in 2001, and this was followed by a significant fall in performance, with a greater effect in schools serving students with lower prior attainment and higher socio-economic disadvantage. The Welsh Government has recently re-introduced 'banding' to group schools according to their performance. Professional Learning Communities (PLCs) have been developed in Wales to improve pupil outcomes and to focus on literacy, numeracy or addressing disadvantage. Families of schools with similar intake characteristics have also been created, and these are used to benchmark performance.

Until recently, primary schools in Northern Ireland (NI) prepared children for a state-funded transfer test, which would determine which pupils should attend selective grammar schools. A revised curriculum was introduced in 2007, state support for transfer tests was withdrawn and the publication in 2009 of 'Every School a Good School' provided a framework for an overarching national body, though the introduction of this has been delayed. Schools are still predominantly faith schools and in most areas dominated by Grammar schools. A local 'Board' may therefore have Catholic Grammar and High Schools, Protestant Grammar and High schools and perhaps a secular comprehensive. Cooperation between schools within a Board area is typically limited to the community schools.

A briefing paper prepared for the Northern Ireland Assembly shows percentage rises between 2005/6 and 2010/11 in GCSE entries in separate science subjects and between 2001/2 and 2010/11 entries to science subjects and mathematics at A level. It also reports on the success of the 17 designated mathematics and science specialist schools in science, technology and mathematics. A large numbers of pupils were able to access enrichment activities funded by the Department for Education Northern Ireland. However, funding has now been removed for both initiatives. The value of CPD is also under-recognised and there is much less access to it. Moreover, those leaving HEIs trained as primary teachers or secondary science teachers find it very difficult to secure permanent, full-time positions, though this is the only permitted route into teaching.

Differences between phases

Transition between different phases of education was discussed in Section A of this report as critical for progression in mathematics and science learning. Evidence for differences in performance between phases is provided in the UK by inspection reports. These suggest that in England, Northern Ireland and Wales overall quality of teaching is better in primary schools than in secondary schools in mathematics. For science, the overall proportion of 'good or outstanding' lessons was similar in both primary and secondary schools, although most 'outstanding' lessons were in secondary schools. There are concerns about the time devoted to science inn primary schools, however, in England at least. The removal of the requirement for end-of-key-stage testing was considered by Ofsted (2011a) to have contributed to innovation and enrichment in teaching and greater inclusion of scientific enquiry, but the wider perception is that it has led to a reduction in the priority attached to it. Science provision in colleges is also a cause for concern, with many judged inadequate.

However, although FE Colleges make a large contribution to the science and mathematics qualifications achieved by learners, the review identified a gap in the literature about workforce issues in this sector. In FE colleges in all nations, changes to funding are setting an extra challenge for leaders and teaching staff.

Student characteristics

The generic features of good teaching and leadership for promoting high performance in mathematics and science and those that are successful in promoting equity for all pupils, regardless of gender, ethnicity or socioeconomic status. However, there is evidence that teacher beliefs about the dispositions of groups of pupils for mathematics and science subjects may affect their expectations, which has been shown to have a significant influence on pupil engagement and on performance. Close monitoring of progress and individualised and evaluated interventions to enable pupils to catch up when they are found to be falling behind have found to be effective in ensuring good progress for all pupils.

Interviews with successful schools and colleges showed a very high degree of consistency in responses about factors which contributed to their high performance. This was so regardless of the prior attainment of pupils with schools including a selective, independent boys' school where all achieved A or A* in mathematics in 2011 and an 11- 16 school serving a highly disadvantaged community, where prior attainment was low and, in addition, some of the feeder primary schools were in 'special measures'. Successful schools and colleges interviewed all emphasised that they cater for students' learning needs individually but that expectations are equally high for all 'to achieve at or above their potential'.

Summary of key points regarding variation

- Outcomes are generally comparable across the four nations in both mathematics and science, though Wales does worst in both
- There are signs that the Scottish system has greater coherence and collegiate sense of purpose than the English, Welsh and Northern Irish – the English system in particular appears to be more fragmented, with schools more often operating in isolation
- Though the factors at work in Northern Ireland may be the same as in the rest of the UK, there are important contextual differences which may mean these play out differently
- Differences between phases are relatively modest, though differences in the scale of organisation impact to some extent on internal structures: these are most compact in primary, and most diffuse in colleges
- The factors already identified as underpinning good teaching are also those most likely to reduce differences in outcome associated with student gender, ethnicity and SES

Principal conclusions regarding workforce and leadership issues

There is striking unanimity across the literature review, the shadowing visits, the interviews and the online survey that schools and colleges which are successful in science and mathematics provision are *collaborative* and *inclusive*.

With regard to **collaboration**:

- Subject leaders are collegiate, lead by example and develop teams with high levels of open exchange, mutual support, shared values and shared goals.
- Subject leaders value good subject knowledge, and deploy and develop it in coordinated fashion – for instance, where staff have lower levels of qualification, they teach at lower levels of provision, but are helped to improve their understanding through appropriate CPD.
- Subject teams work collaboratively with those in other departments, exchanging information and sharing practice via in-house CPD.
- Subject leaders and their teams also work collaboratively with other schools and colleges, sharing CPD and working together to ensure consistent approaches within phases and coordination across them, especially at points of transition.
- Subject leaders have good relationships with their senior managers, and are trusted by them to take responsibility for their area of provision within a no-blame environment.
- Good teaching skills are seen as crucial, and are valued and respected by senior managers and subject leaders, who grant good teachers autonomy and flexibility over methods of delivery.
- This trust and respect extends to pupils and students, who are encouraged by staff at all levels to be open about their strengths and weaknesses and to seek support when they have difficulties.

Successful schools and colleges are **inclusive** in the way they view their students and set up opportunities which cater for different levels of ability:

- Teachers value engagement and enthusiasm as much as achievement, and they promote these by their own example.
- Senior managers and subject leaders have high expectations and set challenging goals, but frame these in terms of individual objectives, not absolute standards.
- Pupils who want to progress to higher levels of study and qualification are encouraged to do so even if the outcome is uncertain, and teaching staff work hard to support them.
- Where possible, curricula and qualifications are made available which are aimed at enabling those with lower levels of ability to progress.
- Teachers make systematic use of investigations and extra-curricular activities which connect subject content to pupils' everyday experience and they encourage them to be adventurous in their thinking.
- Extra-curricular activities include a focus on careers, for instance via visits to and from local industry and universities, helping make the possibility of employment involving science and mathematics seem both real and desirable.

Many of these points are applicable to any area of teaching. However, they have particular importance within the context of science and mathematics, and lead to specific conclusions with regard to future development in four areas which we address in turn below: subject leadership; CPD for teachers; provision of training; and senior manager support. We then consider the implications of these conclusions for the different home nations, and in particular the steps that will be necessary to bring about action. We finish this section by briefly comparing our conclusions with those of other recent reports.

Subject leadership

As disciplines, science and mathematics do not require an understanding of other people. Those with a background in these areas therefore tend to be less adept at the skills which underpin the collaborative and inclusive styles of working identified above. Subject leaders in particular play a distinctive and crucial role in establishing collaborative work patterns, and if they are to be effective need to have both high levels of subject knowledge *and* the skills involved in democratic and collegiate management. They are also very likely to need specific support in order to develop these skills.

At present, take-up of training in subject leadership skills is patchy at best: many of the leaders we interviewed had received no specific preparation for their role, and in fact did not regard it as especially crucial. This is almost certainly a mistaken perception. Schools vary a great deal in the extent to which good subject leadership is found, as the survey bears out. Simply relying on it to emerge spontaneously is therefore hardly likely to be sufficient. In any case, there is a substantial difference between tacit skills acquired through experience, and the explicit understanding that is promoted by effective training. As well as producing awareness of crucial issues that might otherwise be missed (e.g., the importance of succession planning, a point noted only by the trained subject leaders in our sample), explicit understanding provides a firm basis for subsequent discussion, reflection and onward development – in other words, a *professional* approach to the subject leader role. Specific training has to be a necessity if deliberate rather than incidental progress is to be made.

Formal training should only be regarded as a start point, though, if professionalization is to be taken seriously. Well-designed programmes provide important exposure to a range of practices and contexts, a network of contacts, and space for focused reflection. However, they need to be followed up for at least a year by systematic support for deployment of the skills and insights obtained. Ideally, this should involve mentors in the form of experienced and effective subject leaders from other schools or colleges. These mentors would be able to provide an external sounding board and a source of individually tailored advice and guidance at the point when it is actually needed. Acting as a mentor would also enable experienced subject leaders to continue to develop their own understanding. Some current subject leadership programmes do provide follow ups (e.g., those mounted by the National SLC), but only in the form of one-off catch-up sessions some while after training.

Despite its more obvious relevance to secondary schools, a training and support system of this kind is equally important for primary school subject coordinators and their equivalents, whose roles are less well defined; and for college heads of department, who typically operate within larger and more distributed structures involving many part-time staff. Some provision for joint training would also help build more integrated subject leadership across phases, by creating a point of contact for the development of informal collaborative networks. At present, more detailed research is needed before we can come to any firm conclusion on which models of collaboration are most effective, but facilitating bottom-up growth may be important for schools and colleges operating outside structured systems such as those exemplified by the English Trust Group network who participated in our inquiry stage or the networks of connections brokered by the Scottish Local Authorities.

CPD for teachers

Science and mathematics teachers are often guilty of seeing their subject knowledge as established fact. This leads to lesson content which is static in character, and to a reliance on didactic teaching methods aimed simply at imparting knowledge to pupils. Both are counterproductive and need to be addressed as a further fundamental part of the process of professionalising teaching in these areas. Inclusive, pupil-centred approaches to delivery provide a key means of moving away from static content. However, for many science and mathematics teachers, given where they start from, these are a more radical departure than they are in other subjects. As with subject leadership skills, then, specific support is necessary to ensure they are adopted.

Effective pupil-centred methods are arguably more important in science and mathematics, in fact, because of their capacity to stimulate engagement at all levels of ability. This is crucial for promoting general mathematical and scientific literacy, as well as fostering creative approaches among the more able which may in time spark future new discoveries. There are also forms of investigative activity that are uniquely central to mathematics and science (e.g., the application and analysis of measurements, and the coordination of data with hypotheses and conclusions). These present specific and distinctive opportunities to generate novel and effective pupil-centred exercises, and considerable resources are available to help teachers develop these. In particular, there has been substantial research over the past 30 years on the characteristics of science and mathematics knowledge and on pupil-centred methods which successfully promote learning at different levels of the curriculum. Much similar work is still ongoing. Mathematics and science teachers in all phases need to access this growing understanding on a regular basis, and use it to develop new pedagogical skills.

Teacher development in science and mathematics is not just about pedagogical technique, however. The traditional emphasis on established fact stands in stark contrast to the rapid advances in understanding which are characteristic of these disciplines. Efforts to reflect this growth in subject knowledge within lesson content provide an important counterpart to pupil-centred approaches. An emphasis on the dynamic and changing nature of subject knowledge in these fields and the scope for innovation helps promote greater engagement by fuelling a sense of novelty and excitement. Teachers therefore need to regularly access information on new and emerging areas of subject knowledge, as well as ideas about how to incorporate these within their teaching, as a central part of their professional development.

Full participation by teachers in ongoing science and mathematics CPD is a key requirement for the growth of successful schools and colleges, but the importance of this needs to be instilled at an earlier point, during ITE. University-based training programmes do in fact typically emphasise the need for CPD and provide mechanisms for encouraging take-up, for instance by allowing ITE course credits to be carried forward into professional masters degrees. The consistency with which professional approaches to teaching are promoted is unclear, however. The advent of employment-based ITE programmes may have an opposite effect, by encouraging the perception that teaching is essentially a craft, not a profession. The impact of these new routes in ITE needs to be scrutinised very carefully.

Provision of training

The paramount necessity of professional development for both subject leaders and teachers in science and mathematics is ill-supported by the current patchwork quilt approach to provision and the largely laissez-faire system of take-up.

On the positive side, external CPD provided by the NCETM and the SLCs plays an important role in developing subject knowledge and promoting innovative pedagogical techniques. The SLC network runs a range of one day courses delivered jointly by scientists and professional development leaders, focused on knowledge in key areas of contemporary science and ways in which research information can be used to teach 'how science works' at KS4 and post 16. The SLCs also run more conventional courses for non-specialists in physics and chemistry. These courses all recruit well – and better than when first introduced – and are viewed as a high priority by schools for improving expertise. Similarly, the NCETM provides a range of successful online CPD resources designed to support joint development activity between mathematics teachers; holds events to promote sharing of expertise at local, regional and national level; and indexes courses for subject specific enhancement (content and pedagogy) offered by a range of other CPD providers. Both the SLCs and the NCETM also provide or index training for subject leaders, as noted above.

However, although open to teachers across the UK, the SLC and NCETM centres are located only in England, are framed by, and are primarily directed at supporting English provision. This is problematic given the variations in curricula across the four home nations, and in particular the distinctly different framework constituted by the Scottish Curriculum for Excellence: while some aspects of CPD will have general applicability, others need to focus on the specific contexts in which teachers are working. As far as teachers in schools and colleges in Scotland are concerned, within-nation activity ensures that the situation is in fact relatively healthy, though there are limitations. The General Teaching Council for Scotland and the Scottish Science and Engineering Education Advisory Group, amongst others, provide more focused support and encouragement for professional development than that enjoyed by teachers elsewhere. Teachers in Scotland also have access to the Scottish Schools Education Research Centre (SSERC), a Local Authority shared service providing support across all the Scottish Education Authorities for development in science and technology. SSERC activity is supported by the National SLC and covers a range of subject-specific CPD and leadership courses, mounted in both face-to-face and online mode. It is notably less extensive than the SLC network provision, though, and there is no comparable CPD delivery focused on mathematics. Education Scotland provides access to a range of resources for supporting teaching which does include both mathematics and science, and, importantly, these are framed more specifically in terms of the Curriculum for Excellence. The Scottish Qualifications Authority provides similar resources and in addition some access to CPD, though the latter is limited in scope. In general, teachers in Scotland are more reliant on Local Authority organisation of professional development, and although the various authorities do play an active role in this respect, the content and coordination may sometimes be weaker in character because of lower levels of involvement in design and content from those with specific subject expertise.

Teachers in Wales and Northern Ireland fare substantially less well. The National SLC mounts occasional courses in both nations, but these do not amount to a systematic programme of activity, especially in terms of support for the local context. The National SLC also funds CPD in Wales via Techniquest, but this too is restricted in scope. The Welsh Government funds the Wales Institute of Mathematical and Computational Sciences to provide mathematics CPD, but this is limited to South Wales. Joint Local Authority provision exists but this is also patchy in coverage. In Northern Ireland, the Department of Education is currently finalising a draft strategy and implementation plan for the future direction of teacher professional development. At present, it is only directly involved in supporting training via the Regional Training Unit, which concentrates on leadership at senior manager levels.

The problems created by variation in availability and fit are compounded by problems of take-up. Direct participation by teachers in effective professional development activities requires many days of release from school. Schemes which help meet the immediate expense of course participation (e.g., the DfE Impact Awards and the SLC ENTHUSE Awards) are only partly helpful, since they do not address the costs of cover to support teacher release. These create pressure to run courses in twilight mode (i.e., after school working hours), or to release teachers in selective fashion to attend courses relating to areas of immediate need, with subsequent local cascade. Despite the frequent claim from teachers that there is insufficient time for professional development (cf. the survey data), they often collude with senior managers in converting in-service days to twilight sessions and using the saved time as additional holidays.

Twilight sessions and selective local cascade are both poor alternatives, in fact. There is ample evidence from participant and tutor feedback that twilight courses are far less effective than daytime ones due to diminished ability to concentrate and curtailed timescales. Conversely, needs-driven involvement in daytime courses can never equate to systematic professional development, and cascade approaches are problematic. Within-school dialogue following training is a valuable means of supporting deployment, but this should be on the basis of joint exposure, an exchange of informed views and, if possible, peer observation. Cascade approaches are likely to promote distorted implementation, unless they themselves are properly supported by ‘training the trainers’ provision.

Overall, then, a more coordinated, thorough and better supported system of providing professional development for both teachers and subject leaders in science and mathematics – and one which takes into account differences in national context – is crucial if the professionalization identified above is actually to occur.

Senior manager support

Mathematics and science are ‘difficult’ subjects in which pupil achievement is often lower relative to other areas of the curriculum. Science is also an expensive subject that requires more resourcing in terms of facilities. It was a widespread perception among interviewees and respondents to the survey that senior managers must have good understanding of the distinctive demands of mathematics and science in order to set appropriate performance goals, and provide the necessary support in terms of resources and institutional priorities. The survey responses indicate such understanding is far from commonplace, and needs to be substantially better promoted.

There is a wealth of evidence that senior managers have a critical role to play in establishing institutional ethos. For science and mathematics to be successful, they need to a) make suitable staff appointments; b) establish good subject leadership; c) deploy resources to support effective teaching and CPD; d) promote opportunities to progress for weaker as well as stronger students; and e) set an agenda for collaboration, within and across schools and colleges. The current UK context provides a range of opportunities to take positive decisions to support mathematics and science. For instance, the greater budgetary freedom now exerted by Head Teachers in England, makes it possible for them to revert to resourcing CPD through specifically allocated budgets. They now also have the scope to consider alternative models of engagement with CPD, such as vacation provision, and to incentivise take-up of these. In Scotland and in FE colleges in England, the greater curricular flexibility that is available provides opportunities to extend inclusive progression in mathematics and science, which do notably more poorly than other subjects as regards post-16 continuation. Secondary schools in England could also explore their scope to mirror FE provision, especially in mathematics, where post-16 progression is less than half that in Scotland. The strong emphasis of Scottish FE provision on working with business and industry provides a model that might be extended to schools and colleges in Wales and Northern Ireland, where there are similar demographics.

By no means all senior managers choose to take advantage of these opportunities, however, or to support mathematics and science in other ways. As we have detailed, there is clear evidence of a strong association between effectiveness of provision and learning-centred leadership (i.e., leadership which focuses as a priority on teaching and learning). The key step must therefore be greater support for the development and dissemination of this form of leadership, especially in relation to mathematics and science. This is partly because of the distinctive issues that senior managers need to address regarding the resourcing of science teaching in particular and the structural barriers to progression in both mathematics and science. Senior managers also have a key role to play, though, in supporting training for subject leaders and subject-specific CPD for teachers. This is not just a matter of resourcing of training, but of recognising its importance to professionalization. At present, despite much research on the importance of learning-centred leadership, understanding of it remains limited among practitioners – or at least unimplemented – and we were unable to identify any training courses related to mathematics and science aimed specifically at senior managers. Opportunities are being lost as a result.

Implications and steps toward implementation

The introduction of mandatory subject leader training and targets for subject-specific CPD are obvious corollaries of the conclusions above, but this will require:

1) a coordinated system for provision of training
2) mechanisms for defining standards and targets
3) some form of overseeing authority to ensure take-up

At present, the four home nations are at different points of development as far as 1) is concerned, and there is substantial unevenness of provision as a result. Both subject leader training and CPD are at their most developed in England in terms of scope and availability, although post-training support for subject leaders is generally limited, as already noted, and the fit to non-English contexts is restricted at best. Scotland has well-developed provision as regards fit to its distinctive curricular framework, but there are limitations in terms of scope. Wales and Northern Ireland have problems with regard to both scope and availability, so there is simply less opportunity to address issues of fit. The way forward would seem to lie in greater sharing of expertise – and where appropriate, provision – across the four nations, echoing the collaboration that is a hallmark of effective schools and colleges, rather than each attempting to build up their own systems independently. This would make it possible to extend the generalisable aspects of existing National SLC and Scottish provision, whilst at the same time attending to the location of these within the context of the different national curricula, assessment frameworks and administrative systems. For example, CPD materials developed in Scotland to address a specific element of mathematics teaching might be made readily available to providers in Wales, who would consider how this should be adapted to fit the Welsh curriculum. Mounting of the resulting provision might then be managed by trainers from both Scotland and Wales. This approach would help ensure greater coherence of training standards across the UK, while guaranteeing sensitivity to local circumstances.

This expanded collaborative provision would necessarily require increases in resourcing. This might be achieved by the various devolved administrations agreeing to contribute proportionately to a joint funding regime that would meet the costs of both provision of and participation in training. The appeal of this approach is that it is likely to be less expensive than new within-nation development. It might also be possible to offset the increased costs to some extent via EU convergence funds, especially if local enterprises were involved in supporting delivery – which would carry its own benefits in terms of promoting careers. However, a joint funding regime would seem to carry the implicit requirement for a single cross-UK administrative system, which is likely to present considerable political difficulties. More fundamentally, government-led support for teacher CPD, whether centralised or devolved, has arguably never been adequate to meet the demands even of previous levels of provision; the likelihood of sufficient expansion of funding to support enhanced provision being achievable seems remote, especially in current economic circumstances.

A more credible model is expansion via increased incentives for teachers to fund their own development, including via course attendance during school and college vacations, as is commonplace in the US. This model operates in a variety of other professions, where demonstration of engagement in CPD is commonly a requirement for promotion or even being allowed to continue to practice. A shift toward this kind of approach is likely to still require some support from the devolved administrations, but primarily in terms of how school and college employment practices are framed, so as to facilitate a change in the mindset of teachers and senior managers. The more fundamental requirement of this model is the presence of professional organisations or similar structures capable of defining standards and targets both for provision of training and engagement in it, with sufficiently high levels of membership or other forms of control to help enforce these – thereby also helping to address points 2) and 3) above.

As noted previously, Scotland in particular already has the basis of a coherent framework for promoting and recognising professional development, but this is spread across a number of organisations, and more generally the picture is one of fragmentation. There are two basic models that operate within other professions, accreditation via gate-keeping professional associations (e.g., law and accountancy), and licensing via national agencies with legal responsibilities (e.g., driving instructors). In some instances, professional accreditation has acquired legal status and statutory oversight (e.g., medicine and psychology). The ASE's Chartered Science Teacher scheme exhibits many characteristics of a professional accreditation model, including commitment to annual CPD involvement. Participation is voluntary, though, and take-up is consequently limited as yet. There is also no obvious parallel subject association for mathematics teachers beyond the Advisory Committee on Mathematics Education (ACME), which serves the function of providing a channel of communication between the profession and government. The General Teaching Councils (GTCs) provide a potential basis for a licensing model, and the current approach in Scotland exemplifies some aspects of this. The GTCs already carry something of this function with respect to NQT status. However, the abolition of the GTC for England in 2012 undermines the scope for achieving comparable processes across the four home nations. It is also doubtful whether the remaining GTCs are geared up administratively to manage the dialogues necessary to establish agreed standards and targets, or to monitor adherence to these.

If more rapid and coherent progress is to be achieved, a better solution seems likely to be provided by a single overarching professional organisation, with a broader focus than just science or mathematics, capable of leading an initiative to determine standards and targets in consultation with the SLCs, the ASE, NCETM, ACME and other providers of training, including national and local authorities; and then helping coordinate or even broker provision that meets these agreed standards. Although the resulting system of provision would be operating within a structured framework, it would effectively be driven by teachers' perceived needs within their own specific contexts rather than any predefined methods of delivery. The precise mix of mechanisms for providing training could therefore continue to vary nation to nation, as now. The initial training and CPD of professional educational psychologists currently operates within a system of this kind. Scotland and England have different training models and different legal frameworks governing the activity of educational psychologists, which in turn necessitate differentiated CPD provision, and yet professional development is regulated in both nations by the British Psychological Society's (BPS) Chartered Educational Psychologist system.

An organisation such as the Royal College of Teaching (RCT) might potentially take on an equivalent role to the BPS, and establish similar structures. Once set up, monitoring of ongoing engagement in appropriate CPD could take a variety of forms. The BPS requires periodic reporting, with renewal of practicing certificates contingent upon satisfactory responses, but the number of professionals involved is smaller than would be the case with any scheme aimed at teachers, even if it was restricted to science and mathematics. An alternative approach to policing adherence would be to routinely require detailed reporting on subject leader training and CPD participation within school and college inspections by Ofsted, Education Scotland, Estyn in Wales and the Education and Training Inspectorate in

Northern Ireland. Given the importance attached to the outcome of inspections, this might also be the most secure way to achieve compliance. Nevertheless, a system of this kind might still take many years to develop if left to occur in bottom-up fashion, because of the degree of professional consensus required. In order to expedite its growth, there would need to be some additional and specific incentive to take up membership of the overseeing professional organisation, whether statutory – which may be difficult politically - or financial – which presents challenges in terms of resourcing. Further consideration of the precise means by which this type of arrangement might be achieved is beyond the scope of this report, but it represents the most direct path to the professionalization of science and mathematics teaching which we have identified as the key underpinning priority.

Comparison with other recent reports

Our conclusions resonate with those of other reports, but go substantially further, we believe, especially in terms of identifying the specific points on which action is needed. The importance of leadership has been identified in past research, and the 2012 Ofsted report reiterates its role in driving up standards. In common with much previous work, however, that report provides little analysis of *how* or *why* leadership matters. There is also a dominant emphasis on senior leadership, contrary to our view that subject leadership is at least as critical. Similarly, the 2012 CBI report emphasises, as we have, the importance of excellence among subject teachers, and the shift to regimes that might allow teachers to match curriculum and qualifications to their students in better fashion. However, in encouraging greater autonomy for schools it runs contrary to our conclusion that fragmentation is unhelpful and that collaborative provision is more effective. The CBI's emphasis on 'rigorous' school leadership is also contrary to our points about the importance of subject leaders working in democratic, team-oriented fashion.

Recommendations

The conclusions detailed above point unambiguously to the actions that are needed in subject leadership, teacher CPD, senior manager support and provision of training in order to transform science and mathematics education across the UK. These actions have the same overarching goal of creating a genuinely **professional** workforce:

Generic recommendations

1. **Introduce a systematic and mandatory programme of training and support for subject leaders in mathematics and science.** This programme should consist of initial formal training for incoming subject leaders and coordinators, and for those who are likely to take on these roles in the near future, in order to promote effective succession planning. The content of the initial training should focus on democratic management styles, the development of subject teams with shared goals, approaches to staff development, working with senior managers and collaborating with other departments, schools and colleges. Initial training should be followed up by a period of individual support from a mentor based in a similar school or college. Consideration would also need to be given to ways of ensuring comparable standards are met by existing subject leaders via accreditation of prior experience and refresher courses. Funding for involvement might

reasonably be expected to be supported to at least some extent from school and college budgets, given the importance of this training to institutional performance.

2. **Establish explicit and mandatory targets for teacher involvement in subject-specific CPD.** Participation in professional development must be as widespread as possible – and include teachers in all phases – in order to raise the *general* profile of mathematics and science teaching, not just the abilities of those already identified as successful. Setting mandatory targets for CPD engagement, as is the case in other professions, is central to achieving this. The Scottish requirement of 35 hours CPD per annum provides a basic model that should be extended to the rest of the UK. However, specific standards must be set to ensure that coverage includes both subject knowledge and pedagogical approaches; and that a minimum proportion is delivered by those with recognised expertise, including knowledge of the specific curricular contexts in which teachers are working. The costs of participation would need to be met primarily by incentivising self-funding by teachers, and mounting provision at weekends and during school and college vacations to obviate the need for cover for attendance at daytime courses.

3. **Provide training and development opportunities for senior managers focused on learning-centred leadership within mathematics and science.** Given the breadth of subject areas and other concerns for which senior managers have responsibility, it is less appropriate to set mandatory goals for training related specifically to mathematics and science. However, the lack of provision focused on the characteristics of effective senior managers in these areas must be redressed, with training of this kind made a focal part of current efforts to improve leadership standards more generally. The National College for School Leadership's Specialist Leaders of Education scheme provides the start point for a possible model based on guidance from those with identified high-level expertise, but this needs concerted development into a more structured programme of provision.

4. **Establish a system of collaborative exchange and development of training activity in order to systematically extend its reach across the whole of the UK, whilst retaining sensitivity to local context**. Recommendations 1 and 2 in particular entail the development and widespread delivery of coherent training to common standards. A wide range of national and local authority organisations are currently involved in CPD and leadership training, and rather than each nation attempting to promote separate growth of full provision, it would be more cost effective to pool this activity by making content readily available for adaptation to local contexts. Resourcing of this system of collaborative exchange and development would come primarily from the mixture of school/college and self-funded participation identified above.

5. **Identify or establish an overarching professional organisation to take the lead in determining agreed training standards and CPD targets and helping coordinate provision in consultation with existing training providers and subject associations.** The introduction of mandatory subject leader training and targets for subject-specific CPD requires concerted action to ensure a coherent approach is adopted across the UK. The devolved administrations within the four home nations have a role to play in incentivizing the growth of a strong professional body capable of driving this work, but the combination of political differences, lack of public funding and a need for teachers to

embrace CPD as part of their profession means that an autonomous organisation of this kind is the best mechanism for ensuring it happens.

6. **Work with the respective inspection bodies in each of the four home nations to secure monitoring of training uptake within routine reporting.** Given the number of teachers involved, the regularity of school and college inspections, and the importance attached to them, monitoring within them of adherence to mandatory training is likely to be the most effective means of policing available.

Research recommendations

There are two areas in particular in which further research is needed within the short- to medium term:

7. **The differential effects of alternative modes of ITE provision must be reassessed following the introduction of employment-based routes.** There is little evidence that the ITE route through which science and mathematics teachers receive their training has any differential impact on the skills that they take into their NQT period. However, provision within England has undergone such diversification over the last three years that it is no longer clear that this conclusion remains valid. Present circumstances provide the opportunity for a large-scale natural experiment to determine whether HE-based and employment-based training are equally effective, and it is important that this opportunity is taken whilst the training system is still in a state of flux.

8. **The defining characteristics of effective collaborative networks need to be examined in detail.** There are a variety of ways in which networks of schools and colleges are organised, dependent to some extent on national context. While the evidence was generally clear that collaboration was an important feature of effective provision in science and mathematics, it was much less clear which, if any, of the different models are more effective in establishing productive relationships and smooth transition across phases. Again, current circumstances provide an opportunity for investigating this issue in more depth, and generating evidence that will help steer future development in an informed fashion.

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Appendix A: Mapping of Literature on Teachers and Leadership for the Royal Society 'Vision for Science and Mathematics Education 5-19'

1.1 Review of research evidence

The objectives of the review are: a) to synthesise the main ideas, approaches and debates about teachers and leadership of mathematics and science education in schools and colleges in the UK; and b) to draw implications from this synthesis for further inquiry relevant to the Royal Society Vision for mathematics and science education 5-19.

The review addresses the research questions:

- What factors are associated with the incidence of high level and poor performance in science and mathematics education?
- What contribution to outcome is made by the characteristics of teaching staff, especially their ITE and CPD experiences, in terms of the structure, content and take-up of this provision?
- What role does school or college leadership play in the perception and take-up of CPD and in the identification and deployment of innovative/best practice?
- What are the characteristics of effective leaders in science and mathematics education, especially as regards their background and training?
- How far do identified patterns of influence vary according to nation, phase/sector and student characteristics?

1.2 Approach to synthesising research evidence

The review drew on a wide range of publications and other data, including inspection reports; policy documents based on directly commissioned research and calls for evidence (such as reports to the House of Commons Education Committee); evaluation reports; and research literature. Given the wide variety of potential sources of material, and the fact that much of it consists of a) grey literature with restricted circulation, and b) other resources that are unlikely to surface in response to standard online search procedures, the first stage of the exercise involved extensive consultation with members of the ERG to garner their views on important sources of evidence and to obtain their assistance in retrieving these.

A number of existing syntheses of research on effective teaching in mathematics and science, teacher education, professional development and leadership were identified as part of this process, both from within the UK and internationally. Based on usage within the more authoritative of these syntheses, as determined by international citation and the opinion of ERG members, a variety of search terms were then used to identify more specific mainstream sources of evidence relevant to each of the five core research questions. These additional publications were inspected in order to check the consistency of the points already identified and to obtain illustrations of their relevance to mathematics and science education in the UK context. Since many of them (the latter in particular) were small-scale qualitative studies or summaries of inspectorate reports, in themselves their replicability is uncertain; their value derives from the fact that they do echo wider findings. The search for publications continued iteratively until no new relevant points were identified. In this way, a comprehensive – and coherent – literature set was obtained, though it cannot be claimed to be completely exhaustive; this would be extremely difficult to achieve with any degree of certainty.

The approach taken to synthesising points from across the identified literature was similarly iterative. Where conclusions directly bearing on the core research questions had already been made, these were noted along with their supporting evidence, and built up into a composite mapping relating to each question. This mapping was then augmented by relevant points of evidence identified from other sources, and finally worked up into a coherent text, acknowledging and addressing any apparent conflicts or tensions that had surfaced. The resulting narrative was then reviewed by members of the ERG, revised in the light of their comments, and updated.

There are three particular issues noted during the preparation of the mapping document that merit highlighting here:

1) It had been hoped during the planning of the mapping stage that it would be possible to identify existing datasets that might be subjected to further interrogation in order to address the research questions. In the event, the scope for doing this proved extremely limited. With respect to England, the National Pupil Database (NPD) did make it possible to compare school performance in terms of GCSE, AS and A* results and also percentage progression rates to higher levels of study. However, this depended on a lengthy wait for Department for Education release of school code data. Moreover, the information contained in the NPD cannot be triangulated with any of the workforce census data, so it served no purpose for tracking of school performance (in these restricted terms) in relation to any of the key variables of interest. Ultimately, the main use we made of the NPD data was therefore to identify secondary schools for potential inclusion in the case study sample for the inquiry stage. The position in the remaining three countries is worse: no comparable data even exists. One consequence of this paucity was that it left us (perhaps in common with others before us) more reliant on inspectorate data and reporting than we would have cared to be – these are by some margin the most comprehensive resources available, but may contain many inherent biases. The plaint has been made before, not least by the Royal Society, but it bears reiteration: the standard of quantitative data available across the UK is parlous, shocking even, and it greatly hampers impartial secondary analysis.

2) The existing literature on workforce and leadership issues in relation to mathematics and science education is very uneven. General analysis of factors affecting school and college performance is fairly common, for instance, and some of this does address workforce and training issues to a reasonable extent. Analysis of leadership factors, especially at subject level is sparse by contrast, and this has some bearing on the weight that can be attached to the conclusions that we have drawn regarding this, although the follow-up inquiry stage built into the design of the research mitigates this.

3) A particular issue for the review itself is the sheer number of new publications relevant to its scope that appeared within the timeframe for the research. Admittedly relatively little of this has materially altered the picture that began to emerge at an earlier point, but The Institute of Education 'Policy Headlines' almost daily mailing of new journal and website links attests to the scale of activity whilst continuing to underline its variable

quality. Updating of the review has continued during the period up to preparation of this final report.

2. Policy Context

In 2007, the Royal Society noted that 'for at least the past 25 years, that is to say the span of a whole human generation' (p13) there have been concerns over the numbers of skilled mathematics and science teachers (Royal Society, 2007). Similarly in February, 2010, the DBIS Expert group reporting on science and mathematics secondary education noted that 'Science and mathematics education has been much debated. We are not the first to look at this issue … and recommendations from previous reports … retain contemporary relevance' (p7). The DBIS group provides a list of these reports and the recommendations made in an appendix (ibid., Appendix E, p90).

A common factor affecting implementation of all of the reports identified by the DBIS Expert group and, indeed, their own recommendations, is that changes in Government policies for education mean that recommendations made for improvement, when implemented, may be short-lived or inapplicable as changes unrelated to mathematics and science education are introduced. For example, the removal of dedicated funding for the Master's in Teaching and Learning (MTL) in England by the incoming coalition Government in May 2010, conflicted with the DBIS recommendation to support this as a vehicle to improving teaching quality. Specialist school status for secondary schools, associated by the National Audit Office (2010) with better outcomes in mathematics and science, is no longer available in either England or Northern Ireland.

In November 2010 the National Audit Office, in its report of a literature review and a survey of 1,274 children and young people, *Educating the next generation of scientists*, suggested that the following are critical success factors in improving take-up and achievement in mathematics and science:

- careers information and guidance
- quality and quantity of school science facilities
- quality and quantity of science and mathematics teachers
- image and interest
- availability of separate GCSE sciences ('Triple Science')

They recommended that the Department for Education in England should take more systematic action and 'develop an overarching programme with a clear logic, based on evidence of cause and effect. The programme should provide a framework with clear priorities, a well-defined critical path and appropriate measures of progress' (National Audit Office, 2010, p8). As may be seen from the table provided in Appendix A, updated from the 2010 DBIS report, many of the programmes funded under the previous Government to support science and mathematics education have been maintained under the current Coalition Government, notably the continuation of funding in England for the regional Science Learning Centres and the National Centre for Excellence in the Teaching of Mathematics (NCETM).

A significant development since some of the earlier reports is the increasing divergence among the UK nations in terms of educational policy and the recruitment, initial teacher education (ITE), induction and continuing professional development (CPD) of teachers and educational leaders. Thus although concern has been expressed in all UK nations about their country's performance in the PISA 2009 tests (for example, DfE, 2011a; Scottish Science Advisory Council, 2012; Northern Ireland Executive press release, 2010; National Assembly for Wales Enterprise and Learning Committee, 2011) the detail of strategies for addressing this concern differs between administrations.

Divergence and change in policy offer opportunities to identify the most successful strategies for improvement in science and mathematics education and the underlying policies that encourage these. However the continuous pace of change in education policy and systems in the UK has made it more difficult to identify those key actions which, sustained over time, will be effective in breaking the 'self- perpetuating cycle' of too few scientists and mathematicians for academic research and employment, and specifically, for teaching and inspiring future generations.

In Scotland, the Science and Engineering Education Advisory Group (SEEAG) was asked, through workstreams 1 and 2, to investigate similar issues to those considered here, with workstream 1 focusing on 'Building capacity and expertise of teachers' and workstream 2 on 'Practical support for teachers and learners' (SEEAG, 2012a, p8). The workstreams' report (SEEAG, 2011a) recommends that it is not only important that key actions for improving teachers' quality, skills, continuing professional development and educational leadership are implemented, but that they should be addressed together, rather than through separated initiatives if long- standing weaknesses in science and mathematics education are to be addressed.

Sustained action over time can make a difference, as can cultural factors in our society. An example of the former is the success of the TDA (formerly TTA and now the Teaching Agency) campaigns to recruit teacher trainees (House of Commons, 2012). An example of the impact of cultural factors is the eradication of the gender gap in performance in mathematics and science at age 16, noted during the 1970s (Cockcroft, 1982).

There are encouraging signs of improvement in England in the quality of science teaching, particularly in secondary schools (Ofsted, 2011a), and of the take up of all sciences and mathematics at A level, where numbers have increased year-on-year in schools and colleges in England from 2005-6 (DfE, 2012). A project led by the National Centre for Excellence in the Teaching of Mathematics (NCETM) to support the teaching of Further Mathematics has been effective in increasing numbers of entries at A level significantly. Although numbers remain small, this qualification is regarded as very important in many university mathematics departments and entries had previously fallen to a very low level. The Institute of Physics (2012) has reported increases in the numbers entering teacher training courses for physics during the period 2009 to 2011, and anticipates a further increase for 2012.

3. Core research questions

3.1 What factors are associated with the incidence of high level and poor performance in science and mathematics education?

This section summarises what is known about those things within the control of individual schools, and their leaders, which make the greatest difference to students' learning in science and mathematics. It then goes on to consider what is meant by 'high performance in science and mathematics education' at school level and how such schools might be identified.

<u>The importance of good teaching and knowing what this looks like</u>

There is a range of evidence which shows that, for factors within the control of the school or college, overall teaching quality has the greatest effect on the learning of students. Work to define and describe good teaching has been the focus of much research in the UK and internationally.

A recent report from NFER *Mapping of Seminal Reports on Good Teaching* (Rowe et al., 2012) defined good quality teaching as 'ensuring that all pupils achieve, by developing every individual pupil to the best of their potential and ability' (p7). Rowe et al. considered 25 reports, selected from research conducted since 2006, and used these to identify those factors about teaching, teachers and the teaching environment which were consistently found to have positive effects on students' learning. The reports selected were chosen as high quality and representative, in the judgement of the authors, and to give a variety of perspectives and include literature reviews, international comparison studies and school inspection evidence. The credibility of the conclusions is based on the high degree of consistency and lack of contradictions. Findings on teacher characteristics are discussed in section 3.2 of this mapping report with some of the teaching environment factors discussed in sections C and D, with reference to the role of leadership.

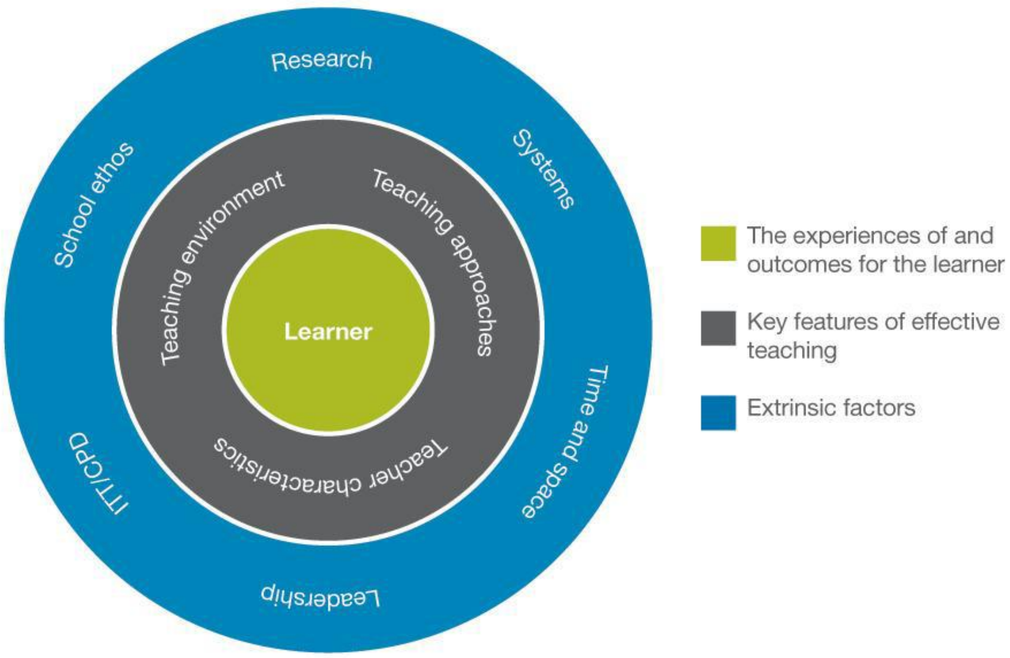

Figure 1: The key features of good teaching (Rowe et al. 2012)

The report emphasises that good teaching is adapted to the context of the school and that good teachers will select from a range of strategies to meet the best needs of a particular group of pupils. The impact of good teaching does not depend on the actions of individual teachers alone, but on the culture and context in which they work. Thus, Rowe et al. use the analytical frame, reproduced above. Rowe et al.'s conclusions from the literature on these aspects are summarised in the following table:

Table 1: The key features of effective teaching (Rowe et al. 2012)

Teaching environment	**Teaching approaches**	**Teacher characteristics**
Calm, well-disciplined, orderly	Interactive (e.g. working and learning together – social constructivism)	Good subject knowledge
Safe/ secure	Use of teacher- pupil dialogue, questioning	Self- efficacy, belief
An ethos of aspiration and achievement for all	Monitoring pupil progress (including the use of feedback)	High expectations
Positive emotional climate	Pupil assessment (including Assessment for Learning)	Motivational
Purposeful, stimulating	Pupil agency and voice (active engagement in their learning)	Provides challenge
Bright, attractive and informative displays	Enquiry- based	Innovative/ proactive
Clean, tidy and well-organised	Effective planning and organisation	Calm
New or redesigned buildings/ spaces	Scaffolding learning	Caring
Lower class sizes	Building on the prior experience and learning of pupils (a constructivist theory of learning)	Sensitive
	Personalisation, responding to individual needs	Gives praise
	Home- school learning, knowledge exchange	Uses humour as a tool
	Use of new technology/ ICT	Engenders trust and mutual respect
	Collaborative practice	Flexible (where appropriate)
	Good use of teaching assistants (TAs)	Builds positive relationships with pupils (relationships for learning)
	Creative use of visits/ visiting experts	Self- reflecting

The NfER report is not subject specific, but the points they identify as being consistently noted in the research considered for their review are also relevant for mathematics and science teaching. However, other research, although not contradicting the generic findings synthesised by Rowe et al. point to additional factors which are important for the teaching of mathematics and for science.

In a Best Evidence Synthesis for the Ministry of Education, New Zealand, Hipkins et al. (2012) note features that are specific to science education including:

- 'the teaching approach used emphasises the place of models, modelling, metaphor and analogies in both science and science education, so that students learn science, learn to *do* science and learn *about* science' (p125);
- '"Nature of science" learning outcomes are achieved when students recognise that science theories are … tested against evidence that has been systematically collected from the natural world.' (p135);

Hipkins et al. note from the evidence reviewed that practical work is considered to be important in science education, but that this should include opportunities for inquiry, in which students formulate and test their own ideas, as well as to illustrate scientific content

The Advisory Committee on Mathematics Education (ACME) conducted research over the two years 2009-11 to consider mathematical needs in England from the perspectives of, on the one hand, the learners themselves and, on the other, on the requirements of Higher Education and employers. In their report on learners' needs (ACME, 2011a,b), they note the need for a secure understanding of key underpinning concepts and the relationships between them, calling for skilful teaching which enables learners to develop both procedural and conceptual understanding through a programme which provides opportunities to use their mathematics in meaningful contexts and to make links to other concepts. Good teaching builds on prior learning and develops conceptual understanding from a sound mastery of material encountered earlier. Importantly, learners should be given sufficient time to develop understanding and confidence in their own abilities to do mathematics.

Poor teaching in mathematics, on the other hand, may mean that even successful students find their lessons boring and depersonalised, with few opportunities for collaboration, and in which they engage only out of sense of obligation (Nardi and Stewart, 2003). A key concern in the Ofsted (2012a) report on mathematics is the variation in the quality of teaching, with good and poor practice occurring in the same school, as well as between schools.

Conclusions about good teaching and learning for mathematics and science are consistently expressed in other research from the UK and overseas (ACME, 2011a; Anthony and Walshaw, 2007; DfE, 2011a; Hipkins et al., 2002; Noyes et al, 2011; Ontario Ministry of Education (n.d.), Royal Society, 2007, 2008a, 2010, 2011; Siraj-Blatchford et al., 2011). The UK inspectorates' descriptors of good subject teaching reflect similar points. (Estyn, 2010, 2011; ETI, 2010; HMIE, 2010a, 2010b; Ofsted, 2010a, 2011a,b,c, 2012a, b).

Planning for progression

Given the importance of building on previous experience and learning, noted above, the transition points when learners experience changes of teacher, move from year to year within a school and from one institution to another require excellent planning and communication between teaching staff if progress in learning is to be maintained. However, concerns have been repeatedly expressed.

The Educational Inspectorate in Northern Ireland (ETI) reported in 2010 on progress in mathematics following the transition from primary to post-primary (secondary in the rest of the UK). Lessons observed differed widely, with just over 60% of lessons observed in primary schools very good or better and just under 30% very good or better in post-primary schools. In post- primary lessons, pupils often worked on repetitive exercises and were not challenged, often repeating work done in primary school. Teachers knew little about the curriculum in a different phase (ie primary did not know much about post-primary and vice versa. Post primary teachers did not use data from primary (ETI, 2010). Ofsted (2012a) noted the problem for mathematics of the lack of planning for consistency and coherence over time, both between year groups within a school and on transfer between schools. In secondary schools, pupils may begin on the GCSE curriculum, increasingly in Year 9, without completing and understanding essential elements of the key stage 3 curriculum. Problems of transition recur following GCSE, where algebra skills may be insufficiently developed for students to cope with the GCE curriculum. There is evidence that students in 11-16 schools are less well prepared for transition to A level mathematics in England, because there is less of an overview of the 14-19 pathway (Noyes et al., 2011)

Issues on transition from primary to secondary school in science were considered in a publication from the Wellcome Trust (Galton, 2009) and considered various approaches to addressing the dip in engagement and achievement in the first few years of secondary school, such as bridging projects. Galton's article argues that such projects are of limited use as issues of progression may be subsumed within the challenge of improving pedagogy in both primary and secondary schools, which, he claimed, has failed to show substantial development despite a large number of initiatives for improvement. Ensuring progression in learning may also mean overcoming barriers which have not been addressed at an earlier stage or issues, such as anxiety about mathematics, which may have been exacerbated by poor experience earlier. A recent comment based on a literature review of research on practice in adult basic skills provides a succinct summary of the challenges faced:

Effective practice in numeracy occurs where teachers build on knowledge learners already have and help them overcome their fear of maths, expose and treat misconceptions as a subject for discussion, promote reasoning and problem solving over 'answer getting', and make creative use of ICT. However, although much is known about what is effective in teaching and learning, these practices are often not observed in delivery (Vorhaus et al., 2011, p 12).

Staff deployment

Ensuring that all students experience the good teaching that enables them to learn effectively depends on the availability of teachers with the required skills and qualities. A report produced by NFER in 2006 (Moor et al.,2006) on the deployment of staff in schools in England found that, in secondary schools, the least-qualified teachers taught the lowest sets, a finding echoed in the most recent Ofsted (2012a) report on mathematics. Analysis of 2010 School Census Data in England (DfE, 2011d) showed that, judged by performance in GCSE examinations, those schools performing most poorly had a slightly lower proportion of teachers with a degree or higher level qualification. The implications of this may be inferred to be of concern from data in the same report which shows that only 51% of hours of mathematics teaching in secondary schools were taught by teachers with a degree- level qualification in the subject, with corresponding figures 80% for biology, 67% for chemistry, 67% for physics and 79% for combined science. For comparison, for English, the figure is 72% (DfE, 2011d). Comparable data for the rest of the UK have not been located. The triple science option, for students to study biology, chemistry and physics as separate subjects at GCSE level is, when available, usually offered to more able pupils. The availability of biology, chemistry and physics specialists is not only likely to restrict the capacity of schools to offer a triple science option for GCSE, but may also, perhaps, affect the ability of schools to staff both this option and combined science courses for less able pupils with teachers with specialist subject expertise.

Classroom-based support staff are now common in primary and, to a lesser extent, in secondary classrooms. A DfE summary of research findings (Whitehorn, 2010) presented mixed evidence from research on the impact of support staff on pupils' academic progress in general, but concluded that effective training, preparation and deployment is essential in maximising their impact. Specifically in relation to mathematics and science, based on an evaluation in 2007, staff in schools that formed part of the pilot specialist secondary mathematics and science HLTA programme gained in confidence and subject knowledge and took on more responsibility, with benefits to staff and students in the subject departments (TDA, 2007). Technician support is considered to be essential in enabling students in secondary schools and colleges to undertake practical work and the DBIS (2010) Expert group recommended that the availability of technician support for teachers should be tracked. Support staff, including science technicians, need to be effectively trained and supported in their role (Association of Science Education, 2012) so that findings on effective CPD and leadership for teachers are also applicable to this sector of the mathematics and science teaching workforce.

<u>Careers education and the image of science and mathematics</u>

Both careers education and guidance and what is called 'image and interest' figure in the National Audit list of critical success factors for improving take- up and achievement in mathematics and science (ibid.). The Education Act of 2011 places full responsibility for securing careers advice and guidance with schools in England from September 2012, requiring that arrangements are made according the school's assessment of the needs of their pupils and with costs to be met from the overall school budget. Although the national STEM centre and its regional partner organisations offer access to enrichment opportunities throughout the UK, the opportunity to benefit from such activity is dependent on schools' participation and the commitment of its teachers.

In most cases, evaluations of STEM careers education or of engagement and enrichment activities consider the impact of an intervention in isolation, rather than by considering the activities as contributing to a holistic approach to raising achievement in mathematics and science. Summaries, provided as case studies, of several evaluation reports are in a resource published by the National STEM Centre (2011) and show the impact of individual schemes on motivation and enjoyment of pupils. Initiatives on careers education, for example, that described in an evaluation by Finegold (2011) of a pilot programme to embed awareness of STEM careers in pupils in the first two years of their secondary education in England are also positive on impact. Bennett et al.'s (2011) study differs in taking as a starting point the identification of factors that resulted in higher take- up at A level of physical sciences. The National Pupil database was used to identify four matched pairs of schools, of similar type, size, with a similar composition of student body, GCSE curriculum offer, examination results and Ofsted judgements, but with different levels of take- up of Physics and Chemistry at A level. Quantitative analysis established that schools with very similar characteristics may have significantly different percentages of pupils continuing the study of physical sciences.   Bennett et al.'s qualitative work paired schools with high levels of progression to physics and chemistry with others which had low levels, compared to the national average. One matched pair was of 11-16 schools and the rest were 11-18 schools. From their case study evidence they concluded that the following school factors were important in those schools that were more successful in encouraging pupils to study physics and/or chemistry post 16: Careers advice and activity, including extra- curricular careers-related activity; Well-organised work experience; Extra- curricular careers promotion such as visits to local industry and universities, opportunities to take Nuffield scholarships, participation in science weeks, and holding careers days with external speakers.

Finegold's evaluation emphasised the importance of school level factors to the success of the initiative, noting that commitment to STEM from senior managers was vital in communicating its status among staff, in establishing the right ethos, providing adequate resources and appointing a member of staff with a clearly defined role to coordinate activity. It may be possible that similar school factors, as well as the enthusiasm and energy of individual teachers of mathematics and science, are important in contributing to the positive impact of all STEM careers education and other activities to improve the image of science and mathematics.

Availability of resources for practical work.

An additional factor from the National Audit Office list is the availability of provision for practical work. Although resourcing facilities and equipment is the responsibility of individual schools, it is not directly related to the workforce issues that are the focus of this mapping. However SCORE, a collaboration of the Association for Science Education, Institute of Physics, Royal Society, Royal Society of Chemistry and Society of Biology, is in process of conducting a survey of schools to determine the availability of suitable facilities (SCORE website, December 2012)

Identifying individual schools and colleges with good and poor performance in mathematics and science

The challenge of identifying schools with successful practice has also been considered in the USA and is relevant to the UK context. The National Research Council's Committee on Highly Successful Science Programs for K-12 Science Education (National Research Council, 2011) was asked to outline criteria for identifying effective STEM schools and programmes (focusing on mathematics and science) and identifying which of these criteria could be addressed with available data and research, and those where further investigation was needed. They give three goals for STEM education: increasing the number of students in advanced study of the subjects; increasing the size of 'STEM capable' workforce (for jobs such as subject teaching etc); increasing STEM literacy for all. For all goals they want to include equity issues relating to participation of women and minorities. They note that such goals are unlikely to be overtly adopted by schools, but that intermediate goals might include progression onto STEM courses at a more advanced level and achievement test scores.

The Committee then considers different approaches for identifying criteria. Test scores are considered useful, but the need for interest, motivation, creativity and commitment to ethical behaviour are also important in relation to student outcomes. Test score data also does not provide information about practices and conditions that might be helpful in improving other schools. They say that another necessary factor is a supportive system of assessment and accountability, with ways to access other information than test scores and to capture the qualities of enquiry-based teaching. They give examples as student course surveys, frequent classroom observation and sampling by external reviewers.

In the UK external review is provided by administration inspectorates and individual school and college inspection reports may be used to identify those settings where the overall quality of teaching and the progress of students is good or outstanding. Some of the inspection reports include information which indicates particular strengths and weaknesses in mathematics and science. A few outstanding settings have been described in detail through case studies available on the inspectorate websites (for example, Ofsted, 2011c, d, 2012b). Also published are reports on survey visits made by inspectors which contribute to subject reports. ACME (2011a) used intelligence from local authority advisers or equivalent to help identify those schools with the outstanding teaching practice described in their report.

Examination results are more readily accessible at school level, for example through the school performance tables published in England for both primary and secondary schools and the data published for secondary schools in Scotland. The English data includes information about mathematics performance at ages 11 and 16, but not science, with the Scottish data giving the number of subjects passed at different levels. Examination data may be misleading as a measure of teaching and teacher quality (for example, Goe and Stickler, 2008). 'Teaching to the test' was discussed in the Royal Society(2010) report on primary science and mathematics education, *Science and mathematics education 5-14*, *A State of the Nation report*, and most recently identified in the Ofsted report *Mathematics made to measure* (2012a) as contributing to repetitive and boring teaching which fails to engage and enthuse pupils, although it may contribute to better examination outcomes in the short term (Venkat and Brown, 2009). The DfE report on Early GCSE entry (DfE, 2011b) suggests that this practice may contribute to poorer pupil outcomes and deter students from continuing to study the subjects involved at advanced levels. ACME (2011c) expressed particular concern about this practice in mathematics, suggesting that in order to ensure the maximum number of students attain a Grade C schools may use the 'easiest means possible rather than focusing on the underlying quality' (p1). In contrast, Collins et al. (2010) found more opportunities for investigative science work in Y6 classes in Wales than in England in a study conducted in 2007-8. Key stage testing has not taken place in Wales since 2004 and the study was conducted just before key stage 2 and 3 tests in England were discontinued. The removal of the requirement for end-of-key-stage testing was considered by Ofsted (2011a) to have contributed to innovation and enrichment in teaching and greater inclusion of scientific enquiry. This is a rapid change from the situation discussed in the Royal Society (2010) report, where test pressure was considered to limit the opportunities for engaging both primary and secondary pupils in 'doing' science, as opposed to acquiring facts.

The number of students who choose to continue the study of mathematics and sciences at an advanced level, either at the same or a different school or college, may be an indicator of good practice, and the National Pupil Database in England offers a way to identify those schools which are more or less successful at motivating pupils to continue study of mathematics or science. DfE analysis of the database found that, in general, pupils with higher grades in the subject were more likely to continue to A level study, with the highest impact of grade in mathematics, with high progression from A* and A, but low from B and C grades. 11-18 schools have slightly higher progression rates across all grades and subjects than 11-16 schools and independent and grammar schools had higher progression rates, reflecting the higher GCSE grade distribution in these schools (DfE, 2012b).

Bennett et al.'s (2011) use of the NPD to identify schools with high take- up rates in Physics and Chemistry has been referred to earlier. As part of evaluation work on 14-19 curriculum pathways in mathematics, Noyes and Sealey (2011) also used the National Pupil Database to identify schools for further case study work. The quantitative element of their work affirms the strong correlation between high achievement at GCSE and subsequent takeup of A level study. Their article provides a detailed picture of the key role of a Head of Department in encouraging progression through specific practices such as additional sessions on algebra for Y11 students in what they believe is an atypical school.

Noyes and Sealey suggest that, as well as factors within the control of the school, the recent increases in A level participation are at least partly due to cultural factors, such as greater awareness of the lifetime economic benefits of qualifications in mathematics. Research by the Wellcome Trust (2010) and Jinn et al, (2011) provide evidence of the wide range of factors influencing pupils' subject choice. Many of these, such as the influence of parents and relatives, are difficult to influence by individual school actions.

Another approach to identifying schools with successful practice is by considering those which took part in CPD or other activity which has been shown to have an impact on examination results and which may also contribute to good teaching. The National Audit Office (2010) in its report, *Educating the next generation of scientists*, used multiple regression analysis to investigate the relationship between intervention programmes put in place through the *Science and Innovation Investment Framework* (2004) and outcomes in terms of participation and achievement. Specialist school status (now discontinued in England and Northern Ireland), participation in enhancement and enrichment activities, Science Learning Centre training days, STEM ambassador activities and the 'Researchers in residence' programme were all found to make a significant difference to the numbers of students gaining grades A* to C at GCSE and A to C at A level in science subjects and mathematics.

Summary points:

Key Factors contributing to high performance in mathematics and science are:

- **Good Teaching**

There is high consensus, among researchers, policy makers and practitioners about the importance of good teaching. There is similarly high consensus about the characteristics of good teaching which apply to all subjects and also about those which are specifically for mathematics and for science. There is agreement that good teaching focuses on understanding, achievement and progress for all learners and that it promotes engagement and enthusiasm for the subject, as well as high examination performance.

- **Planning for progression**

The importance of teaching that builds on secure prior knowledge and understanding is recognised in the research literature. Issues of progress at transition when students move from class to class, from school to school and from one level of study to another (such as from GCSE to A level) are sources of concern.

- **Staff deployment**

The Royal Society 2007 State of the Nation report, *The UK's science and mathematics teaching workforce,* drew on detailed research on staff deployment in England (Moor et al., 2006). More recent detailed and comprehensive data has not been identified. However, evidence from School Census data in England suggests that teachers in mathematics and science subjects, especially physics, do not all have degree- level qualifications in the subject taught. Ofsted evidence further suggests that the least qualified teachers continue to be deployed to teach lower sets. There is limited evidence about the deployment and impact of support staff in either mathematics and science .

- **Careers education and the image of science and mathematics**

There is evidence to suggest that careers education and enrichment activities can contribute to both enthusiasm for mathematics and science and for continued study of the subject. Evaluations of initiatives have tended to consider the impact of a short- term intervention in isolation, rather than as part of an overall strategy to raise performance in mathematics and science.

- **Identifying individual schools and colleges with good and poor performance in mathematics and science.**

Although there may be agreement that 'good' performance in mathematics and science education is of enabling confident, skilled and enthusiastic students to continue to all levels of further and higher education and employment, evidence from the USA shows that there is considerable challenge in identifying suitable measures for such performance. The information available in the public domain in the UK for identifying schools with good performance is limited, particularly for Scotland, Wales and Northern Ireland.

3.2 What contribution to outcome is made by the characteristics of teaching staff, especially their ITE and CPD experiences, in terms of the structure, content and take-up of this provision?

Measures for good teaching and for good teachers are problematic (Grunow et al.,2011; Goe and Stickler, 2008). There is general consensus that good teachers, in all subjects, have both excellent subject knowledge and subject- specific pedagogy, together with enthusiasm, high expectations and the ability to engage their students (House of Commons, 2012) but the debate on how best to measure teacher quality is ongoing (for example, the debate on the use of value-added measures in the USA (New York Times, 6 January 2012). This section looks at what is known about different ITE routes in the UK, concluding that, although the ITE route may make little difference to the quality of teachers, the school- based induction and support in the early stages of a teacher's career do make a difference to the likelihood that the teacher will stay in the profession once trained.

There is, similarly, consensus about the ongoing need for CPD throughout a teacher's career. CPD is necessary for keeping all good teachers up-to- date with developments in their subject area and with research evidence on teaching and learning. CPD is also essential for improving the quality of teaching for those who lack the skills and subject expertise to ensure that their students have the best opportunity to learn. This section looks at some of the challenges in improving teachers' practice. Evidence on successful change in teaching and learning emphasises the role of leadership, which is considered in more detail in Section 3.3.

<u>Initial Teacher Education (ITE</u>)

The ITE route taken in the UK is not a reliable indicator for good teachers and teaching. Evidence taken in England for the Education Committee's Report *Great teachers: attracting, training and retaining the best* (House of Commons, 2012) indicated that the routes taken for initial training of teaching staff were all effective in preparing teachers to teach, although the committee recommended that universities should contribute in partnership with schools to enable the development of subject and research knowledge, alongside practical skills. Newly Qualified Teacher (NQT) survey reports are based on surveys sent to all NQTs in February of the year following completion of ITE, asking them to rate the extent to which their ITE had prepared them for teaching. Satisfaction ratings are at their highest level ever in nearly all categories for teachers completing training in 2010, including in preparation for teaching their subject. Concern raised in an earlier Royal Society report (2007) about the subject- knowledge preparation for teachers in employment-based routes have been largely addressed (Evans et al., 2008). In a new question for 2011, 80% of those in employment based initial teacher training (EBITT) for primary teaching considered that their preparation was 'very good' or 'good' for teaching mathematics, compared with 82% on University routes and 87% in School centre initial teacher training providers (SCITTs). For comparison, these figures are much higher than for preparation to teach phonics and comprehension (average 58% 'good' or 'very good'). Overall 85% of maths and 79% of science secondary trainees responded 'very good' or 'good' for preparation to teach their subject (Teaching Agency, 2012).

In a wide-ranging literature review conducted for the Scottish Government, Menter et al. (2010) found that any differences between training routes which may be evident at the entry into the profession are eliminated within five years of qualifying. DBIS (2010) concluded that it is most important to maximise the number of qualified maths and science teachers available and that funds should be made available to enable all suitably qualified applicants to access training through standard and non-standard routes.

<u>Retention following Initial teacher education and the importance of the NQT induction year</u>
The proportion of teacher trainees in mathematics and science who do not take up a teaching post at the end of their PGCE year is relatively high. Smithers and Robinson (2011) found that 70% of those who had begun training to be mathematics teachers in 2009/10 were in a teaching post in the following school year. The corresponding figures for science subjects were 66.2 % for physics, 65.0% for chemistry, 71.8% for biology and 70.7% for general or combined science. The Institute of Physics (2012) noted that 15% of trainees did not complete their training course. To improve retention, the IOP is facilitating peer groups of physics teachers, with the hope that both trainees and teachers in the early years of their career with benefit from support and mentoring from their network. Between 2009 and 2011, the TDA provided funding for a two- year pilot programme for mentoring approximately 800 trainee and early career teachers of secondary science and mathematics, which ran between and for an evaluation of this programme (MacLeod et al., 2012). The programme was designed so that mentees who were either in their PGCE, NQT or post-qualifying year could access the support of trained mentors who were not part of their school or training provider and, as such, took no part in assessment of these beginning teachers. Mentors were recruited and trained to provide support in a range of ways, with the mentees choosing the pattern of support that best suited their needs. The flexibility, responsiveness and independence of the support provided was valued highly by mentees, who opted in to the programme. MacLeod et al. conclude that the mentoring programme was successful, both in terms of improving the confidence and skills of trainees and encouraging them to stay in the profession. They also conclude that it was cost- effective, saving more than the setting up and running costs through improving progression from training to teaching and subsequent retention in the profession. Additional mentoring support is a prominent feature of the TeachFirst training route, available throughout the two- year programme and this may be a contributory factor to the generally high quality of teaching seen at the end of their first year of training (Ofsted, 2011f). However TeachFirst trainees were only 1.2% of the 38,429 mathematics and science teacher trainees in 2009/10 (81 mathematics and 82 science). Data from earlier cohorts suggest that only half are expected to stay in teaching. Further expansions of TeachFirst planned under the Coalition Government will make little impact on the quality of teaching overall. However, as TeachFirst graduates are employed in schools in challenging circumstances, their impact for some students in disadvantaged circumstances may be more significant than the overall totals suggest.

A summary of research conducted on behalf of the Wellcome Trust (2011) concludes that a one-year course of teacher training provided by a Post-graduate certificate in Education (PGCE) secondary science course is insufficient to ensure sufficient subject knowledge and subject-specific pedagogy. Continuing Professional Development (CPD) which begins in the induction year and continues through the early years of teaching is essential for confident and skilled teaching of science. For mathematics, the Curriculum for Excellence Maths Excellence Group in Scotland (Wiliam and Thoreson, 2011) make a similar point, as also did Williams (2008) in his review *Mathematics Teaching in Early Years Settings and Primary Schools*

'… it is the conclusion of this review that, in the short term, it is unrealistic to seek improved competence levels in mathematics teaching in primary schools by placing higher hurdles in front of training teachers as they enter their training course; and that it is equally unrealistic to seek to introduce significant new mathematics materials into the majority of what are already full undergraduate and PGCE courses. If the arguments … on the need for subject and pedagogical knowledge depth are accepted, then the only remaining route to raising mathematical understanding among the teaching profession in the primary sector is through properly funded and rewarded continuing professional development. (p 12)

<u>Induction for newly- qualified mathematics and science teachers</u>
Longitudinal research qualitative research over four years, based on a sample of 50 new entrants to teaching in the USA by Johnson (2004) suggested that the expectations of beginning teachers for support and development are not being met in all schools and that this contributes to high rates of 'wastage' from the system. There is evidence that induction could be used to better effect to develop the subject knowledge and subject pedagogical skills of new entrants in <u>all</u> subjects, as well as in encouraging them to continue in the profession, and that the quality of mentoring should be improved (House of Commons, 2012a). IPSOS Mori (2010), in examination of data on teachers in their fourth year of teaching, found that teachers of mathematics and science were no more likely than teachers of other subjects to be considering leaving the profession.

> Amongst secondary and primary teachers, there are no differences between specialists in terms of their intentions to remain in teaching, nor are there any apparent differences in reasons for leaving teaching or factors motivating teachers to continue in their career (p 4).

Haggarty et al. (2011) used surveys and interviews to investigate experiences of the induction year among secondary mathematics and science NQTs in England, finding that the induction year fails to build reflective pedagogy, focusing instead on practical issues such as behaviour management. Induction tutors do not use the opportunity to encourage reflection on teaching and learning and see their role as helping mentees to settle in to school routines. However, school routines and support for more generic skills may be essential in encouraging retention and were identified in the Wellcome Trust (2011) research as priorities by the NQTs themselves. The *Becoming a Teacher Project (2003-2009)* in England explored beginner teachers' experiences of training, Induction and early professional development. The project covered both primary and secondary teachers and all subject areas. Hobson et al. (2007) reports on findings which explore the experience NQTs, based on telephone survey evidence from 2446 teachers, face- to- face interviews with 73 and e- mail exchanges with 46, supplemented by face- to- face interviews with 27 induction tutors. They found that the most immediate concerns are those of managing behaviour and of challenging relationships with pupils and parents. They note the importance of understanding and taking account of the emotional aspects of development as a teacher, such as role- identity, confidence, self- efficacy and motivation. In an international comparative study of training of mathematics teachers, Burghes (2011) concludes not only that retention of mathematics specialists in the profession is a key factor for improving the quality of mathematics education in England, but also that better school-based support and CPD could improve retention. The longitudinal study was based on a sample of approximately 200 primary and secondary mathematics teacher trainees on a PGCE route, and included interviews in both the training and the induction year. The research team were surprised to find, that in the training year, approximately half of both primary and secondary trainees envisaged a lifetime's career in teaching. In practice, approximately 15% of their sample failed to take up a teaching post or left at the end of the first year. In line with Hobson et al's findings, they noted that beginning secondary teachers in particular are concerned about the challenges of managing behaviour, as well as having a good knowledge of teaching strategies. Lack of support from the school and a 'blame' culture in relation to behaviour issues, lack of opportunities for professional development and overwhelming paperwork were cited most frequently as reasons for leaving the profession.

Continuing Professional Development (CPD)

CPD has been identified in an international review as being more efficient in improving the quality of teaching than investing further in initial teacher training, for example by extending the length of the latter (Musset, 2010). Relying on improvements in ITE to raise the quality of teaching would take a long time given that the number of new entrants to the profession is small in relation to the number of teachers already in schools. In UK nations the need for career- long professional development, including subject knowledge enhancement and the development of leadership has been identified for all teachers and for those teaching STEM subjects in particular (for example, DBIS, 2010; Donaldson, 2010; Estyn, 2010; House of Commons, 2012a; Welsh Government, 2012a). The literature review on teacher education by Menter et al. (2010), commissioned by the Scottish Government for the Donaldson report (2010), analyses extensive evidence which indicates that professional development has an impact on outcomes in all subjects.

The New Zealand Ministry of Education *Teacher Professional Learning and Development Best Evidence Synthesis Iteration* (Timperley et al., 2007) is based on a core of 97 individual studies and groups of studies that met a set of methodological criteria (Alton- Lee, 2004) and had substantive student outcomes associated with teacher professional learning and development. The range of outcomes included personal, social, and academic attributes together with a number of supplementary studies which were used to complement the analysis of the core studies. These studies either met the methodological criteria but reported limited or no change in student outcomes, or had substantive student outcomes but did not provide sufficient methodological details to allow for judgments to be made about the links between professional learning and student outcomes. Timperley et al.'s synthesis confirmed that continuing professional development can improve students' learning, but that effective CPD or what they term 'Professional Learning and Development (PL&D)' was characterised by some key contextual features:
Seven elements in the professional learning context were identified in the core studies as important for promoting professional learning in ways that impacted positively and

substantively on a range of student outcomes: providing sufficient time for extended opportunities to learn and using the time effectively; engaging external expertise; focusing on engaging teachers in the learning process rather than being concerned about whether they volunteered or not; challenging problematic discourses; providing opportunities to interact in a community of professionals; ensuring content was consistent with wider policy trends; and, in school-based initiatives, having leaders actively leading the professional learning opportunities.In addition to the influence of context, research has also shown that content and approach to delivery are important. That is, PL&D that integrates theory and practice, builds links between teaching and learning, utilises a variety of content, and where understandings are discussed and negotiated produces better outcomes. (Timperley et al., 2007, pxxvi)

In a more recent, non-systematic, summary of research on professional development, prepared for use by schools participating in collaborative CPD as part of Teaching School Alliances (National College, 2012), Stoll, Harris and Handscomb draw on the findings of Timperley et al.'s best evidence review and, in a continuation of the iterative process which draws in more recent studies and reports, propose nine claims for 'Great professional development that leads to great pedagogy' based on research, noting that these are interconnected:

1. Effective professional development starts with the end in mind.
2. Effective professional development challenges thinking as part of changing practice.
3. Effective professional development is based on assessment of individual and school needs.
4. Effective professional development involves connecting work- based learning and external expertise.
5. Effective professional learning opportunities are varied, rich and sustainable.
6. Effective professional development uses action research and enquiry as key tools.
7. Effective professional development is strongly enhanced through collaborative learning and joint practice development.
8. Effective professional development is enhanced by creating professional learning communities within and between schools.
9. Effective professional development requires leadership to create the necessary conditions. (Stoll et al., 2012, p2)

Effective CPD in general thus focuses on pupil outcomes and learner needs (Bubb and Earley, 2007) and needs the support of leaders (Ofsted, 2010b). Professional development should be planned to meet the needs of individuals, and institutions. Evidence suggests that when undertaken in a systematic way across the school workforce, staff development underpinned by performance management can lead to improved outcomes for pupils and staff (Walker et al. 2011). Evaluating impact should be planned from the start (Earley and Porritt, 2009; Guskey, 2000). In mathematics and science, strong effects of professional development on practice are found where it recognises the teacher's context , is sustained over time, is focused on how to teach specific kinds of content, how to use specific pedagogical skills and on analysis of learning, including conceptual understanding and skills (National Research Council, 2011). Research and enquiry and collaborative learning, including professional learning communities, lesson study, coaching and mentoring can contribute to effective professional development (Cordingley, 2009; Joyce and Showers, 2002; Burghes and Robinson, 2009).

Stoll et al.'s (2012) summary considers the approaches to CPD that lead to positive change at teacher and classroom level and this approach is followed in the following paragraphs. The NFER review of research *What leads to positive change in teaching practice?* (Maughan et al., 2012) considers change from an institutional level and highlights the key importance of leadership. This is considered in more detail in Section 3.3.

<u>The impact of CPD on the quality of teaching in mathematics and science</u>

The impact of collaborative work <u>between</u> schools is reported in Hill and Matthews (2010), who provide data and case studies to show how the National Leaders of Education programme has successfully raised the quality of teaching and learning in National Support Schools, with senior and middle leaders from the home school working with heads of department, including in mathematics, to analyse successes and issues and share good practice. Strong partnership working between schools and colleges, was noted as effective in the HMIE (2010b) report on Life Sciences, based on visits to eight colleges and good partnership working by a London FE college with local schools in science is presented as an Ofsted good practice case study (2011c). An evaluation of the work of the NCETM found that several of the projects with successful outcomes were across school/college boundaries (Sheffield Hallam University, 2010). Collaborative work between schools is a focus of some current Government policies in the UK. Professional Learning Communities (PLCs) have been developed in Wales to improve pupil outcomes and to focus on literacy, numeracy or addressing disadvantage (Welsh Government, 2011b). Teaching School Alliances (TLAs) in England have been funded to use an action- research approach to joint working on a common theme. In many cases these are built on existing networks of schools (National College, 2012). In Scotland, the Science and Engineering Education Advisory Group (2012a) report notes successful initiatives for professional learning communities for STEM subjects and recommends that these should be supported and encouraged by the Government, by Universities and by local authorities as a means of effective professional development and innovation.

The Ofsted (2011a) report on science, in commenting on the good or outstanding CPD that it found in most secondary schools, noted that sharing good practice, including when teachers had attended external courses, was found to improve teaching. This Ofsted report referred favourably to the work of the Science Learning Centres in the provision of high-quality external training and on its impact on teaching practices and pupils' learning in the schools visited, although it noted that this provision was not sufficiently used by primary schools. Science Learning Centres are also increasingly providing CPD within schools, tailored to their needs. Evaluation of training offered by the *Support for Science Education in Scotland through CPD* programme showed positive impact on the practices of teachers and technicians attending (Hall et al., 2011). The same report shows that two- thirds of the schools in Scotland accessed the programme over the two years from 2009-11.

National and regional Science Learning Centres are funded by the Wellcome Trust, and opened in 2005. The National Centre provides CPD opportunities for primary teachers, secondary/post 16/FE teachers and lecturers of science, design and technology and psychology, teaching assistants and technicians throughout the UK. The recent *Evaluation of the Science Learning Centre Network* (Clarke and Thom, 2012a), commissioned in 2009 by the DfE and The Wellcome Trust, investigated the effectiveness and impact of CPD offered by the centres. They found that awareness of and usage of the National and the regional centres have grown steadily, although primary schools lag behind secondary and further education sectors in both awareness and usage. The *Enthuse* evaluation report for 2010-11, (National Science Learning Centre, 2012) found that 53% of all mainstream, state, secondary schools in the UK have used the National Centre since it opened in 2005 and 98% of all secondary schools and colleges in England have used the network of regional Science Learning Centres (SLCs). Clarke and Thom found that the main barriers to attendance identified by teachers were around senior management commitment and a reluctance to spend time away from their pupils. Teachers felt that impact of training was most likely to be found in increased engagement and enthusiasm among their pupils as a result of changes to teaching that they made following course attendance. Clarke and Thom also claim a link to improved attainment in secondary schools using the centres:

Looking beyond students' enjoyment and engagement, there is a positive association between SLC usage and improvement in science attainment. Linked SLC usage and school performance data suggests that SLC-using schools have been improving their science attainment faster than the national average, and faster than wider attainment in the school. (p iii).

The strategy adopted in identifying this link was to plot all secondary schools which had used the SLC network between 2006 and 2009 against their performance in science at KS4 in 2009 and 2010, with the different time periods intended to capture effects as new approaches were introduced in schools following attendance at an SLC. They found that, as usage of the SLC network increases, the proportion of pupils achieving two grades A-C* which cover the KS4 science programme increases. The association is, however, weak (Clarke and Thom, 2012b).

Participants on science learning centre courses are provided with an impact tool, which they can use as a framework for identifying their own individual learning intentions and for identifying and recording changes in their own practice, the change within their school or college team and the changes in students' learning. In addition to Clarke and Thom's finding, other external evaluation reports on impact provide further encouraging evidence of the impact on teaching practice and on students' learning. (National Audit Office, 2010; Bennett et al., 2010; Rietdijk et al. 2011, Scott et al. 2010).

The effectiveness of involvement in research as part of CPD in science is demonstrated in work from Australia by Berry et al. (2009) as well as in work from the UK. For example, the 'Action Research in Physics' (ARP) programme evaluated by Rietdijk et al.(2011) ran between 2009 and 2011 for 110 teachers (and involved more than 2000 pupils) across England. Across 18 months, teachers participated in three separate CPD sessions of one day each focusing on: action research theory and explanation; physics teaching strategies and feedback from individual teachers' actions. The evaluation team used questionnaires and focus groups, both before and after the intervention, with teachers and pupils directly involved. They compared pupils' responses with those from a control group, consisting of pupils one year older. For pupils, benefits reported were an increase in interest in physics; finding physics less difficult and having more time for reflection in lessons and an increase in the likelihood of taking physics at a level beyond GCSE. Teachers were highly engaged by the action research approach and were found to become more reflective about their teaching strategies. Evaluation is ongoing in an ESRC project, epiSTEMe, led by the University of Cambridge which has co-designed and trialled teaching modules for Year 7 pupils in mathematics and science with a pilot group of teachers and is currently providing training on their use with a much larger number of other teachers (Ruthven et al., 2010). Evaluation of the pilot results show positive impact on student attitudes and growth in knowledge, but it has yet to be seen if gains can be sustained when implemented on a larger scale.

More generally, the NFER (2011) final evaluation report on the three- year STEM cohesion programme in England, which supported a coordinated approach to the provision of information and opportunities on CPD and enrichment activities, was positive about the overall impact. NFER found that teachers reported greater knowledge of and engagement with the CPD and enrichment provision and that teachers increased use of practical activities with students. Students reported enjoying science more. A direct link to student attainment outcomes could not be demonstrated directly, because of the number of intervening variables.

Ofsted (2011a) found that take up of provision, in the schools visited, from the Science Learning Centres was patchy and that the science CPD provided in primary schools was not sufficient to improve teachers' confidence or understanding, particularly of scientific enquiry and the physical sciences, although it noted the positive impact of the Primary Science Quality Mark and Association of Science Education (ASE) materials. Ofsted found that primary teachers benefited from collaborative approaches to planning.

For mathematics, the Sheffield Hallam (2010) report on the impact of the NCETM found strong evidence of positive impact of its work overall in supporting professional development. As part of its work, NCETM has provided funding to support 'projects'. *Teacher Enquiry Projects* support development at school level, *Mathematics Knowledge Networks* bring together teachers from different schools and colleges and *Regional Projects* encourage regional networks. This type of CPD was found to have the greatest impact on pupils, with various measures cited by teachers as evidence, including improved attainment, improved engagement and improved confidence. However the research team found that many teachers found it difficult to identify impact.

The Sheffield Hallam report confirmed previous findings on effective CPD in mathematics (NCETM, 2009). In the 2009 study, researchers used a range of methods to investigate 30 CPD initiatives representing different models of CPD for teachers of mathematics to provide a detailed picture of the content of CPD opportunities and how these were received by teachers. CPD fell into three categories: courses, networks and within- school work. In all categories, teachers identified practical, stimulating activities; opportunities to network; a focus on mathematics and support for reflection and the change process as features of effective CPD. To various degrees, teachers reported improvements in students' attitudes and confidence and improved attainment as evidence of impact. Teachers also noted knowledgeable and enthusiastic leaders as a feature of effective CPD and this element is amplified in the report through illustrations from observations and interviews. Subject leadership of the CPD event or network (external or internal to the school or college) and whole-school leadership of CPD were seen to be influential in contributing to the effectiveness of CPD from the perspective of the teachers and the researchers.

How important is subject knowledge?

The distinctions between subject knowledge, pedagogic knowledge and pedagogic content knowledge are problematical with research studies finding conflicting relationships or non-relationships on effectiveness. Subject knowledge may be represented by the level of qualification in mathematics attained by the teacher, although Goulding et al. (2002) suggest that, for primary teachers, audit may be more reliable. Their study noted weaknesses in understanding and a link between insecure mathematics subject knowledge and poor planning and teaching when subject knowledge was assessed through audit, but cited an earlier study by Kings College which found no link between qualifications in mathematics and teaching effectiveness. The importance of mathematics- specific pedagogical knowledge for teaching for the understanding of underpinning concepts in mathematics is emphasised by Swain and Swan (2007) in their evaluation of curriculum development work with tutors of adult numeracy. Swain and Swan found that tutors had levels of formal subject qualifications more than sufficient for the mathematics content taught, but did not have the necessary mathematics- specific pedagogical knowledge and deep understanding of core concepts, such as place value or division to teach these effectively. Swain and Swan claim that primary teachers gain, through their ITE and CPD, much better conceptual understanding of these core concepts. Together with the greater tendency in primary schools for teachers to plan together and work collaboratively (James, 2007), this may help account for the higher proportion of 'good or better' mathematics lessons observed by Ofsted in primary schools than in lower sets in secondary schools and the increasing gap between higher and lower attainers observed in secondary education. Swain and Swan's conclusion that professional development in teaching fundamental concepts is necessary in improving the teaching for understanding in adult numeracy may also, perhaps, be applied to secondary school teachers and, particularly those responsible for teaching lower sets. Moor et al. (2006) and Ofsted (2012a) found that these teachers were least likely to be mathematics specialists, so unlikely to have received initial training on relevant mathematics pedagogy even though their own mathematical knowledge might be adequate for the content taught.

A different perspective on the development needs of non-specialist teachers is offered by the research of Crisan and Rodd (2011). The Training and Development Agency (TDA) provided funding to support a pilot *Mathematics Development Programme for Teachers* intended to address concerns about a lack of subject knowledge by those teachers, not qualified in mathematics, who are teaching the subject in secondary schools. Crisan and Rodd's research investigated the development of a sample of teachers following this pilot course. Teachers who are not subject specialists continue to be eligible in 2012- 13 for subject knowledge enhancement courses, which are also available for returners to teaching. Crisan and Rodd wanted to investigate 'how ... already qualified teachers come to see themselves as mathematics teachers?' (p30), noting the importance of teacher role identity (as in Hobson et al., 2007). They found that learning new mathematics, developing a view on the nature of mathematics and teaching mathematics in different ways all contribute to a mathematics teacher identity. There was a discrepancy between teachers' confidence in being a mathematics teacher and subject knowledge, for example in algebra, which remained relatively weak at the end of the course when tested by a mock GCSE paper. However, participants maintained that their own difficulties with mathematics made it easier for them to teach pupils who might also have difficulties and they said the course made them feel like 'mathematics teachers.' It is possible that their own difficulties made it easier for them to realise the importance of engaging with fundamental concepts about mathematics.

For science subjects, there have been initiatives by both the Royal Society of Chemistry and the Institute of Physics to raise the confidence and expertise of non- specialists who are teaching these subjects. The IOP has introduced the *Stimulating Physics Network*, consisting of coordinators and 'knowledgeable, experienced and enthusiastic … Teaching and Learning Coaches' (IOP, n.d.) funded by the Department for Education for secondary schools in England. Through the network, schools can access CPD, model lessons and activities for pupils as well as teachers. 350 *Stimulating Physics Network Partner Schools* receive further support, including in- school bespoke CPD for non- specialists. The Royal Society of Chemistry programme for non specialist teachers ran for three years from 2007 and consisted of four face- to- face days of training. An interim evaluation (Jones et al., 2008) concluded that the programme was effective in its aim of improving confidence and their use of resources. It was also effective in increasing pupils' enjoyment of their chemistry lessons.

A weakness of all CPD programmes aimed at improving teachers' subject and pedagogical specialist knowledge is the lack of evaluation of long- term impact, either on the teachers' behaviours or on the learning of pupils.

<u>Challenges for sustained change in teaching practice through CPD</u>

The significance of individual, affective factors such as role identity and motivation on the impact of CPD are reinforced in other research (Thoonan et al., 2011). In mathematics, a small- scale study in the US by Turner et al. (2011) describes how a team of academics worked with mathematics teachers in a middle school over a period of nine months to change teaching practices. Even with sustained, individualised support, it was the teachers with high self- efficacy for teaching in general who were successful in improving the learning of their students, rather than the teacher with better mathematics subject knowledge but low self- efficacy as a teacher and with difficulty in reflecting on her own practice. For well-qualified and experienced teachers, there may be other individual barriers to changing established teaching practices. Golding (2012), in her recent small study on the changes needed to deliver a new GCSE curriculum in mathematics, found that changing practice, even for well-qualified and experienced teachers in a supportive department, is challenging for those teachers who find it more difficult to be reflective and creative. Similarly Watson and De Geest (2010) used ethnographic methods to follow the progress of three secondary mathematics departments who purposefully introduced and reviewed changes in teaching practices in key stage 3 with the explicit intention of improving the mathematics learning of previously low attaining students (in which they were all successful but to varying degrees). Despite high commitment and perseverance from most members of the department, Watson and De Geest's detailed description shows differing degrees of professional understanding in discussions about pedagogy and that some team members refused to engage with the project. The NCETM (2009) report on effective CPD, in descriptions of in-school work, noted many positive responses from teachers and enthusiastic well-informed subject leaders. They also found that it was difficult to engage all members of a department in sharing practice. Both Watson and Geest and the NCETM report suggest that innovative approaches to teaching for understanding in mathematics may be resisted not only by individuals but also fail to be understood or supported by senior leaders within the school.

'Resistance' from individual teachers to CPD is part of a model discussed by Vargas-Atkins et al.(2009) in research on collaborative teacher-learning networks in Liverpool. Vargas-Atkins and her colleagues believe that taking up CPD (and by implication applying it into practice) is a complex mix of personal attitude and access to high quality CPD that is perceived to be relevant by the individual concerned. Their paper applies and extends a model developed in an earlier Wellcome Trust funded project to categorise teachers into groups of 'believers, seekers, agnostics, sceptics – according to their attitudes to CPD' (Wellcome Trust, 2006, p3) with a further group of 'providers' representing those who lead and enthuse learning networks. 'Believers' were enthusiastic about CPD; 'seekers' thought that CPD should be available to all, but wanted more opportunities, particularly in their own subject area; 'agnostics' approved of CPD in principle but quality and subject relevance were highly significant in persuading them of its value. About 12% were the 'sceptics', who perceived CPD as an imposition. The 'providers' were a subset of the 'believer' group, able to organise and motivate and offering skills and support to other members of their network groups. Clarke and Thom were similarly able to group teachers attending Science Learning Centres into six categories ranging from 'encouraged' to 'rejectors', based on responses to the 1402 telephone interviews conducted in 2010,which formed part of their research (Clarke and Thom, 2012b, p D55).

The challenges of changing teaching practice are further discussed by Stigler and Hiebert (2009) and exemplified in another US study of experienced teachers. (Silver et al.,2009) examined portfolios of evidence submitted for accreditation by the National Board for Professional Teaching Standards in the area of Early Adolescence/Mathematics. Although candidates are experienced teachers, submitting examples of best work as evidence for teaching for understanding, researchers were concerned to find that tasks presented were not intellectually challenging and did not require mathematical reasoning.

Bearing in mind Vargas-Atkins et al.'s category model may be helpful in increasing and sustaining the impact of CPD. It may also be the case that high-quality CPD needs to be complemented by individualised support to ensure widespread and sustainable changes in teaching practices in classrooms across the system. Leaders at school and college level need to monitor the impact of CPD on classroom practice carefully and have a number of flexible strategies in place to address individual teacher needs, such as lack of self- efficacy, thin subject teacher identity or difficulty with reflection. No one strategy seems to work for all teachers. Although successful for many, even individual, sustained coaching support seems to have been insufficient for some of the teachers in a mathematics coaching programme in Victoria, Australia (Ocean, 2009). Survey responses (421 in 2009 and 496 2010) in to Clarke and Thom's evaluation indicated that many respondents felt that more could have been done within the school to improve impact of CPD:

Course participants were asked what, if anything, was needed to ensure that the impacts of the course are sustained over time. The most frequently mentioned thing was communication. Respondents felt that to ensure the benefits of the course were sustained, it was key to share information with colleagues, making sure all teachers were using some aspect of it where possible. One respondent suggested setting up a blog to let others know the impact that the course was having on the school. (Clarke and Thom, 2012b, p C60)

<u>What are the characteristics of effective mathematics and science CPD in individual schools?</u>
The *Staff development outcomes study* (SDOS), which investigated how staff development could lead to improved outcomes for pupils and staff included 35 case studies of high-performing schools (Bubb et al., 2009). Staff development in these schools tended to be led by experienced senior staff:

School ethos was fundamental to staff development and in those schools where it was strong, leaders fostered – and all staff felt – a sense of both entitlement to and responsibility for their own development and learning, closely linked to benefits for the pupils. Staff turnover was low and morale was high at these schools. (Earley, 2010, p474).

Advanced Skills Teachers (ASTs) were introduced in 1998 in England, initially funded centrally to work across schools and local authorities. Research carried out for the Training and Development Agency found that ASTs can support the development of their colleagues and that ASTs can help to align CPD with school strategic priorities and performance management (Pedder et al. 2010). Subject Leaders of Education have recently been appointed, by the National College in England, with a similar role to promote teaching and learning across schools within Teaching School Alliances, with their impact yet to be determined. The Subject Leader Coach in colleges was introduced to support changes to teaching and learning in subject areas and the use of new teaching resources in FE colleges but evaluation of the impact of role has not been located.

Chartered Science Teachers (CSciTeach) and Chartered Mathematics Teachers (CMathTeach) have been introduced in England, through subject associations, to recognise excellent practice on ongoing engagement and commitment to professional development, but evidence of their impact is not available. In Scotland, it has been recommended that the Chartered Teacher scheme is to be discontinued in the light of limited evidence of positive impact (McCormac, 2011) although this is disputed by the Association of Chartered Teachers Scotland, who cite evidence from a number of case studies on its website. (Association of Chartered Teachers Scotland, 2012).

Summary points

- **Initial Teacher Education**

Recent evidence suggests that concerns raised in the Royal Society State of the Nation Report (2007) about the quality of diverse routes for the initial training of teachers in mathematics and science have been addressed and that the diversity of routes, including TeachFirst, is increasing the numbers of trainees in these subjects, including in physics.

- **Retention from Teacher training and the Induction year.**

Approximately 30% of teacher trainees in mathematics and science subjects do not take up a teaching post in the year following their training. Although there is further loss in the early years of teaching, there are no apparent differences in the reasons, or proportions, of mathematics and science teachers when compared to other subject areas. The support offered by schools to beginning teachers appears to be a critical factor in encouraging teachers to remain in the profession and in developing their knowledge and skills for teaching well. The evaluation of a pilot project (MacLeod et al., 2012), which provided mentoring support external to the school for trainee and early career teachers, was successful. This may indicate that further study of external support networks for teachers in training and at the beginning of their careers (such as that offered by the Institute of Physics) is worthy of further consideration.

- **Continuing Professional Development**

There is a high degree of consensus of the ongoing need for high quality CPD for teachers of mathematics and science at all stages of their career. There is agreement about the features of high quality CPD that is effective in improving the quality of teaching. The work of the National and Regional Science Centres and, in England, the National Centre for Excellence in Mathematics in supporting subject- specific CPD, through the variety of approaches which evidence shows to be effective, is recognised as valuable. Support within the school, provided through good leadership and considered further in the next section, is essential for ensuring that CPD is available and matched to teachers' needs, that learning is shared among colleagues and that impact on teaching is monitored. Evidence suggests that individual factors of identity and confidence, or of resistance to change, affect the level to which CPD affects change in teacher behaviour and it may be concluded that such issues also need to be addressed within the school. The impact of Chartered Teachers in Scotland and Advanced Skills Teachers in England has not been determined from the evidence available to this review.

- **Subject Knowledge**

Although it is agreed that subject knowledge is important, the distinction and relationships between domain subject knowledge, pedagogic knowledge and pedagogic content knowledge are problematic. However, there is consensus that teachers need a deep understanding of key concepts as well as the skills to teach these for understanding. They also need to have sufficient depth of knowledge to understand the significance of fundamental concepts and where these will lead at later stages of study. Evidence suggests that subject qualifications alone are not a reliable indicator for the effectiveness of teaching and that continuing professional development in subject knowledge is needed, whether or not teachers have relevant subject qualifications.

3.3 What role does school or college leadership play in the perception and take up of CPD and in the identification and deployment of innovative/best practice?

Increasing autonomy for individual schools throughout the UK means that setting priorities and providing the resources to support these are increasingly the responsibility of individual school leaders. This section looks at the importance of school leadership factors in contributing to high performance in mathematics and science.

There is extensive evidence of the importance of whole school leadership in promoting school improvement and pupil learning (for example, Barber et al, 2010; Day et al, 2011; Jackson and Marriott, 2012; Leithwood et al., 2006). Values and vision together with personal characteristics such as commitment, passion and resilience have been identified in discussions of successful school leadership, together with analyses of the practices used by school leaders to improving outcomes for students. In a meta- review of leadership effects, Robinson et al. (2009) in a systematic review of 134 studies which linked school leadership to student learning identified influence through ensuring teacher learning and development as the most significant factor in improving outcomes. A recent review commissioned by NFER, (Maughan et al., 2012) initially selected and reviewed 132 items of literature and, in consultation with a group of experts in the field, included 21 items in the final review. Their review comes to similar conclusions about what is required from leaders in order to ensure sustained, positive changes in teaching practice. These may be summarised as:

- Strategic Leadership: including setting a clear and realistic vision, based on a clear rationale and adapted to the local context within the wider national policy context;
- Creating the right culture of change and a climate for learning, for both teachers and students;
- Distributive leadership so that agents of change are supported at different levels of the school or college hierarchy;
- Involving and listening to the wider school community; teachers, students, support staff, parents and outside partners;
- Ensuring that resources and systems are in place;
- Encouraging both peer led collaboration between teachers within the school or in different schools, or with researchers, that supports practice development and individual reflective practice;
- Monitoring and evaluation through systematic collection of evidence from and about learners.

The Ofsted (2010b) report *Good professional development in schools. How does leadership contribute?* used improvement in inspection judgement as one measure of success. Ofsted said that those schools that improved substantially between 2005 and 2009 had ‘well-targeted professional development that focused on teaching and learning and on outcomes for pupils’ (p29) In less successful schools, leaders ‘inability to analyse their own performance and deal robustly with any shortcomings meant that they did not target relevant professional development where it was most needed’ (p29). In *Successful Science* (2011a), Ofsted identified similar factors in relation to successful science CPD.

The implication of these findings about school leadership is perhaps that the way in which the school articulates a vision for science and mathematics and identifies the knowledge and skills required by teachers of these subjects is critical for improvement. A common understanding of what constitutes good learning and of the teaching needed to enable this is essential in ensuring relevant and effective professional development.

The role of school leaders in both giving status to and prioritising funding for science and mathematics CPD may also become more critical in a period of increasing funding restraints, including for the STEM careers education (noted as significant in contributing to studying physical sciences by Bennett et al.(2011), discussed above). NFER (2011) in their evaluation of the STEM cohesion project in England noted concerns about the 'rarely cover' requirement restricting opportunities for teachers to engage in external CPD opportunities in the final year of the project and a lack of cohesion between STEM and careers activities in schools was noted, as well as senior leadership teams not prioritising STEM careers information and guidance.

The role of whole-school leadership in mathematics education has been investigated by the NCETM (Morton, 2009; NCETM, 2008, 2009, 2010a, b). Head teachers in successful secondary schools recognised and valued the importance of mathematics and had a clear vision for the subject which they expected to be shared by the department. Good communication was considered essential and line managers of the mathematics subject leader were often mathematics specialists within the senior leadership team, enabling them to understand the purpose of changes in classroom practice. Leaders, both the head teacher and the governing body, encouraged recruitment and retention through engagement with ITE institutions, used mentoring and coaching to nurture trainees, newly-qualified and developing teachers and 'grew their own' from motivated teaching assistants and other school staff. Retention was further encouraged through good resourcing and working conditions, encouragement of professional and personal development and opportunities for promotion and responsibility. CPD was considered as an entitlement for all staff and a blend of approaches, such as working on outside projects, collaborative practice and use of external experts was seen as most effective. In primary schools the leadership of the head teacher was considered vital in ensuring a whole school ethos which supported improvement, a vision for sustainable success through high-quality teaching and learning and appropriate resourcing. These head teachers appointed knowledgeable and enthusiastic subject leaders and supported them in influencing practice throughout the school, through well-focused professional development which built teachers' subject and subject-pedagogical knowledge. The curriculum was designed to include opportunities for using and applying mathematics, for engaging parents and for involving children in their own learning. Policies for setting or grouping pupils by ability were used pragmatically and reviewed in light of children's progress. ICT was used creatively to support learning. For colleges, it was recommended that senior leadership teams should clearly identify a leader with responsibility for all aspects of mathematics across the college, provide suitable accommodation and resources, establish and encourage collaborative teaching teams, professional development and the sharing of practice, including through the deployment of a mathematics 'Subject Learning Coach'.

The views of the head teachers of schools with successful practice may usefully be contrasted with the Burghes (2011) findings from reasons for leaving the profession given in surveys and interviews with NQTs, and noted in section 3.2 above. Leaders in successful schools are proactive in ensuring that their teachers are supported and developed in their induction year, as part of a continuum of targeted and individualised professional development. The emphasis in the NCETM reports on informed whole- school leadership may also be contrasted with evidence presented earlier from ACME (2011c), Watson and de Geest (2010) and NCETM (2009) where senior leaders may have a different vision for mathematics teaching and learning, in which test results are considered more important than understanding. The lack of subject knowledge and understanding of the rationale for particular teaching and learning strategies for mathematics and science teaching among senior leaders may be a barrier and this may be more significant than for other areas of the curriculum. For example, Spillane (2005) looked at whole-school leadership of literacy and of mathematics in middle schools in Chicago and found clear differences in practice. Mathematics expertise tended to be considered as external to the school with 'input' to teachers from subject leaders or external trainers. Literacy leadership is seen as cross-curricular, with meetings and discussions participated in by staff at all levels. There are more conversations and networks about literacy than mathematics, both formal and informal.

In England, evidence from the annual school workforce census was analysed for the report commissioned by the National College from Earley and Higham (forthcoming). The data indicates that classroom teachers with qualifications in science or mathematics are more slightly more likely to progress to assistant or deputy head roles in secondary schools, although slightly less likely to progress from there to head teachers. Overall, the head teachers, and other categories of senior leaders with qualifications in particular subjects is similar to the proportion among classroom teachers. However, perhaps because the number of non- specialists teaching mathematics lowers the proportion with mathematics subject qualifications overall, the proportion of head teachers with a mathematics subject qualification is relatively low 5.5% (5.4% of classroom teachers) whereas for English it is 11.7% (9% of classroom teachers). 18.2% of secondary head teachers reported a science subject background with 20.1% of classroom teachers doing so. In primary schools, just 3.7% of head teachers reported a mathematics background (2.3% if classroom teachers), with 9.9% a science subject background (9.6% of classroom teachers) and 10.5% an English background (9.5% of subject teachers).

Evaluation of the impact of continuing professional development on pupil learning has been identified as a weakness (Maughan et al. 2012; Ofsted, 2010b, 2011a, 2012a). Muijs and Lindsay (2008) noted participant evaluations as the most frequent method seen. Impact has been addressed to some degree through the work and toolkits of the National STEM centre, the Science Learning Centres and NCETM, but it is uncertain to what degree impact is consistently evaluated at school and college level. Evaluation studies tend to be completed shortly after new initiatives are introduced, are limited to the impact of the initiative rather than as part of other work being done to improve achievement in mathematics and science and with little evidence of how change is sustained and positive impact accumulates. Clarke and Thom's (2012a, b) longitudinal work on the Science Learning Centres Network suggests that teachers believe that support from senior leaders and good communications are needed to sustain the positive impact of CPD completed through the Network.

A recent evaluation study (Straw et al., 2012) does, however, give some insight into school level factors relating to the sustainability of improvement following innovation. For two years, 2009-10 and 2010-11, the Wellcome Trust gave a grant of £10 000 to each of eight secondary schools in Camden to support action plans for cross-curricular STEM activity. The evaluation makes an assessment of the sustainability of approaches which have been found to be successful in the short- term. The study is of interest as many other evaluation reports of short-term initiatives are commissioned either during or shortly after the projects are completed, with little opportunity to evaluate long- term changes in teachers' approaches to pedagogy and students' enjoyment, engagement and achievement in science and mathematics. This report, although it was completed at the end of the two-year project, does begin to address sustainability issues and considers the influence of factors that changed from the first to the second year at the level of the school, rather than individual teachers. The report found that 'enhancement and enrichment' activities alone were unlikely to lead to sustained change. For example, some pupils commented on the difference which continued between the practical and challenging activities in enrichment programmes and what they experienced in normal lessons. The researchers suggest that enhancement and enrichment activities need to be repeated regularly, throughout the school, so that messages are reinforced and that these are particularly valuable at points when students are making options choices. Those schools which used funding to develop changes in schemes of work and to pay for release time and responsibility allowances for coordination of changes were considered to have a greater chance of sustaining improvements to practice. The importance of the support of senior leaders, both whole-school and heads of department was stressed very strongly, with a recommendation that STEM activity be embedded as high priority within the school improvement plan and with designated responsibility allowances and time allowances for planning. Without this support, it is considered unlikely that change will be maintained, however enthusiastic individual members of staff may be.

'Senior leaders need to be convinced of the value and benefits of interdisciplinary STEM activity (i.e. motivating and engaging pupils, the development of transferable skills and conceptual thinking, and broadening career horizons and encouraging further STEM study etc.) and that a focus on STEM may support a priority to raise attainment' (Straw et al., 2012, p 63).

It may perhaps be inferred that unless senior leaders in schools are committed to raising achievement and progression in science and mathematics subjects, and knowledgeable about how this might best be done, sustainable and widespread improvement will not occur. The National Strategies approach was not successful in achieving the widespread change in classroom practice required (National Audit Office, 2008). The challenge of scaling up change that is successful at pilot level is a focus of the epiSTEMe project (Ruthven et al., 2010). The success or otherwise of Curriculum for Excellence in Scotland has yet to be determined (Priestley and Minty, 2011).

Summary Points

The importance of whole school or college leadership and the ways in which effective leadership is enacted have been confirmed through extensive international research. The majority of such research has been generic and it has been more challenging for this review to identify any additional features of school leadership that are necessary for high performance in mathematics and science. This review has identified a gap in the research literature on subject- specific instructional leadership. There is some evidence that suggests that whole school or college leaders need to understand and support a shared understanding of the factors that promote high performance in mathematics and science learning that extends beyond short- term indicators such as examination results or successful enrichment projects.

3.4 What are the characteristics of effective leaders in science and mathematics education, especially as regards their background and training?

The TTA (1998) standards for subject leaders established expectations for subject leadership in England and formed the background for a number of studies on subject leadership in general (Bennett et al.,2003; Burrows,2004; Busher,Harris and Wise,2000; Ghamrawi, 2010;Glover and Miller,1999; Hammersley-Fletcher and Strain,2011; Harris,2001; Jarvis, 2010; Poultney, 2007;Turner, 2003; Wright, 2006). All emphasise the importance and influence of subject leadership in raising standards of teaching and learning in the subject area and of the need for subject leaders who are enthusiastic and knowledgeable about their subject, both in subject knowledge and subject pedagogy. In the most successful subject areas, there is trust, collaborative working and sharing of ideas. Data is used effectively and teachers are regularly observed teaching, by their peers as well as for performance management purposes. Barriers to a focus on teaching and learning in all departments are the pressure of administrative requirements and a shortage of time for subject leaders to carry out their role effectively.

Successful subject leaders have good support from senior leaders in the school. Heck and Hallinger (2009) present evidence from a longitudinal survey in 195 US schools over a five year period. They believe 'that the effects of school leadership are largely mediated by academic and social conditions present in the school and aimed towards learning outcomes' (p662). Using specially- designed mathematics tests, they found that improvement in mathematics scores was better where there was more distributed leadership, although noting the limitations of their study in not examining the nature of distribution in detail. In England, Hammersley-Fletcher and Strain (2011) studied the change in primary school middle leaders' attitudes over the last 15 years and suggest that actions for change in primary schools are primarily controlled by the head teacher.

This review has identified no recent research specifically on the characteristics of effective leaders in science or mathematics, athough a report by Ernest (1989) highlighted the challenges of this role at that time. The more recent evidence discussed here is from inspection reports or from small- scale case studies. Ofsted (2011a) found good or better leadership and management for science in four out of five secondary schools and identified as common features: good support and challenge from the senior leadership team; a structure with clear roles and responsibilities; clear standards for the quality of teaching; good tracking of individual students, which was used to inform effective intervention and planning; collaborative planning and sharing of good practice. Ofsted's (2011d) report *Good practice in Primary mathematics: evidence from 20 successful schools* noted similar factors. The most common weakness, noted in both reports, was in failing to challenge teachers about poor practice and, in primary schools, lack of subject knowledge. Research on whole-school leadership (Day et al., 2011) found that context, and the skills and qualities that leaders use in responding to context are important, although all leaders seem to do similar things. For subject leadership, Wright (2006) found that staff shortages in secondary schools limited the capacity for improvement, even for the group of effective leaders in his study. Staff shortages are particularly acute for secondary school subject leaders in mathematics and science in England (Ofsted, 2012; House of Commons, 2012b). Subject leadership is better in primary in England for mathematics than in secondary schools reflecting the collegiate working practices found in primary settings (Ofsted,2012a).

Burrows (2004) found that primary subject leaders in general spoke positively about teamwork in their schools, but challenging other staff was avoided and left to the Senior Leadership Team. Higgins and Burns (2011) provide a case study of the leadership of the implementation of the New Zealand primary numeracy strategy (similar to those of the UK nations). Results indicate that the lead teacher can effectively support reform goals when this role is shared with others and when one (there were two in the school studied) lead teacher also holds a designated leadership role in the school, such as that of assistant principal. This allows the senior leader to manage more challenging staff and situations. They say 'what appears to be important in promoting instructional improvement is hybrid patterns of leadership – the combination of hierarchical and heterarchical leadership enactments – rather than either of these on their own' (p795).

This review has identified a limited amount of literature on how middle and subject leaders in general can be prepared effectively for their role (Jones, 2006; Matthews, 2011; Rhodes et al., 2006; Rhodes and Brundrett, 2008; Turner, 2006; Turner and Sykes, 2007). In their report on the identification and development of leadership talent, Rhodes et al. (2006) recommend:

... head teachers should ensure ... guidance and advice to staff concerning their longer-term career planning, know the strengths and areas for further development of their staff, engage effective leadership development mechanisms such as shadowing, networking, peer-coaching, and learning walks in other schools, encourage teamwork, trust and make time for leadership development. (p 7)

The 157 Group and CfBT Education Trust thinkpiece, *Leading learning in further education (*Fletcher, 2012) gives an example of successful leadership development across a college, through training newly- appointed curriculum managers 'in relevant skills such as project management, evaluation and peer assessment' (p29) followed by project work in cross- college teams which was then presented to all teaching staff.

It is interesting to note that although the Ofsted (2011a) report on science found good or better leadership in 80% of the secondary schools visited between 2007 and 2010, only 20% of these science subject leaders claimed to have had training for their role. More information about how subject leaders were prepared, with or without training, was not provided in the Osted report. The National Science Learning Centre offers award-bearing leadership courses: New and Aspiring Heads of Science; Extending the Role of the Science Subject Leader (Primary); and Senior Technicians Accredited Co-leaders in Science with participants reporting strong effects on their leadership practice (National Science Learning Centre, 2012) The NCETM programmes were found to be highly effective in developing subject leaders (Sheffield Hallam University, 2010). Their website offers (in June, 2012): a secondary Heads of Department Network; Primary Mathematics Subject Leader Development Days; a new Professional Development Lead Support Programme; dedicated microsites, with online professional development materials, for secondary and primary mathematics leadership development; information about the accredited Mathematics Specialist Teacher (MaST) programme. The evaluation of MaST which was commissioned by the former DCSF from NFER, has yet to be published. For FE, the excellence gateway (http://tlp.excellencegateway.org.uk/tlp/stem/stem-lm.html) provides access to professional development materials for mathematics subject leadership in the learning and skills sector.

Support from whole school leaders is considered essential for the development of leadership skills. The recent 'Teaching Leaders' programme and the introduction of the Specialist Leader of Education (SLE) role by the National College to complement the work of National Leaders of Education (NLE) and Local Leaders of Education (LLE) has further potential to support subject leader training in England.

Summary points

The importance of good subject leadership and high performance is established in the literature for all subjects, and the importance of establishing trust and of challenging poor practice is also well established. This review has identified in a gap in the literature on subject leadership specifically for mathematics and science. Although the importance of support for subject leaders by the school or college leadership team is agreed, this review has identified a further gap in the literature on how effective subject leaders are prepared for and supported in their role.

3.5 How far do identified patterns of influence vary according to nation, phase/sector and student characteristics?

By nation

For information about the school systems in the three smaller UK nations see
http://www.stemnet.org.uk/regions/1526/content/northern-ireland-schools-and-colleges
http://www.stemnet.org.uk/regions/1525/content/scotland-schools-and-colleges
http://www.stemnet.org.uk/regions/1527/content/wales-schools-and-colleges

Information for England is provided by region, for example, http://www.stemnet.org.uk/regions/1636/content/west-midlands-schools-and-colleges

PISA – school factors
In section 3.1 of this report, the challenges of identifying schools with high performance in mathematics and science were discussed. Measures for comparing performance in the different nations of the UK are also limited. The most recent round of PISA international tests, conducted in 2009 is used here, as the most readily available basis for comparison.

When performance in PISA maths 2009 tests is considered (Bradshaw et al, 2010), there is no significant difference in the mean score in either mathematics or science for England, Scotland and Northern Ireland, although the mean score for Wales was significantly lower than the other three parts of the UK in both subjects. Scotland had the greatest proportion of higher- achieving pupils in mathematics in the UK (and similar to the OECD average). In science, Northern Ireland had a slightly greater proportion of pupils at higher levels than England and Scotland, with Wales having the lowest proportion. Of UK nations, Wales also had the greatest proportion at the lowest levels in both science and mathematics.

Bradshaw et al.'s analyses (Bradshaw et al., 2010 a,b,c) of similarities and differences from the PISA school surveys found differences between UK nations in reported shortages of resources and staffing as shown in the table below. The availability of suitable teaching staff in England and the shortage of laboratory equipment in Wales are noticeable. Shortages of suitably-qualified teachers are frequently cited as a cause of relatively poor international pupil performance in mathematics and science but differences in relation to staffing within the UK do not emerge at the level of these tests. Corresponding data for Scotland are not included in the analysis provided by the Scottish Government (Cooke and Bejtka, 2010).

Table 2: Information provided in Bradshaw (2010 a, b, c)

Is your school's capacity to provide instruction hindered by any of the following staffing or resource issues?			
	To some extent/a lot		
	England	Northern Ireland	Wales
A lack of suitably qualified science teachers	16%	7%	8%
A lack of suitably qualified mathematics teachers	30%	6%	8%
A lack of qualified English/Welsh teachers	14%	4%	2%
A lack of qualified teachers in other subjects	15%	4%	17%
A lack of other support personnel	16%	17%	21%

Shortage or inadequacy of science laboratory equipment	15%	12%	32%
Shortage or inadequacy of instructional materials (e.g. textbooks)	12%	11%	26%
Shortage or inadequacy of computers for instruction	32%	42%	43%
Shortage or inadequacy of computer software for instruction	18%	33%	40%

Policy climate

'Performativity' and its impact

In a literature review conducted as part of a report for the National College, Earley and Higham (2013, forthcoming) draw attention to the increasing diversity and autonomy of schools in England with the spread of academies, including academy chains, formal partnerships and federations and the introduction of free, studio and University Technical Colleges within the state system, accompanied by a reduction in the role of local authorities. These changes may be particularly significant for mathematics and science. For example, opportunities for variations from national pay scales and the freedom to employ teachers without a teaching qualification together with greater disparities in funding may add to variation in the ability of schools to attract and retain good teachers when these are in short supply. In a system where monitoring is primarily through success in external tests so that schools with previously 'outstanding' or 'good' inspection judgements much less likely to be visited by Ofsted, there is a risk that the pressure to sustain test success, rather than understanding and enthusiasm for the subject may increase further. A recent paper (Norris, 2012) draws attention to a culture of 'performativity ' in England and potentially adverse effects on student learning.

Perryman et al. (2011) report on case studies in four secondary schools in England which focus particularly on the impact of the requirement for both English and mathematics to be included in the '5A* to C' grades measure in England, which has been used as a key school indicator since 2007. The importance of this indicator may be gauged from press reports on the reactions of schools to a fall in the percentage of GCSE A* to C grades in English, and to a lesser extent in mathematics, in summer 2012 (for example, The Guardian, 23 August 2012). They note negative effects, such as increase in stress and a decrease in autonomy and opportunities to teach creatively for individual teachers. However, in the case study schools, the negative effects were counterbalanced by core subjects (in which science is also included, although not the focus of this study) being given status as important subject areas, with priority for resources, support from senior leaders and the power to influence school policies or modify them to the needs of the department. All of the schools in these case studies had strong and stable staffing in mathematics and English and pupils attained well at GCSE. There was an awareness among the teachers interviewed that they would be liable to much greater intervention from senior school leaders and to increased stress if results were not maintained.

Recent announcements from the Coalition Government (DfE, 2012c) call for new examinations to be introduced to replace GCSE and their proposals are currently, in September 2012, subject to consultation. If implemented, the speed of the required change, will require that secondary schools in England will need to adjust priorities for use of staff training time to preparation for teaching new syllabuses, which has the risk of diverting resources from efforts to improve the quality of teaching overall.

The case for public accountability through examination performance is supported by some evidence which compares outcomes in England and Wales, but which does not take into account other factors such as the generally lower levels of funding in Welsh schools. Students in England and Wales follow similar curricula, with GCSE at age 16 providing the assessment at the end of key stage 4. In both nations, secondary school league tables, based on performance at GCSE were published from 1992 onwards and still continue in England. The Welsh Assembly Government abolished school performance tables in 2001. Burgess et al. (2010) looked at the change in performance, measured by GCSE outcomes in Wales following this change, with England providing a control scenario. They found a significant fall in performance following the cessation of publication of tables in Wales, with a greater effect in schools serving students with lower prior attainment and higher socio-economic disadvantage. Students in Wales also performed worse than other UK nations in the PISA tests. The Welsh Government has recently re-introduced ‘banding’ to group schools according to their performance, with the objective of targeting support and is currently consulting on reintroducing tests for literacy and numeracy.

Pressures on schools to improve rapidly, for example to take a school out of special measures or to hit floor targets in England, may have a negative impact on improvement of teaching and learning in the longer term. Morley (2006) notes that as a head teacher appointed to get a school out of special measures, he had to adopt rigid approach which he felt inhibited the longer term development of reflective and leadership abilities in relation to teaching and learning.

<u>Proposal for continued study of mathematics to the age of 18 in England.</u>
The House of Lords Select Committee on Science and Technology (2012), recently called for greater compulsion to study mathematics for post- 16 students in England:

The study of maths should be compulsory for all students post-16 and maths to A2 level should be a requirement for students intending to study STEM subjects in HE. In addition, we urge HEIs to introduce more demanding maths requirement for admissions into STEM courses as the lack, or low level, of maths requirements at entry acts as a disincentive for pupils to study maths and high level maths at A level. (p 7)

This followed a similar call by Education Minister Michael Gove in 2011 in a speech to the Royal Society for all students to study mathematics up to the age of 18 (ACME 2011d). ACME subsequently produced a discussion paper (ACME, 2012) which discussed issues to be resolved on the nature of qualifications to be offered and comments on the need to plan for an increase in the supply of mathematics teachers and the professional development of existing staff to meet new demands. Harris (2012) used focus groups with students and staff in FE colleges, a survey of teachers in FE and interviews to research the reaction of staff and students for mathematics to be made compulsory within a system which otherwise offers a free choice of study, finding much resistance from students. The report calls for a more holistic view of the programme of study post-16.

<u>Teacher Education initiatives in England</u>
The Coalition Government in England has introduced a number of changes to initial teacher education, placing lead responsibility for development of training with schools, especially with Teaching Schools and expanding the TeachFirst programme (DfE,2011c). Applicants for entry to training will be expected to pass more demanding tests in English and mathematics from September 2013 (DfE, 2012d). Teacher Standards have been revised. Lead responsibility for CPD has similarly been placed with schools, with central funding for the Master's in Teaching in Learning (MTL) removed. However, Dfe funding for the NCETM and the Science Learning Centres has been maintained, with amendments to the remit to focus on supporting school-based CPD. DfE funding for subject knowledge enhancement courses for non-specialist teachers and returners to teaching continues to be available, with these courses provided by Universities (for example, Institute of Education,2012). This is encouraging in light of evidence presented earlier of the high proportion of lessons taught by non-specialists and Ofsted (2012a) evidence about the poorer quality of teaching in lower sets taught by such teachers.

<u>Curriculum for Excellence in Scotland</u>
In Scotland too, there are moves to a more decentralised structure and a reduction in the support from local authorities (SEEAG, 2011a, b.). Within schools there has been a reduction in the number of STEM specialists in Principal Teacher (i.e. subject leader) and Assistant Principal Teacher roles in secondary schools (Jackson, 2012). The Scottish Government's approach to educational reform is based on Curriculum for Excellence (CfE), which became mandatory for schools in Scotland in 2010-11. Its aims are to support good teaching and cross-curricular themes to support learning, with greater autonomy for teachers and recognition of their professionalism. Evidence on the success of implementation is currently limited and the changes have yet to be worked through to senior and University entrance level, with some uncertainty about assessment and qualification for University entrance (Brown and Minty, 2012). Although most teachers are positive about the principles of CfE, there are concerns. Research carried out in one local authority (Priestley and Minty, 2011) found that progress with implementation varied widely, with primary schools further ahead than secondary schools. In the latter, some teachers were concerned about the lack of detail about assessment for the senior stage and there was some resistance, from those teachers whose view of learning was as transmission of knowledge. Workload was seen to have increased for all teachers and morale was low,

with funding cuts and staff shortages proving to be barriers. The role of leadership in providing a vision and necessary resources, including time, for CPD was seen as critical to success.

In Scotland, teachers have an entitlement of a minimum of 35 hours CPD each year and are expected to keep a record of this. They may choose to enter the Chartered teachers' scheme. The Scottish system recognises the importance of the induction year and all new eligible newly qualified teachers who have graduated from a Scottish university are guaranteed a one-year teaching post with a maximum class commitment of 0.7 full-time equivalent, with time set aside for professional development and access to a mentor. All teachers in Scotland are required to register with the General Teaching Council for Scotland (GTCS). (Scottish Government, 2010). The Scottish Government has acted on recommendations in the SEEAG (2012a) report, by providing additional funding for CPD provision for science teachers and further CPD funding for primary teachers in delivering science learning.

<u>'Count, Read Succeed', 'Every School a Good School' and 'A Call to Action' in Northern Ireland</u>

Until recently, primary schools in Northern Ireland (NI) prepared children for a state- funded transfer test, which would determine which pupils should attend selective grammar schools, a significant feature of the Northern Irish education system. In the light of increasing concern about the wide variance in outcomes between different types of school and the underachievement of particular categories of pupils, with disadvantaged, white, urban, Protestant boys performing particularly poorly, a revised curriculum was introduced in 2007, state support for transfer tests was withdrawn and the publication in 2009 of 'Every School a Good School' provided a framework for an overarching national body, the Educational and Skills Authority (ESA) to provide strategic support and challenge for school improvement. The introduction of this body has been delayed, with legislation due to take place this year (2012) for its introduction in April 2012. Specific concerns were identified in relation to literacy and numeracy skills and an inquiry, chaired by Sir Robert Salisbury, produced its final report in 2011, shortly after the publication of the strategy document 'Count, Read, Succeed', the NI strategy to improve these skills, to which earlier reports of the inquiry had contributed (DENI, 2011a,b). Despite progress in implementing the curriculum, Salisbury noted the urgent need for coordination across the nation on school improvement, to establish consistent expectations across the areas of the five Education and Library Boards and is critical of the delay in establishing this. The inquiry team restates the key challenges for the Northern Ireland government in addressing disparity of outcome between schools and 'the long tail of underachievement', including the gap between boys' and girls' outcomes.

The report calls for higher expectations for qualifications and skills in numeracy and literacy for initial teacher entrants, including a test as used in England and higher expectations of NQTs in terms of subject knowledge by appointing panels. An interesting feature of 'Count, Read, Succeed' is in the attention given to subject leadership in secondary schools. They call for school leaders to ensure that subject leaders are provided with sufficient time to undertake their role in improving teaching and learning, promoting collaborative practice and monitoring standards. In relation to subject coordination in primary schools, the Salisbury report stated:

It is essential that … numeracy coordinators in primary schools demonstrate a strong background in maths … and ideally are specialists in the … area (s). (Literacy and Numeracy Taskforce, 2011, p13)

A briefing paper prepared for the Northern Ireland Assembly (Perry, 2012) provides an update on developments relating to the uptake of STEM subjects and the STEM strategy following the *Report of the STEM Review in 2009* (DENI and DELNI, 2009). This shows percentage rises between 2005/6 and 2010/11 in GCSE entries in separate science subjects and between 2001/2 and 2010/11 entries to science subjects and mathematics at A level and reports on the success of the 17 designated mathematics and science specialist schools in science, technology and mathematics, funded to March 2011. It further notes that large numbers of pupils (58 500 of a school population of approximately 320 000) were able to access enrichment activities funded by the Department for Education Northern Ireland, through Sentinus, an educational charity to March 2011.

The response of the Northern Ireland Government to the 'Call to Action' report (DENI, 2011c), as well as the discussion in the Northern Ireland Assembly Education Committee (Northern Ireland Assembly, 2011) provides hints of the pressure of reducing educational budgets and the impact on implementing reforms. Continuation funding for the specialist schools and Sentinus programmes is no longer available. An overarching issue for Northern Ireland is oversupply of teachers and the need to cut school places in a climate where there are complex patterns of provision (for example, South Eastern Education and Library Board, 2012). The Northern Ireland Government, together with the Welsh Government has sought to distance itself from statements made by the Education Secretary for England, calling for greater communication on any change in the qualification system (Welsh Government, 2012b, BBC 17 September, 2012). Any change to GCSEs made in England would have implications in Northern Ireland and in Wales.

Guidance has been produced for schools on the induction and early career development of new teachers in Northern Ireland, with teacher education and cpd currently under review.

<u>Curriculum Development in Wales</u>

The Welsh Baccalaureate, introduced in 2003, differs significantly from the English Baccalaureate, which is made up of GCSEs in academic subjects only (including English, mathematics and science). The Welsh Baccalaureate is available at three levels, Foundation, Intermediate and Advanced Level and includes personal development and key skills, including that of numeracy. Continuous Professional Development is an expectation for all school staff in Wales, as part of a Performance Review and Development process, including the requirement to maintain a CPD portfolio. The Welsh Government provided funding for pilot phases of a structured professional learning community network, the school effectiveness framework, which is promoted as a vehicle for collaborative teacher and leadership development throughout the country, with the intention of improving the school system as a whole (Harris and Jones, 2010). In Wales pupil numbers are falling in secondary schools but rising in primaries, with surplus places overall. Successive reorganizations have failed to keep up with overall falls in pupil numbers, with a consequent high cost of maintaining places which are not needed. Concern over the costs of this and the impact on the resources available to improve the quality of education were reported by Estyn (2012a).

Irish, Gaelic and Welsh medium schools

Northern Ireland, Scotland and Wales have schools where subjects are taught through the mediums of Irish, Gaelic and Welsh respectively and it is a high priority to recruit trainee teachers who can teach in these languages. Data on teacher vacancies in Wales in 2010 show that mathematics and science vacancies in Welsh medium schools were filled successfully, although there were fewer applications for each vacancy than in English-medium schools (Welsh Government, 2012b). No evidence has been located to suggest that mathematics or science teaching is any different in the relatively small number of schools where subjects are taught through Irish, Gaelic or Welsh.

Differences between phases

In England, Northern Ireland and Wales the quality of teaching is judged by national inspectorates to be better in primary than in secondary schools in mathematics (Ofsted, 2012; Estyn, 2010; ETI, 2010). However, the 2012 Ofsted report suggested that the lack of subject specialists in primary schools affected the quality of teaching for higher attaining pupils. For science, the overall proportion of 'good or outstanding' lessons was similar in both primary and secondary schools, although most 'outstanding' lessons were in secondary schools (Ofsted, 2011) and good practice in KS3 and KS4 was also being applied at A level. Science provision in colleges was a cause for concern, with 5 of the 31 colleges inspected having 'inadequate' provision.

In England, the FE sector, comprising FE Colleges, Sixth Form Colleges, Training Providers and Adult and Community Education make a large contribution to the science and mathematics qualifications achieved by learners (Royal Academy of Engineering, 2011). The sector is particularly successful in providing access and achievement routes for those learners who were not successful in gaining qualifications at school, for example through opportunities to re- sit GCSEs and the provision of numeracy courses. However the most recent *Skills for Life* survey shows that there has been a small decline in the numeracy skills of adults in England since 2003, suggesting that there is still considerable room for improvement (DBIS, 2011).

At GCE A or AS level or equivalent most science and mathematics provision is in schools, although a substantial amount is provided in sixth form or General FE colleges. One of the interesting findings of the Royal Academy of Engineering analysis is the variability between years, in the numbers taking various qualifications and also the variation between regions. The proportion of Level 3 provision in mathematics and science appears to vary between local authorities, regardless of whether it is provided in schools or the FE and Skills sector, although it is considered that further analysis of all 14+ science provision would be required before conclusions on uptake of science might be made. The report notes that little is known about the numbers or qualifications of mathematics and science teachers in the sector. The introduction of a requirement for teachers in FE to be both qualified and to engage in regular CPD is recent, compared with the requirements for the school sector, with legislation introduced in 2007 (DBIS, 2012a). This was revoked by the current Government, with effect from September 2012. Although the requirement for minimum qualifications has been retained for 2012-13, pending a review and reform of these qualifications by the Learning and Skills Improvement Service (LSIS) (DBIS, 2012c). Colleges are now able to make their own decisions on the continuing professional development of teachers, although discretionary advice is likely to be provided through a proposed Guild for Further Education (DBIS, 2012d).

In the area of adult basic skills, more is known about the characteristics of staff, including those of adult numeracy. A recent literature review commissioned by DBIS (Vorhaus et al., 2011) found evidence of links between the qualifications of numeracy teachers and outcomes for students and also that outcomes were better when students were taught by lecturers on full- time contracts. However, they also found that most teachers of numeracy were on part- time and/or temporary contracts and that levels of qualifications and training were variable.

By student characteristics

In general terms, in order to ensure that all pupils learn and progress equally well in school, they need to experience good teaching, with the features described earlier in this mapping report. One of the factors which seems even more significant when considering different rates of progress in the statutory stages of education and the continuation of learning to higher levels, particularly in mathematics and science, is the need for equally high expectations by teachers of all pupils. It is not only of continuing concern that teachers may have lower expectations of girls, of students from some ethnic groups and of some children from disadvantaged backgrounds, but there may also be disadvantages, as well as advantages, in the assumptions made about students in relation to a 'boffin or geek' identity (Mendick and Francis, 2012). In 2000 Gillborn and Mirza reported on the complexity of factors linking gender, ethnicity and social class and the wide variation in outcomes for different groups at GCSE level among different local authorities in England. This variation continues, and with greater availability of data in England, is shown to also occur between schools which otherwise appear to have similar characteristics.

Closing the Gap

One of the long-standing concerns for the UK has been the 'Long tail of underachievement' (Cockcroft, 1982) and evidence that the wide gap between the highest and the lowest attainers is linked to the socio-economic circumstances of the child (for example, Knowles and Evans, 2012; Ofsted 2012; Siraj- Blatchford et al., 2011). Knowles and Evans draw on OECD data from PISA 2009 which shows that other countries are much more successful in ensuring equity in educational outcomes. The Sutton trust and the Carnegie Corporation provide data comparing educational outcomes and social mobility in four Anglophone countries; the USA; the UK; Australia and Canada which shows that both Australia and Canada are much more successful at ensuring that students from disadvantaged backgrounds make similar progress at school to others (The Sutton Trust, 2012). In both the UK and the USA gaps get wider as children move up through, increasing particularly through secondary school in the UK.

Evidence suggests that the characteristics of good teaching in general are also those that are most successful in ensuring equity (Ofsted, 2012; Xu et al. (2012), OECD, 2011) but that good teaching is even more important for those students from disadvantaged backgrounds. The Royal Society (2008) report *Exploring the relationship between socioeconomic status and participation and attainment in science education* found that factors affecting the both participation beyond age 16 and attainment in science were not different from the effect of these factors in general. In mathematics, Ofsted (2012a) expressed concern, not only that the proportion of pupils performing below levels expected for their age increases as they progress through schooling but, in addition, the poorest teaching is seen in lower sets in secondary schools. Successful schools track achievement and progress carefully and put in place interventions to help those children who are found to be falling behind to catch up. An example of an effective intervention is the *Numbers Count*, programme which provides intensive, one-to-one intervention support for primary-age pupils (everychildcounts.edgehill.ac.uk). Clifton and Cook (2012) suggest that repeated interventions may be needed for many children, in order to overcome the disadvantage of poverty and poor home circumtances. They cite good practice in Finland, saying that 30% of Finnish pupils receive catch- up support at some stage of their education, removing any associated stigma. The Sutton Trust have recently published a toolkit, based on research findings, for use by schools in deciding how to use their resources to improve attainment for disadvantaged pupils, for example through use of Pupil Premium funding in England (Higgins et al., 2012). The authors emphasise that decisions made by school leaders will depend on local context and the needs of children and their community. They also emphasis the crucial importance of school- based evaluation of the impact of any intervention strategies used.

There is evidence that students with low prior attainment perform better in mixed-ability than in setted groups in mathematics (Boaler, 2008; Wiliam and Bartholomew, 2004). However, Ofsted (2012a) found, in England, few secondary schools that teach mathematics in mixed-ability groups and in these the quality of teaching was variable, as it was in the setted groups. Mendick (2008) found that the way mathematics is taught, by being presented as something which requires natural ability (rather than hard work) to succeed, can exclude pupils, with those from disadvantaged backgrounds and girls particularly at risk.

A recent longitudinal research study from the USA focuses on the impact of CPD for science teachers which was intended to increase the use of inquiry- based teaching practices. The authors suggest that policies to reduce equity, in this case the *No Child Left Behind* policy, may limit the learning experiences of pupils from disadvantaged groups. Diaconu et al. (2012) looked at an inservice programme in Texas targeted at elementary schools where high proportions of students were disadvantaged and in which there was pressure to improving standards of performance in external tests. They suggest that the push to get attainment levels of students with a low starting point up to the expected standard for the grade group made it harder for teachers to implement inquiry- based methods of teaching. The programme that they discuss involved attendance at training for one day per week for a year, the formation of learning communities and the involvement of school leaders, with a mandatory introductory session for principals to ensure understanding of the reasons for teaching science through inquiry. Unfortunately the authors do not comment further on the significance of gaining the support of principals, although the programme was successful in all three years covered by the evaluation in both changing teaching practices and in raising attainment in state tests.

By Gender

Although the attainment of girls in mathematics and science at age 16 is on a par with that of boys in England, Scotland and Wales, concern remains in Northern Ireland. Progression rates to A level are of concern, with boys much more likely to continue to study mathematics, physics and chemistry after GCSEs, with this pattern also noted in other countries (for example, Van Langen et al., 2008). In Scotland, relatively similar proportions of males and females leave school with Higher Grade and Advanced Higher Grade qualifications in STEM subjects but a gender imbalance begins to show in higher education (SEEAG, 2012a) and fewer female STEM graduates go on to STEM careers (Royal Society of Edinburgh, 2012). A recent publication from the Institute of Physics (IoP, 2012) *It's different for girls,* drew attention to the differences in the proportions of girls and boys progressing to A level physics from different types of schools. Although, effects were found for both boys and girls, they were greater for girls, with a greater likelihood for girls' progression in schools with sixth forms and in single- sex schools. They found that '49% of maintained, co-ed schools sent no girls on to take A-level physics in 2011' (p7). The recommendations made by the IoP to redress this imbalance build on earlier review of research commissioned by them (Murphy and Whitelegg, 2005). Murphy and Whitelegg noted the importance of teachers' expectations and support, with a tendency for teachers to underestimate girls' abilities in relation to those of boys. The Institute of Physics recommend that gender stereotyping be actively challenged, both within schools and through gender equity being included in Ofsted criteria and government targets for A level participation.

By Ethnicity

At age 16, underachievement of boys and girls from some ethnic groups of is of concern, with those from Traveller communities, Black Caribbean, Mixed and some White boys performing less well. The links between ethnicity and low SES are complex. For example, as is pointed out by Richardson and Wood (2004), within the British Pakistani community some groups in London and the South East have educational attainment at or above national averages but other groups in the North and the West Midlands have lower educational attainment than national and regional averages. DfE data continue to show wide variation among the attainment at GCSE level of all different ethnic groups in different local authorities in England. Wide variations are also found in local authority and school- level data on the attainment and progress of pupils who are eligible for free school meals. Religion may a further complicating factor in identifying issues in relation to achievement in of different groups. For example, in Northern Ireland, poor, white, Protestant boys in Belfast perform significantly worse than other groups. Gillborn and Mirza's research (2000) showed that ethnicity was a greater influence on attainment than either gender or social class. One more recent piece of research suggests that all Black Caribbean students continue to experience barriers to progress, including lower expectations from their teachers, whatever their social and economic background (Vincent et al., 2011).

More able and talented pupils

A report commissioned by the Sutton Trust analysed PISA 2009 data to show that the proportion of 15- year –olds gaining the highest marks in mathematics in England was low, compared with many other OECD countries (Smithers and Robinson, 2012). Supporting more able and talented pupils in secondary schools was in Wales was also prompted by PISA 2009 and was the focus of a survey report published by Estyn (Estyn, 2012b). Although terminology used in the reports is similar, the Sutton Trust report discusses the needs of about 5% of pupils, whereas the Estyn report considers the needs of about 20% of pupils. Unsurprisingly, the recommendations for addressing the needs of more able pupils are similar to good practice in securing progress in learning for all children; needs are identified; progress is tracked, including at transition from primary to secondary school; and consistently good teaching challenges learners to achieve high standards. Coordinators for more able and talented pupils in schools engage parents in supporting their children and arrange enrichment activities, often as part of a local authority network. Mentoring support is provided for more able pupils from disadvantaged backgrounds. Hattie (2009) suggests that acceleration programmes may also be effective with more able students. Smithers and Robinson suggest specialist schooling for able pupils. They also recommend that efforts are made to bring together the small number of children, of whom they estimate approximately two per year group, who fall into their exceptionally able group.

Summary points

- **Differences between nations**

  - The availability of suitably qualified staff to teach mathematics and science differs among England, Wales and Northern Ireland is provided through the PISA 2009 international study, but this is not available for Scotland. Results show that it is more difficult to recruit qualified staff in England. Performance of pupils in England and Northern Ireland in PISA tests in mathematics is similar, with pupils in Wales performing less well.

  - All four UK nations place high priority on mathematics and science education, evidenced through national policy documents. In England, there are changes underway which affect all stages of workforce development, with greater responsibility at school level for initial teacher education, continuing professional development as well as for other factors which have found to contribute to performance in mathematics and science, such as for careers education. There is also a significant amount of curriculum change that affects both mathematics and science, including a proposal to ensure that all pupils study mathematics to the age of 18. Changes to GCSE and A level examinations proposed by the Secretary of State in England may also affect schools in Northern Ireland and Wales, which have used these qualifications. In Scotland, *Curriculum for Excellence* affects all areas of the curriculum and the affect on the teaching and learning of mathematics and science is not yet known.

- **Differences between phases**

Transition between different phases of education was discussed in Section 3.1 of this report as critical for progression in mathematics and science learning. Evidence for differences in performance between phases is provided in the UK by inspection reports. These suggest that overall quality of teaching is better in primary schools than in secondary schools in mathematics and science. Although Further Education Colleges make a large contribution to the science and mathematics qualifications achieved by learners, this review has identified a gap in the literature about workforce issues in this sector.

- **Student characteristics**

The Royal Society (2008) report *Exploring the relationship between socioeconomic status and participation and attainment in science education* found that factors affecting the both participation beyond age 16 and attainment in science were not different from the effect of these factors in general. This review has similarly found that the generic features of good teaching and leadership for promoting high performance in mathematics and science and those that are successful in promoting equity for all pupils, regardless of prior attainment, gender, ethnicity or socioeconomic status. However, there is evidence that teacher beliefs about the dispositions of groups of pupils for mathematics and science subjects may affect their expectations, which has been shown to have a significant influence on pupil engagement and on performance. Close monitoring of progress and individualised and evaluated interventions to enable pupils to catch up when they are found to be falling behind have found to be effective in ensuring good progress for all pupils.

Appendix B: Analysis of Mathematics and Science Teacher Survey Conducted by IOE for the Royal Society, November 2012

This appendix contains the raw data and statistical analysis arising from the survey of mathematics and science teachers carried out by IOE in November 2012. The data is used in the main report, but this appendix is not narrated.

Sample description

School/college characteristics

	N	%
Nation		
England	332	77.8
Northern Ireland	1	.2
Scotland	64	15.0
Wales	15	3.5
Other	15	2.5
Phase of education		
Further education	23	5.5
Primary education	42	10.0
Secondary education	355	84.5
Type of school/college		
Local authority administered	170	41.3
Academy	115	27.9
Independent/private school	103	25.0
General FE college	11	2.7
Sixth form college	13	3.2
of FSM eligible pupils		
0-5	138	33.7
6-10	45	11.1
11-20	37	9.0
21-30	36	8.8
More than 30	67	16.3
Not sure	87	21.2

Respondents characteristics

	N	%
Job title (seniority level)		
Teacher	190	48.6
AST	21	5.4
Subject lead	121	30.9
Senior manager	34	8.7
HE post	18	4.6
Other	7	1.8
Job title (subject area)		
Maths	200	46.4
Science non-specific	114	26.5
Physics	45	10.4
Chemistry	12	2.8
Biology	29	6.7
Science and maths	29	6.7

Unspecified	2	0.5
Subjects taught (multiple choice)		
Mathematics	225	52.1
General science	143	33.3
Physics	113	26.3
Chemistry	72	16.7
Biology	92	21.4
Other	51	11.9
Self-description		
a biology teacher	26	6.1
a chemistry teacher	15	3.5
a maths teacher	126	29.7
a physics teacher	48	11.3
a science teacher	66	15.6
a teacher	112	26.4
other	31	7.3

Respondents characteristics by nation

	England		Scotland		Northern Ireland		Wales		Other	
	N	%	N	%	N	%	N	%	N	%
Job title (seniority level)										
Teacher	139	46.0	36	62.1			6		8	
AST	11	3.6	8	13.8					1	
Subject lead	101	33.4	10	17.2			6		4	
Senior manager	33	10.9			1					
HE post	13	4.3	3	5.2						
Other	5	1.7	1	1.7			1			
Job title (subject area)										
Maths	159	48.0	26	41.3	1		4		6	
Science non-specific	88	26.6	14	22.2			7		5	
Physics	32	9.7	8	12.7			2		2	
Chemistry	8	2.4	3	4.8			1			
Biology	25	7.6	2	3.2					2	
Science and maths	18	5.4	10	15.9			1			
Unspecified	1	0.3								
Subjects taught (multiple choice)										
Mathematics	176	53.3	34	54.0	1		4		6	
General science	102	30.9	27	42.9			8		6	
Physics	83	25.2	17	27.0			5		7	
Chemistry	57	17.3	6	9.5			7		2	
Biology	77	23.3	7	11.1			4		4	
Other	41	12.4	8	12.7						
Self-description										
a biology teacher	21	6.4	2	3.2			1		2	
a chemistry teacher	9	2.8	4	6.3			2			
a maths teacher	106	32.5	12	19.0	1		3		2	
a physics teacher	33	10.1	9	14.3			4		2	
a science teacher	55	16.9	5	7.9			2		4	
a teacher	80	24.5	26	41.3			2		3	
other	22	6.7	5	7.9			1		2	

Respondents characteristics by type of school

	Local authority administered		Academy		Independent/private school		General FE college		Sixth form college	
	N	%	N	%	N	%	N	%	N	%
Job title (seniority level)										
Teacher	73	50.3	56	52.3	45	50.6			6	
AST	13	9.0	5	4.7	2	2.2				
Subject lead	37	25.5	37	34.6	32	36.0	2		5	
Senior manager	15	10.3	9	8.4	8	9.0	1			
HE post	4	2.8			1	1.1	5			
Other	3	2.1			1	1.1			1	
Job title (subject area)										
Maths	82	52.9	58	31.1	32	31.1	4		6	
Science non-specific	39	25.2	42	20.4	21	20.4	1		2	
Physics	9	5.8	6	23.3	24	23.3	1		2	
Chemistry	3	1.0	3	4.9	5	4.9				
Biology	5	3.2	2	16.5	17	16.5	2		3	
Science and maths	17	11.0	4	3.9	4	3.9	2			
Unspecified										
Subjects taught (multiple choice)										
Mathematics	96	61.9	62	53.9	37	35.9	6		6	
General science	62	40.0	42	36.5	27	26.2	1		3	
Physics	36	23.2	29	25.2	34	33.0	3		2	
Chemistry	27	17.4	27	23.5	9	8.7				
Biology	28	18.1	26	22.6	24	23.3	3		5	
Other	24	15.5	7	6.1	8	7.8	1		2	
Self-description										
a biology teacher	2	1.3	1	0.9	17	16.7	1		4	
a chemistry teacher	5	3.2	3	2.6	4	3.9				
a maths teacher	45	29.0	41	35.7	20	19.6	3		6	
a physics teacher	10	6.5	11	9.6	20	19.6	1		2	
a science teacher	25	16.1	27	23.5	10	9.8			1	
a teacher	57	36.8	26	22.6	23	22.5	2			
other	11	7.1	6	5.2	8	7.8	2			

Respondents characteristics by education phase

	Primary		Secondary		Further	
	N	%	N	%	N	%
Job title (seniority level)						
Teacher	24		155	49.8	3	
AST	2		18	5.8		
Subject lead	6		100	32.2	8	
Senior manager	7		26	8.4	1	
HE post			6	1.9	7	

Other			6	1.9		
Job title (subject area)						
Maths	11		169	49.6	9	
Science non-specific	9		93	27.3	4	
Physics			41	12.0	2	
Chemistry			10	2.9		
Biology			24	7.0	5	
Science and maths	21		4	1.2	2	
Subjects taught (multiple choice)						
Mathematics	30	73.2	173	50.7	11	
General science	28	68.3	101	29.6	4	
Physics	2	4.9	101	29.6	5	
Chemistry	1	2.4	62	18.2	1	
Biology	1	2.4	78	22.9	9	
Other	12	29.3	29	8.5	5	
Self-description						
a biology teacher			21	6.2	4	
a chemistry teacher			13	3.8		
a maths teacher	3		111	32.6	7	
a physics teacher			43	12.6	2	
a science teacher	3		59	17.3	2	
a teacher	30		72	21.1	4	
other	4		22	6.5	2	

Respondents characteristics by of FSM pupils in school as reported by respondents

	0-5		6-10		11-20		21-30		More than 30	
	N	%	N	%	N	%	N	%	N	%
Job title (seniority level)										
Teacher	61	50.0	20	48.8	17	51.5	9	29.0	27	47.4
AST	4	3.3	3	7.3	4	12.1	1	3.2	3	5.3
Subject lead	44	36.1	10	24.4	9	27.3	13	41.9	19	33.3
Senior manager	12	9.8	6	14.6	2	6.1	5	16.1	6	10.5
HE post			2	4.9	1	3.0			2	3.5
Other	1	0.8					3	9.7		
Job title (subject area)										
Maths	52	38.0	23	52.3	12	34.3	17	53.1	32	51.6
Science non-specific	31	22.6	14	31.8	16	45.7	11	34.4	17	27.4
Physics	24	17.5	3	6.8	3	8.6	1	3.1	1	1.6
Chemistry	6	4.4	2	4.5					1	1.6
Biology	14	10.2			2	5.7			3	4.8
Science and maths	10	7.3	2	4.5	2	5.7	3	9.4	8	12.9
Subjects taught (multiple choice)										
Mathematics	61	44.5	25	56.8	13	37.1	20	62.5	41	66.1
General science	40	29.2	16	36.4	20	57.1	11	34.4	26	41.9
Physics	39	28.5	15	34.1	10	28.6	10	31.2	12	19.4
Chemistry	15	10.9	11	25.0	6	17.1	7	21.9	13	21.0
Biology	30	21.9	5	11.4	11	31.4	6	18.8	15	24.2
Other	14	10.2	8	18.2	4	11.4	2	6.2	5	8.1
Self-description										
a biology teacher	15	11.0			1	2.9			2	3.2
a chemistry teacher	6	4.4	3	6.8	1	2.9				
a maths teacher	32	23.5	15	34.1	6	17.1	12	37.5	21	33.9
a physics teacher	21	15.4	4	9.1	5	14.3	2	6.2	2	3.2

a science teacher	16	11.8	7	15.9	11	31.4	7	21.9	11	17.7
a teacher	35	25.7	11	25.0	10	28.6	7	21.9	22	35.5
other	11	8.1	4	9.1	1	2.9	4	12.5	4	6.5

Qualifications and educational background of respondents

	N	%
Teaching experience (in years)		
0-5	107	25.4
6-10	95	22.6
11+	219	52.0
Subject of a degree (multiple choice)		
Mathematics	137	32.2
Physics	62	14.6
Chemistry	58	13.6
Biology	76	17.8
ICT	6	1.4
Engineering	32	7.5
Education	51	12.0
Other	106	24.9
Form of teacher education (multiple choice)		
Bachelor of education or equivalent	48	11.5
Post graduate certificate or equivalent	325	77.6
Graduate teacher programme	33	7.9
Other	29	6.9

Qualifications and educational background of respondents by nation

	England		Scotland		Northern Ireland	Wales	Other
	N	%	N	%	N	N	N
Teaching experience (in years)							
0-5	85	26.3	15	23.8		5	2
6-10	75	23.2	16	25.4		2	2
11+	163	50.5	32	50.8	1	8	11
Subject of a degree (multiple choice)							
Mathematics	105	32.0	21	33.3	1	4	5
Physics	42	12.8	13	20.6		3	4
Chemistry	41	12.5	10	15.9		6	1
Biology	65	19.8	6	9.5		2	3
ICT	3	0.9	2	3.2			1
Engineering	19	5.8	7	11.1		1	3
Education	38	11.6	9	14.3		1	2
Other	90	27.4	12	19.0		1	2
Form of teacher education (multiple choice)							
Bachelor of education or equivalent	37	11.5	8	12.7			2
Post graduate certificate or equivalent	239	74.5	55	87.3	1	14	13
Graduate teacher programme	32	10.0	1	1.6			0
Other	26	8.1	1	1.6		1	1

Qualifications and educational background of respondents by type of school

	Local authority administered		Academy		Independent/private school		General FE college		Sixth form college	
	N	%	N	%	N	%	N	%	N	%
Teaching experience (in years)										
0-5	34	22.2	42	36.8	21	20.4	1		3	
6-10	38	24.8	27	23.7	23	22.3			3	
11+	81	52.9	45	39.5	59	57.3	8		7	
Subject of a degree (multiple choice)										
Mathematics	55	35.9	34	29.6	26	25.2	5		3	
Physics	16	10.5	12	10.4	24	23.3	2		2	
Chemistry	20	13.1	17	14.8	10	9.7	1		1	
Biology	23	15.0	26	22.6	20	19.4	1		3	
ICT	4	2.6			1	1.0				
Engineering	10	6.5	10	8.7	10	9.7	1			
Education	24	15.7	17	14.8	4	3.9	1			
Other	42	27.5	26	22.6	24	23.3	3		4	
Form of teacher education (multiple choice)										
Bachelor of education or equivalent	24	15.7	13	11.4	9	9.1	1			
Post graduate certificate or equivalent	120	78.4	85	74.6	74	74.7	8		12	
Graduate teacher programme	9	5.9	15	13.2	7	7.1	1		1	
Other	5	3.3	7	6.1	13	13.1				

Qualifications and educational background of respondents by phase of education

	Primary	Secondary		Further
	N	N	%	N
Teaching experience (in years)				
0-5	5	91	26.9	4
6-10	18	72	21.3	2
11+	18	175	51.8	14
Subject of a degree (multiple choice)				
Mathematics	5	116	34.2	10
Physics	1	54	15.9	4
Chemistry		48	14.2	3
Biology	5	64	18.9	5
ICT	1	4	1.2	1
Engineering		30	8.8	1
Education	17	28	8.3	2
Other	19	75	22.1	6
Form of teacher education (multiple choice)				
Bachelor of education or equivalent	18	26	7.8	2
Post graduate certificate or equivalent	21	266	79.6	17
Graduate teacher programme	1	30	9.0	2
Other	2	25	7.5	1

Qualifications and educational background of respondents by of FSM pupils in school as reported by respondents

	0-5		6-10		11-20		21-30		More than 30	
	N	%	N	%	N	%	N	%	N	%
Teaching experience (in years)										
0-5	27	19.7	6	13.6	9	25.7	9	29.0	29	48.3
6-10	37	27.0	10	22.7	7	20.0	7	22.6	17	28.3
11+	73	53.3	28	63.6	19	54.3	15	48.4	14	23.3
Subject of a degree (multiple choice)										
Mathematics	32	23.4	18		11		11		17	27.9
Physics	26	19.0	8		2		2		6	9.8
Chemistry	13	9.5	9		4		6		8	13.1
Biology	29	21.2	5		8		6		12	19.7
ICT					2					
Engineering	16	11.7	2		3				2	3.3
Education	14	10.2	7		7		3		7	11.5
Other	30	21.9	6		10		11		23	37.7
Form of teacher education (multiple choice)										
Bachelor of education or equivalent	15	11.2	4	9.1	3	8.8	5	15.6	7	11.3
Post graduate certificate or equivalent	107	79.9	35	79.5	28	82.4	25	78.1	44	71.0
Graduate teacher programme	8	6.0	5	11.4	3	8.8	1	3.1	9	14.5
Other	9	6.7	1	2.3			3	9.7	6	9.4

Qualifications and educational background of respondents by seniority level

	Teacher		**AST**		**Subject lead**		**Senior manager**		**HE post**	
	N	%	N	%	N	%	N	%	N	%
Teaching experience (in years)										
0-5	76	41.5	2	10.0	12	10.4	2	6.1	1	7.1
6-10	41	22.4	4	20.0	33	28.7	8	24.2	1	7.1
11+	66	36.1	14	70.0	70	60.9	23	69.7	12	85.7
Form of teacher education (multiple choice)										
Bachelor of education or equivalent	21	11.8	1	5.0	7	6.2	10	29.4	1	6.2
Post graduate certificate or equivalent	133	74.7	17	85.0	94	83.2	23	67.6	15	93.8
Graduate teacher programme	16	9.0	2	10.0	8	7.1	2	5.9		
Other	17	9.6			7	6.2	1	2.9		

Qualifications and educational background of respondents by subject teaching

	Mathematics		General science		Physics		Chemistry		Biology	
	N	%	N	%	N	%	N	%	N	%
Teaching experience (in years)										
0-5	62	29.0	30	22.1	22	20.6	13	20.3	15	17.2
6-10	55	25.7	36	26.5	26	24.3	14	21.9	17	19.5
11+	97	45.3	70	51.5	59	55.1	37	57.8	55	63.2
Form of teacher education (multiple choice)										
Bachelor of education or equivalent	33	15.4	17	12.6	5	4.7	2	3.1	3	3.5
Post graduate certificate or equivalent	159	74.3	107	79.3	90	84.1	49	75.4	70	82.4
Graduate teacher programme	15	7.0	11	8.1	11	10.3	13	20.0	10	11.8
Other	18	8.4	3	2.2	5	4.7	3	4.6	3	3.5

Degree subject and subjects taught

	Mathematics		**General science**		**Physics**		**Chemistry**		**Biology**	
	N	%	N	%	N	%	N	%	N	%
Mathematics	128	59.0	9	6.6	9	8.3	3	4.6	3	3.4
Physics	11	5.1	28	20.6	51	47.2	6	9.2	5	5.7
Chemistry	6	2.8	28	20.6	22	20.4	38	58.5	17	19.3
Biology	8	3.7	41	30.1	24	22.2	23	35.4	61	69.3
ICT	4	1.8	1	0.7	2	1.9	1	1.5	1	1.1
Engineering	19	8.8	5	3.7	13	12.0	2	3.1	1	1.1
Education	36	16.6	20	14.7	5	4.6	6	9.2	6	6.8
Other	61	28.1	38	27.9	14	13.0	7	10.8	20	22.7

Influence on becoming a teacher of maths and/or science

Were any of the following influential in your decision to become a teacher of mathematics and/or science?

	Responses		**Percent of Cases**
	N	**Percent**	
Family member	91	12.4	22.2
A teacher	132	17.9	32.2
Availability of a bursary	50	6.8	12.2
Advertising	12	1.6	2.9
Passion for your subject	270	36.7	65.9
Work/voluntary experience in a school	105	14.3	25.6
The Teach First programme	18	2.4	4.4
Other	58	7.9	14.1
Total	736	100.0	179.5

By degree subject

	Mathematics		Physics		Chemistry		Biology		Engineering		Education		Other	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Family member	31	23.7	14	23.7	13	23.2	10	13.2	11	34.4	8	17.4	21	21.0
A teacher	48	36.6	17	28.8	22	39.3	15	19.7	16	50.0	19	41.3	21	21.0
Availability of a bursary	12	9.2	5	8.5	5	8.9	10	13.2	9	28.1	3	6.5	11	11.0
Advertising	3	2.3	1	1.7	3	5.4	3	3.9	2	6.3	3	6.5	4	4.0
Passion for your subject	91	69.5	44	74.6	46	82.1	59	77.6	14	43.8	29	63.0	55	55.0
Work/voluntary experience in a school	32	24.4	19	32.2	12	21.4	21	27.6	8	25.0	10	21.7	21	21.0
The Teach First programme	3	2.3	0	0.0	1	1.8	1	1.3	1	3.1	0	0.0	12	12.0
Other	19	14.5	8	13.6	8	14.3	8	10.5	4	12.5	8	17.4	23	23.0
Total	131		59		56		76		32		46		100	

By experience

	0-5		6-10		11+	
	N	%	N	%	N	%
Family member	26	23.5	26	28.6	39	19.4
A teacher	41	39.2	29	30.8	61	30.1
Availability of a bursary	19	18.6	16	17.6	14	6.6
Advertising	5	4.9	2	2.2	5	2.6
Passion for your subject	68	63.7	60	64.8	139	68.4
Work/voluntary experience in a school	42	40.2	29	31.9	34	16.8
The Teach First programme	18	17.6	0		0	
Other	8	7.8	13	14.3	33	15.8
	106		92		205	

By subject taught

	Mathematics		General science		Physics		Chemistry		Biology	
	N	%	N	%	N	%	N	%	N	%
Family member	45	21.6	29	22.8	25	23.8	15	23.8	15	17.0
A teacher	67	32.2	47	37.0	32	30.5	23	36.5	25	28.4
Availability of a bursary	21	10.1	19	15.0	22	21.0	12	19.0	16	18.2
Advertising	8	3.8	2	1.6	3	2.9	2	3.2	3	3.4
Passion for your subject	130	62.5	85	66.9	77	73.3	55	87.3	69	78.4

Work/voluntary experience in a school	52	25.0	46	36.2	28	26.7	14	22.2	25	28.4
The Teach First programme	17	8.2					1	1.6		
Other	29	13.9	22	17.3	14	13.3	7	11.1	10	11.4

By phase of education

	Further		Primary		Secondary	
	N	%	N	%	N	%
Family member	5	21.7	3	8.6	81	23.5
A teacher	8	34.8	10	28.6	112	32.5
Availability of a bursary	1	4.3	1	2.9	48	13.9
Advertising		0.		0.0	12	3.5
Passion for your subject	17	73.9	19	54.3	231	67.0
Work/voluntary experience in a school	3	13.0	13	37.1	88	25.5
The Teach First programme		0.0		0.0	18	5.2
Other	4	17.4	9	25.7	44	12.8
	23		35		345	

As a teacher of maths or science, who has the most influence on you?

	Frequency	Percent	Valid Percent
A teacher in a previous school/college	13	3.0	3.6
A tutor/trainer in a previous school/college	11	2.6	3.1
Students	99	23.0	27.7
Your head teacher	24	5.6	6.7
Your peers	104	24.1	29.1
Your subject leader/coordinator	77	17.9	21.6
Others	29	6.7	8.1
Total	357	82.8	100.0
Missing	74	17.2	
TOTAL	431	100.0	

No statistically significant differences based on:

School type

By level of seniority

By subject area taught

Nation

% of FSM pupils

Rating for teaching maths and science

Statistically significant differences based on:

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
As a teacher of maths or science, who has the most influence on you?	A teacher in a previous school/college	Count	0	0	13	13
		% within What phase of education do you teach in?	0.0%	0.0%	4.4%	3.7%
	A tutor/trainer in a previous school/college	Count	1	1	9	11
		% within What phase of education do you teach in?	4.8%	2.8%	3.0%	3.1%
	Students	Count	10	13	75	98
		% within What phase of education do you teach in?	47.6%	36.1%	25.3%	27.8%
	Your head teacher	Count	0	6	17	23
		% within What phase of education do you teach in?	0.0%	16.7%	5.7%	6.5%
	Your peers	Count	8	7	89	104
		% within What phase of education do you teach in?	38.1%	19.4%	30.1%	29.5%
	Your subject leader/coordinator	Count	0	4	71	75
		% within What phase of education do you teach in?	0.0%	11.1%	24.0%	21.2%
	Others	Count	2	5	22	29
		% within What phase of education do you teach in?	9.5%	13.9%	7.4%	8.2%
Total		Count	21	36	296	353
		% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.014

By teaching experience

Crosstab

			For about how many years have you been teaching?			Total
			0-5	6-10	11+	
As a teacher of maths or science, who has the most influence on you?	A teacher in a previous school/college	Count	1	2	9	12
		% within For about how many years have you been teaching?	1.1%	2.4%	5.0%	3.4%
	A tutor/trainer in a previous school/college	Count	4	4	3	11
		% within For about how many years have you been teaching?	4.4%	4.8%	1.7%	3.1%
	Students	Count	23	27	49	99
		% within For about how many years have you been teaching?	25.3%	32.5%	27.4%	28.0%
	Your head teacher	Count	1	8	14	23
		% within For about how many years have you been teaching?	1.1%	9.6%	7.8%	6.5%
	Your peers	Count	32	17	54	103
		% within For about how many years have you been teaching?	35.2%	20.5%	30.2%	29.2%
	Your subject leader/coordinator	Count	29	16	32	77
		% within For about how many years have you been teaching?	31.9%	19.3%	17.9%	21.8%
	Others	Count	1	9	18	28
		% within For about how many years have you been teaching?	1.1%	10.8%	10.1%	7.9%
Total		Count	91	83	179	353
		% within For about how many years have you been teaching?	100.0%	100.0%	100.0%	100.0%

Chi-square test, $p=0.005$

Teaching mathematics ratings and trajectories

How would you personally rate the teaching of maths in your school/college?

	Frequency	Percent	Valid Percent
Poor	7	1.6	2.2
Good	4	.9	1.3
Excellent	172	39.9	54.8
Total	131	30.4	41.7
Missing	314	72.9	100.0
Total	117	27.1	
	431	100.0	

No statistically significant differences based on:

By subject area taught

By teaching experience

Statistically significant differences based on:

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
How would you personally rate the teaching of maths in your school/college?	Poor	Count	0	0	7	7
		% within What phase of education do you teach in?	0.0%	0.0%	2.7%	2.2%
	Moderate	Count	0	0	4	4
		% within What phase of education do you teach in?	0.0%	0.0%	1.5%	1.3%
	Good	Count	13	28	131	172
		% within What phase of education do you teach in?	65.0%	82.4%	50.6%	55.0%
	Excellent	Count	7	6	117	130
		% within What phase of education do you teach in?	35.0%	17.6%	45.2%	41.5%
Total		Count	20	34	259	313
		% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.031

By type of school

Crosstab

			Typeofschool					Total
			Local authority administered	Academy	Independent/ private school	General FE college	Sixth form college	
How would you personally rate the teaching of maths in your school/ college?	Poor	Count	3	3	0	0	0	6
		% within Typeofschool	2.4%	3.6%	0.0%	0.0%	0.0%	2.0%
	Moderate	Count	4	0	0	0	0	4
		% within Typeofschool	3.3%	0.0%	0.0%	0.0%	0.0%	1.3%
	Good	Count	81	50	24	5	8	168
		% within Typeofschool	65.9%	59.5%	30.8%	45.5%	72.7%	54.7%
	Excellent	Count	35	31	54	6	3	129
		% within Typeofschool	28.5%	36.9%	69.2%	54.5%	27.3%	42.0%
Total		Count	123	84	78	11	11	307
		% within Typeofschool	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By level of seniority

Crosstab

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
How would you personally rate the teaching of maths in your school/college?	Poor	Count	2	1	1	2	1	0	7
		% within Level of seniority	1.4%	5.9%	1.1%	7.4%	10.0%	0.0%	2.4%
	Moderate	Count	1	0	0	0	0	1	2
		% within Level of seniority	0.7%	0.0%	0.0%	0.0%	0.0%	33.3%	0.7%
	Good	Count	76	11	49	15	4	1	156
		% within Level of seniority	54.3%	64.7%	53.3%	55.6%	40.0%	33.3%	54.0%
	Excellent	Count	61	5	42	10	5	1	124
		% within Level of seniority	43.6%	29.4%	45.7%	37.0%	50.0%	33.3%	42.9%
Total		Count	140	17	92	27	10	3	289
		% within Level of seniority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By nation

Crosstab

			And in which nation is the school/college?					Total
			England	Nothern Ireland	Scotland	Wales	Other	
How would you personally rate the teaching of maths in your school/college ?	Poor	Count	5	0	2	0	0	7
		% within And in which nation is the school/college?	2.0%	0.0%	4.3%	0.0%	0.0%	2.2%
	Moderate	Count	0	0	0	4	0	4
		% within And in which nation is the school/college?	0.0%	0.0%	0.0%	33.3%	0.0%	1.3%
	Good	Count	139	0	22	7	4	172
		% within And in which nation is the school/college?	56.5%	0.0%	46.8%	58.3%	50.0%	54.8%
	Excellent	Count	102	1	23	1	4	131
		% within And in which nation is the school/college?	41.5%	100.0%	48.9%	8.3%	50.0%	41.7%
Total		Count	246	1	47	12	8	314
		% within And in which nation is the school/college?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

% of FSM pupils (over)

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
How would you personally rate the teaching of maths in your school/college ?	Poor	Count	1	0	2	1	2	0	6
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	0.9%	0.0%	6.9%	4.5%	4.3%	0.0%	1.9%
	Moderate	Count	0	0	1	1	2	0	4
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	0.0%	0.0%	3.4%	4.5%	4.3%	0.0%	1.3%
	Good	Count	47	19	19	18	35	31	169
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	41.6%	54.3%	65.5%	81.8%	76.1%	49.2%	54.9%
	Excellent	Count	65	16	7	2	7	32	129

	% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	57.5%	45.7%	24.1%	9.1%	15.2%	50.8%	41.9%
Total	Count	113	35	29	22	46	63	308
	% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

Would you say that the teaching of maths in your school/college is

	Frequency	Percent	Valid Percent
In decline	9	2.1	2.6
Staying the same	103	23.9	29.3
Improving slowly	176	40.8	50.0
Improving rapidly	64	14.8	18.2
Total	352	81.7	100.0
Missing	79	18.3	
Total	431	100.0	

No statistically significant differences based on:

By nation

By teaching experience

Statistically significant differences based on:

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
Would you say that the teaching of maths in your school/college is	In decline	Count	1	1	7	9
		% within What phase of education do you teach in?	4.8%	2.9%	2.4%	2.6%
	Staying the same	Count	8	3	91	102
		% within What phase of education do you teach in?	38.1%	8.6%	31.2%	29.3%
	Improving slowly	Count	9	13	151	173
		% within What phase of education do you teach in?	42.9%	37.1%	51.7%	49.7%
	Improving rapidly	Count	3	18	43	64
		% within What phase of education do you teach in?	14.3%	51.4%	14.7%	18.4%
Total		Count	21	35	292	348
		% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By type of school

Crosstab

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
Would you say that the teaching of maths in your school/college is	In decline	Count	3	5	0	1	0	9
		% within Typeofschool	2.2%	5.0%	0.0%	9.1%	0.0%	2.6%
	Staying the same	Count	32	20	40	3	5	100
		% within Typeofschool	23.0%	19.8%	48.2%	27.3%	45.5%	29.0%
	Improving slowly	Count	75	55	34	5	4	173
		% within Typeofschool	54.0%	54.5%	41.0%	45.5%	36.4%	50.1%
	Improving rapidly	Count	29	21	9	2	2	63
		% within Typeofschool	20.9%	20.8%	10.8%	18.2%	18.2%	18.3%
Total		Count	139	101	83	11	11	345
		% within Typeofschool	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.004

By level of seniority

Crosstab

			Level of seniority						Total
			Teacher	AST	Subject lead	Seniour manager	HE post	Other	
Would you say that the teaching of maths in your school/college is	In decline	Count	1	0	4	1	1	0	7
		% within Level of seniority	0.7%	0.0%	3.7%	3.3%	10.0%	0.0%	2.2%
	Staying the same	Count	49	4	29	7	5	1	95
		% within Level of seniority	32.2%	21.1%	27.1%	23.3%	50.0%	33.3%	29.6%
	Improving slowly	Count	81	14	46	13	4	1	159
		% within Level of seniority	53.3%	73.7%	43.0%	43.3%	40.0%	33.3%	49.5%
	Improving rapidly	Count	21	1	28	9	0	1	60
		% within Level of seniority	13.8%	5.3%	26.2%	30.0%	0.0%	33.3%	18.7%
Total		Count	152	19	107	30	10	3	321
		% within Level of seniority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.056

By taught subject area

Crosstab

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
Would you say that the teaching of maths in your school/college is	In decline	Count	4	3	0	0	0	2	0	9
		% within Subject	2.5%	3.2%	0.0%	0.0%	0.0%	8.3%	0.0%	2.6%
	Staying the same	Count	42	25	15	6	11	4	0	103
		% within Subject	26.1%	26.3%	40.5%	54.5%	47.8%	16.7%	0.0%	29.3%
	Improving slowly	Count	85	47	20	5	11	7	1	176
		% within Subject	52.8%	49.5%	54.1%	45.5%	47.8%	29.2%	100.0%	50.0%
	Improving rapidly	Count	30	20	2	0	1	11	0	64
		% within Subject	18.6%	21.1%	5.4%	0.0%	4.3%	45.8%	0.0%	18.2%
Total		Count	161	95	37	11	23	24	1	352
		% within Subject	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.008

By % of FSM

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
Would you say that the teaching of maths in your school/college is	In decline	Count	1	0	1	1	3	2	8
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	0.8%	0.0%	2.9%	4.3%	5.2%	3.0%	2.3%
	Staying the same	Count	49	12	11	4	3	20	99
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	40.5%	27.9%	32.4%	17.4%	5.2%	29.9%	28.6%
	Improving slowly	Count	50	25	15	12	40	34	176
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	41.3%	58.1%	44.1%	52.2%	69.0%	50.7%	50.9%
	Improving rapidly	Count	21	6	7	6	12	11	63
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	17.4%	14.0%	20.6%	26.1%	20.7%	16.4%	18.2%
Total		Count	121	43	34	23	58	67	346

	% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.008

By rating maths teaching

Crosstab

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
Would you say that the teaching of maths in your school/college is	In decline	Count	1	0	2	2	5
		% within How would you personally rate the teaching of maths in your school/college?	14.3%	0.0%	1.2%	1.6%	1.6%
	Staying the same	Count	3	0	37	51	91
		% within How would you personally rate the teaching of maths in your school/college?	42.9%	0.0%	22.0%	39.8%	29.6%
	Improving slowly	Count	3	4	94	50	151
		% within How would you personally rate the teaching of maths in your school/college?	42.9%	100.0%	56.0%	39.1%	49.2%
	Improving rapidly	Count	0	0	35	25	60
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	0.0%	20.8%	19.5%	19.5%
Total		Count	7	4	168	128	307
		% within How would you personally rate the teaching of maths in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.003

Teaching science ratings and trajectories

How would you personally rate the teaching of science in your school/college?

	Frequency	Percent	Valid Percent
Poor	6	1.4	1.8
Moderate	45	10.4	13.4
Good	164	38.1	48.8
Excellent	121	28.1	36.0
Total	336	78.0	100.0
Missing	95	22.0	
Total	431	100.0	

<u>No statistically significant differences based on:</u>

By level of seniority

By nation

By teaching experience

<u>Statistically significant differences based on:</u>

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
How would you personally rate the teaching of science in your school/college?	Poor	Count	0	2	4	6
		% within What phase of education do you teach in?	0.0%	5.7%	1.4%	1.8%
	Moderate	Count	1	8	34	43
		% within What phase of education do you teach in?	5.3%	22.9%	12.2%	13.0%
	Good	Count	11	20	132	163
		% within What phase of education do you teach in?	57.9%	57.1%	47.5%	49.1%

	Excellent	Count	7	5	108	120
		% within What phase of education do you teach in?	36.8%	14.3%	38.8%	36.1%
Total		Count	19	35	278	332
		% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.039

By type of school

Crosstab

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
How would you personally rate the teaching of science in your school/college?	Poor	Count	3	3	0	0	0	6
		% within Typeofschool	2.3%	3.0%	0.0%	0.0%	0.0%	1.8%
	Moderate	Count	24	17	3	0	1	45
		% within Typeofschool	18.5%	17.0%	3.8%	0.0%	8.3%	13.6%
	Good	Count	69	52	28	4	8	161
		% within Typeofschool	53.1%	52.0%	35.0%	44.4%	66.7%	48.6%
	Excellent	Count	34	28	49	5	3	119
		% within Typeofschool	26.2%	28.0%	61.2%	55.6%	25.0%	36.0%
Total		Count	130	100	80	9	12	331
		% within Typeofschool	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By taught subject area

Crosstab

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
How would you personally rate the teaching of science in your school/college?	Poor	Count	5	0	0	0	0	1	0	6
		% within Subject	3.7%	0.0%	0.0%	0.0%	0.0%	4.2%	0.0%	1.8%
	Moderate	Count	30	5	0	0	1	8	1	45
		% within Subject	22.1%	5.1%	0.0%	0.0%	4.0%	33.3%	100.0%	13.4%
	Good	Count	65	54	16	8	10	11	0	164
		% within Subject	47.8%	54.5%	41.0%	66.7%	40.0%	45.8%	0.0%	48.8%
	Excellent	Count	36	40	23	4	14	4	0	121
		% within Subject	26.5%	40.4%	59.0%	33.3%	56.0%	16.7%	0.0%	36.0%
Total		Count	136	99	39	12	25	24	1	336
		% within Subject	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By % of FSM

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
How would you personally rate the teaching of science in your school/college?	Poor	Count	2	0	1	1	1	1	6
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	1.8%	0.0%	2.9%	4.3%	1.8%	1.6%	1.8%
	Moderate	Count	5	5	4	6	19	5	44
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	4.4%	12.5%	11.8%	26.1%	33.3%	7.8%	13.3%
	Good	Count	50	21	16	13	30	33	163

		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	43.9%	52.5%	47.1%	56.5%	52.6%	51.6%	49.1%
	Excellent	Count	57	14	13	3	7	25	119
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	50.0%	35.0%	38.2%	13.0%	12.3%	39.1%	35.8%
Total		Count	114	40	34	23	57	64	332
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By rating of maths teaching

Crosstab

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
How would you personally rate the teaching of science in your school/college?	Poor	Count	1	0	4	0	5
		% within How would you personally rate the teaching of maths in your school/college?	16.7%	0.0%	2.5%	0.0%	1.7%
	Moderate	Count	1	1	27	1	30
		% within How would you personally rate the teaching of maths in your school/college?	16.7%	25.0%	17.2%	0.8%	10.4%
	Good	Count	2	2	96	43	143

		% within How would you personally rate the teaching of maths in your school/college?	33.3%	50.0%	61.1%	35.2%	49.5%
	Excellent	Count	2	1	30	78	111
		% within How would you personally rate the teaching of maths in your school/college?	33.3%	25.0%	19.1%	63.9%	38.4%
Total		Count	6	4	157	122	289
		% within How would you personally rate the teaching of maths in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

Would you say that the teaching of science in your school/college is:

	Frequency	Percent	Valid Percent
In decline	7	1.6	2.1
Staying the same	81	18.8	24.5
Improving slowly	191	44.3	57.7
Improving rapidly	52	12.1	15.7
Total	331	76.8	100.0
Missing	100	23.2	
Total	431	100.0	

No statistically significant differences based on:

By level of seniority

By teaching experience

By School phase

By taught subject area

By % of FSM

Statistically significant differences based on:

By nation

Crosstab
Crosstab

			And in which nation is the school/college?					Total
			England	Nothern Ireland	Scotland	Wales	Other	
Would you say that the teaching of science in your school/college is	In decline	Count	3	1	3	0	0	7
		% within And in which nation is the school/college ?	1.2%	100.0%	5.9%	0.0%	0.0%	2.1%
	Staying the same	Count	64	0	14	2	1	81
		% within And in which nation is the school/college ?	24.8%	0.0%	27.5%	16.7%	11.1%	24.5%
	Improving slowly	Count	152	0	22	10	7	191
		% within And in which nation is the school/college ?	58.9%	0.0%	43.1%	83.3%	77.8%	57.7%
	Improving rapidly	Count	39	0	12	0	1	52
		% within And in which nation is the school/college ?	15.1%	0.0%	23.5%	0.0%	11.1%	15.7%
Total		Count	258	1	51	12	9	331
		% within And in which nation is the school/college ?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By science teaching rating

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
Would you say that the teaching of science in your school/college is	In decline	Count	2	1	3	0	6
		% within How would you personally rate the teaching of science in your school/college?	33.3%	2.3%	1.9%	0.0%	1.8%
	Staying the same	Count	1	9	31	40	81
		% within How would you personally rate the teaching of science in your school/college?	16.7%	20.5%	19.4%	34.5%	24.8%
	Improving slowly	Count	3	32	106	47	188
		% within How would you personally rate the teaching of science in your school/college?	50.0%	72.7%	66.2%	40.5%	57.7%
	Improving rapidly	Count	0	2	20	29	51
		% within How would you personally rate the teaching of science in your school/college?	0.0%	4.5%	12.5%	25.0%	15.6%
Total		Count	6	44	160	116	326
		% within How would you personally rate the teaching of science in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

Leadership in maths

How would you rate your subject leader/coordinator in maths?

	Frequency	Percent	Valid Percent
Poor	13	3.0	3.7
Moderate	48	11.1	13.8
Good	140	32.5	40.3
Excellent	124	28.8	35.7
I am the subject leader/coordinator in mathematics	22	5.1	6.3
Total	347	80.5	100.0
Missing	84	19.5	

Total	431	100.0	

No statistically significant differences based on:

By type of school

By level of seniority

By teaching experience

By School phase

By taught subject area

By % of FSM

Statistically significant differences based on:

By nation

Crosstab

			And in which nation is the school/college?					Total
			England	Nothern Ireland	Scotland	Wales	Other	
How would you rate your subject leader/coordinator in maths?	Poor	Count	10	0	2	0	1	13
		% within And in which nation is the school/college?	3.9%	0.0%	4.0%	0.0%	12.5%	4.0%
	Moderate	Count	32	0	11	5	0	48
		% within And in which nation is the school/college?	12.5%	0.0%	22.0%	45.5%	0.0%	14.8%
	Good	Count	105	0	28	2	5	140
		% within And in which nation is the school/college?	41.2%	0.0%	56.0%	18.2%	62.5%	43.1%
	Excellent	Count	108	1	9	4	2	124
		% within And in which nation is the school/college?	42.4%	100.0%	18.0%	36.4%	25.0%	38.2%
Total		Count	255	1	50	11	8	325
		% within And in which nation is the school/college?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.012

Rating of maths teaching

Crosstab

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
How would you rate your subject leader/coordinator in maths?	Poor	Count	4	0	3	0	7
		% within How would you personally rate the teaching of maths in your school/college?	57.1%	0.0%	1.9%	0.0%	2.4%
	Moderate	Count	3	4	19	3	29
		% within How would you personally rate the teaching of maths in your school/college?	42.9%	100.0%	12.3%	2.5%	10.1%
	Good	Count	0	0	81	46	127
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	0.0%	52.6%	38.0%	44.4%
	Excellent	Count	0	0	51	72	123
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	0.0%	33.1%	59.5%	43.0%
Total		Count	7	4	154	121	286
		% within How would you personally rate the teaching of maths in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By maths trajectory

Crosstab

	Would you say that the teaching of maths in your school/college is				Total
	In decline	Staying the same	Improving slowly	Improving rapidly	

How would you rate your subject leader/coordinator in maths?	Poor	Count	1	6	6	0	13
		% within Would you say that the teaching of maths in your school/college is	12.5%	6.0%	3.7%	0.0%	4.0%
	Moderate	Count	3	17	27	1	48
		% within Would you say that the teaching of maths in your school/college is	37.5%	17.0%	16.8%	1.9%	14.9%
	Good	Count	3	43	70	24	140
		% within Would you say that the teaching of maths in your school/college is	37.5%	43.0%	43.5%	45.3%	43.5%
	Excellent	Count	1	34	58	28	121
		% within Would you say that the teaching of maths in your school/college is	12.5%	34.0%	36.0%	52.8%	37.6%
Total		Count	8	100	161	53	322
		% within Would you say that the teaching of maths in your school/college is	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.024

Would you describe your mathematics subject leader/coordinator as being:

	Responses		Percent of Cases
	N	Percent	
Highly enthusiastic about teaching	161	7.1	50.0
Highly enthusiastic about maths	210	9.3	65.2
Approachable	236	10.4	73.3
Highly organised	167	7.4	51.9
Good at paperwork	153	6.8	47.5
Source of advice and support	160	7.1	49.7
Good at using pupil performance data	163	7.2	50.6
Good at maintaining pupil/student discipline	166	7.3	51.6
Always ready to listen to staff	166	7.3	51.6
Good team leader	153	6.8	47.5
Innovator and source of fresh ideas	87	3.8	27.0

Maintains high profile for the department/or for maths in the school or college	137	6.0	42.5
A very hard worker	194	8.6	60.2
Ensures resources are available for you to do your job	112	4.9	34.8
Total	2265	100.0	703.4

By phase of education

$MathLead*Whatphaseofeducationdoyouteachin Crosstabulation

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	14	15	128	157
		% within Whatphaseofeducationdoyouteachin	82.4%	48.4%	47.4%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	14	17	177	208
		% within Whatphaseofeducationdoyouteachin	82.4%	54.8%	65.6%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	14	28	191	233
		% within Whatphaseofeducationdoyouteachin	82.4%	90.3%	70.7%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	11	15	139	165
		% within Whatphaseofeducationdoyouteachin	64.7%	48.4%	51.5%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	11	13	127	151
		% within Whatphaseofeducationdoyouteachin	64.7%	41.9%	47.0%	
	Source of advice and	Count	8	18	132	158

support:Would you describe your mathematics subject leader/coordinator as being	% within Whatphaseofeducationdoyouteachin	47.1%	58.1%	48.9%	
Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	8	13	140	161
	% within Whatphaseofeducationdoyouteachin	47.1%	41.9%	51.9%	
Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	11	18	134	163
	% within Whatphaseofeducationdoyouteachin	64.7%	58.1%	49.6%	
Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	11	22	130	163
	% within Whatphaseofeducationdoyouteachin	64.7%	71.0%	48.1%	
Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	10	16	124	150
	% within Whatphaseofeducationdoyouteachin	58.8%	51.6%	45.9%	
Innovator and source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	Count	6	10	70	86
	% within Whatphaseofeducationdoyouteachin	35.3%	32.3%	25.9%	
Maintains high profile for	Count	6	11	118	135

	the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	% within Whatphaseofeducationdoyouteachin	35.3%	35.5%	43.7%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	12	20	158	190
		% within Whatphaseofeducationdoyouteachin	70.6%	64.5%	58.5%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	8	14	89	111
		% within Whatphaseofeducationdoyouteachin	47.1%	45.2%	33.0%	
Total		Count	17	31	270	318

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By nation

$MathLead*Andinwhichnationistheschoolcollege Crosstabulation

			And in which nation is the school/college?					Total
			England	Nothern Ireland	Scotland	Wales	Other	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	134	1	19	3	4	161
		% within Andinwhichnationistheschoolcollege	52.8%	100.0%	40.4%	27.3%	44.4 %	
	Highly enthusiastic about	Count	180	1	20	4	5	210

maths:Would you describe your mathematics subject leader/coordinator as being	% within Andinwhichnationistheschoolcollege	70.9%	100.0%	42.6%	36.4%	55.6%	
Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	185	1	37	8	5	236
	% within Andinwhichnationistheschoolcollege	72.8%	100.0%	78.7%	72.7%	55.6%	
Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	140	1	17	5	4	167
	% within Andinwhichnationistheschoolcollege	55.1%	100.0%	36.2%	45.5%	44.4%	
Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	125	1	20	5	2	153
	% within Andinwhichnationistheschoolcollege	49.2%	100.0%	42.6%	45.5%	22.2%	
Source of advice and support:Would you describe your mathematics subject leader/coordinator as being	Count	133	1	20	3	3	160
	% within Andinwhichnationistheschoolcollege	52.4%	100.0%	42.6%	27.3%	33.3%	
Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	134	1	19	3	6	163
	% within Andinwhichnationistheschoolcollege	52.8%	100.0%	40.4%	27.3%	66.7%	
Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	138	1	20	4	3	166
	% within Andinwhichnationistheschoolcollege	54.3%	100.0%	42.6%	36.4%	33.3%	
Always ready to listen to	Count	139	1	21	0	5	166

	staff:Would you describe your mathematics subject leader/coordinator as being	% within Andinwhichnationist heschoolcollege	54.7%	100.0%	44.7%	0.0%	55.6 %	
	Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	130	1	15	4	3	153
		% within Andinwhichnationist heschoolcollege	51.2%	100.0%	31.9%	36.4%	33.3 %	
	Innovator and source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	Count	80	1	4	0	2	87
		% within Andinwhichnationist heschoolcollege	31.5%	100.0%	8.5%	0.0%	22.2 %	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	117	1	14	1	4	137
		% within Andinwhichnationist heschoolcollege	46.1%	100.0%	29.8%	9.1%	44.4 %	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	165	1	25	1	2	194
		% within Andinwhichnationist heschoolcollege	65.0%	100.0%	53.2%	9.1%	22.2 %	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	93	1	15	1	2	112
		% within Andinwhichnationist heschoolcollege	36.6%	100.0%	31.9%	9.1%	22.2 %	
Total		Count	254	1	47	11	9	322

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By type of school

$MathLead*Typeofschool Crosstabulation

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	58	44	40	7	10	159
		% within Typeofschool	45.7%	47.8%	50.6%	77.8%	90.9%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	69	61	60	7	10	207
		% within Typeofschool	54.3%	66.3%	75.9%	77.8%	90.9%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	100	63	52	8	9	232
		% within Typeofschool	78.7%	68.5%	65.8%	88.9%	81.8%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	52	48	52	6	7	165
		% within Typeofschool	40.9%	52.2%	65.8%	66.7%	63.6%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	56	40	42	5	8	151
		% within Typeofschool	44.1%	43.5%	53.2%	55.6%	72.7%	
	Source of advice	Count	64	48	36	2	8	158

and support:Would you describe your mathematics subject leader/coordinator as being	% within Typeofschool	50.4%	52.2%	45.6%	22.2%	72.7%	
Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	65	50	35	3	7	160
	% within Typeofschool	51.2%	54.3%	44.3%	33.3%	63.6%	
Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	63	45	43	6	6	163
	% within Typeofschool	49.6%	48.9%	54.4%	66.7%	54.5%	
Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	63	43	46	5	7	164
	% within Typeofschool	49.6%	46.7%	58.2%	55.6%	63.6%	
Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	54	41	43	4	7	149
	% within Typeofschool	42.5%	44.6%	54.4%	44.4%	63.6%	
Innovator and	Count	28	25	25	2	5	85

	source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	% within Typeofschool	22.0%	27.2%	31.6%	22.2%	45.5%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	43	42	44	3	4	136
		% within Typeofschool	33.9%	45.7%	55.7%	33.3%	36.4%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	74	57	48	7	6	192
		% within Typeofschool	58.3%	62.0%	60.8%	77.8%	54.5%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	45	31	25	3	6	110
		% within Typeofschool	35.4%	33.7%	31.6%	33.3%	54.5%	
Total		Count	127	92	79	9	11	318

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By level of seniority

$MathLead*Levelofseniority Crosstabulation

			Level of seniority						Total
			Teacher	AST	Subject lead	Seniour manager	HE post	Other	
$MathLead a	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	66	6	58	14	6	1	151
		% within Levelofseniority	46.8%	35.3%	59.2%	48.3%	85.7%	33.3%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	89	10	67	20	5	1	192
		% within Levelofseniority	63.1%	58.8%	68.4%	69.0%	71.4%	33.3%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	110	12	68	22	6	2	220
		% within Levelofseniority	78.0%	70.6%	69.4%	75.9%	85.7%	66.7%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	70	8	58	15	5	1	157
		% within Levelofseniority	49.6%	47.1%	59.2%	51.7%	71.4%	33.3%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	60	8	57	13	5	3	146
		% within Levelofseniority	42.6%	47.1%	58.2%	44.8%	71.4%	100.0%	
	Source of advice	Count	72	8	59	13	2	1	155

	and support:Would you describe your mathematics subject leader/coordinator as being	% within Levelofseniority	51.1%	47.1%	60.2%	44.8%	28.6%	33.3%	
	Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	72	6	53	17	3	2	153
		% within Levelofseniority	51.1%	35.3%	54.1%	58.6%	42.9%	66.7%	
	Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	68	10	54	16	6	3	157
		% within Levelofseniority	48.2%	58.8%	55.1%	55.2%	85.7%	100.0%	
	Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	75	9	50	17	4	1	156
		% within Levelofseniority	53.2%	52.9%	51.0%	58.6%	57.1%	33.3%	
	Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	68	8	53	13	3	1	146
		% within Levelofseniority	48.2%	47.1%	54.1%	44.8%	42.9%	33.3%	
	Innovator and	Count	30	6	34	7	3	1	81

	source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	% within Levelofseniority	21.3%	35.3%	34.7%	24.1%	42.9%	33.3%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	57	10	50	12	2	1	132
		% within Levelofseniority	40.4%	58.8%	51.0%	41.4%	28.6%	33.3%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	90	10	58	21	5	2	186
		% within Levelofseniority	63.8%	58.8%	59.2%	72.4%	71.4%	66.7%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	52	7	35	10	3	2	109
		% within Levelofseniority	36.9%	41.2%	35.7%	34.5%	42.9%	66.7%	
Total		Count	141	17	98	29	7	3	295

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By taught subject area

$MathLead*Subject Crosstabulation

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	84	31	15	5	12	13	1	161
		% within Subject	56.8%	36.9%	40.5%	50.0%	57.1%	61.9%	100.0%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	100	43	31	7	17	11	1	210
		% within Subject	67.6%	51.2%	83.8%	70.0%	81.0%	52.4%	100.0%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	119	54	24	7	13	18	1	236
		% within Subject	80.4%	64.3%	64.9%	70.0%	61.9%	85.7%	100.0%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	72	36	27	9	14	8	1	167
		% within Subject	48.6%	42.9%	73.0%	90.0%	66.7%	38.1%	100.0%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	77	33	17	6	10	9	1	153
		% within Subject	52.0%	39.3%	45.9%	60.0%	47.6%	42.9%	100.0%	

	Source of advice and support:Would you describe your mathematics subject leader/coordinator as being	Count	98	28	12	6	7	8	1	160
		% within Subject	66.2%	33.3%	32.4%	60.0%	33.3%	38.1%	100.0%	
	Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	92	32	16	5	9	9	0	163
		% within Subject	62.2%	38.1%	43.2%	50.0%	42.9%	42.9%	0.0%	
	Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	89	33	16	5	10	12	1	166
		% within Subject	60.1%	39.3%	43.2%	50.0%	47.6%	57.1%	100.0%	
	Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	103	25	10	4	11	12	1	166
		% within Subject	69.6%	29.8%	27.0%	40.0%	52.4%	57.1%	100.0%	
	Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	80	31	18	4	10	9	1	153
		% within Subject	54.1%	36.9%	48.6%	40.0%	47.6%	42.9%	100.0%	
	Innovator and	Count	52	12	6	3	6	7	1	87

	source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	% within Subject	35.1%	14.3%	16.2%	30.0%	28.6%	33.3%	100.0%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	75	22	18	7	7	8	0	137
		% within Subject	50.7%	26.2%	48.6%	70.0%	33.3%	38.1%	0.0%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	106	34	22	7	10	14	1	194
		% within Subject	71.6%	40.5%	59.5%	70.0%	47.6%	66.7%	100.0%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	80	15	3	1	5	7	1	112
		% within Subject	54.1%	17.9%	8.1%	10.0%	23.8%	33.3%	100.0%	
Total		Count	148	84	37	10	21	21	1	322

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % of FSM

$MathLead*Approximatelywhatpercentageofpupilsstudentsinyourschool Crosstabulation

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?					Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	56	20	11	13	26	126
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	48.7%	50.0%	40.7%	61.9%	48.1%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	81	24	20	13	35	173
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	70.4%	60.0%	74.1%	61.9%	64.8%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	81	30	20	12	42	185
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	70.4%	75.0%	74.1%	57.1%	77.8%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	67	19	12	9	27	134
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	58.3%	47.5%	44.4%	42.9%	50.0%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	61	17	11	12	25	126
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	53.0%	42.5%	40.7%	57.1%	46.3%	
	Source of advice and	Count	57	18	12	7	34	128

	support:Would you describe your mathematics subject leader/coordinator as being	% within Approximatelywhatpercentageofpupilsstudentsin yourschool	49.6%	45.0%	44.4%	33.3%	63.0%	
	Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	55	18	12	8	30	123
		% within Approximatelywhatpercentageofpupilsstudentsin yourschool	47.8%	45.0%	44.4%	38.1%	55.6%	
	Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	63	17	12	12	34	138
		% within Approximatelywhatpercentageofpupilsstudentsin yourschool	54.8%	42.5%	44.4%	57.1%	63.0%	
	Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	60	17	11	11	33	132
		% within Approximatelywhatpercentageofpupilsstudentsin yourschool	52.2%	42.5%	40.7%	52.4%	61.1%	
	Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	59	16	11	10	26	122
		% within Approximatelywhatpercentageofpupilsstudentsin yourschool	51.3%	40.0%	40.7%	47.6%	48.1%	
	Innovator and source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	Count	35	7	8	6	17	73
		% within Approximatelywhatpercentageofpupilsstudentsin yourschool	30.4%	17.5%	29.6%	28.6%	31.5%	
	Maintains high	Count	52	15	8	9	25	109

	profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	45.2%	37.5%	29.6%	42.9%	46.3%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	66	29	15	13	32	155
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	57.4%	72.5%	55.6%	61.9%	59.3%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	35	10	9	9	22	85
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	30.4%	25.0%	33.3%	42.9%	40.7%	
Total		Count	115	40	27	21	54	257

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of maths teaching

$MathLead*Howwouldyoupersonallyratetheteachingofmathsinyourscho Crosstabulation

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	1	0	76	72	149
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	0.0%	48.7%	59.0%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	2	2	102	88	194
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	66.7%	50.0%	65.4%	72.1%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	1	2	123	94	220
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	50.0%	78.8%	77.0%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	0	1	78	73	152
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	25.0%	50.0%	59.8%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	1	3	66	66	136
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	75.0%	42.3%	54.1%	
	Source of advice	Count	1	0	82	66	149

	and support:Would you describe your mathematics subject leader/coordinator as being	% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	0.0%	52.6%	54.1%	
	Good at using pupil performance data:Would you describe your mathematics subject leader/coordinator as being	Count	0	1	76	70	147
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	25.0%	48.7%	57.4%	
	Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	2	2	77	72	153
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	66.7%	50.0%	49.4%	59.0%	
	Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	1	0	81	73	155
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	0.0%	51.9%	59.8%	
	Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	0	0	74	72	146
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	0.0%	47.4%	59.0%	
	Innovator and	Count	0	0	44	36	80

	source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	0.0%	28.2%	29.5%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	0	0	55	70	125
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	0.0%	35.3%	57.4%	
	A very hard worker:Would you describe your mathematics subject leader/coordinator as being	Count	2	0	93	81	176
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	66.7%	0.0%	59.6%	66.4%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	1	1	56	47	105
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	25.0%	35.9%	38.5%	
Total		Count	3	4	156	122	285

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of maths leader

$MathLead*Howwouldyourateyoursubjectleadercoordinatorinmaths Crosstabulation

			How would you rate your subject leader/coordinator in maths?				Total
			Poor	Moderate	Good	Excellent	
$MathLead[a]	Highly enthusiastic about teaching:Would you describe your mathematics subject leader/coordinator as being	Count	1	5	59	84	149
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	12.5%	11.6%	43.7%	69.4%	
	Highly enthusiastic about maths:Would you describe your mathematics subject leader/coordinator as being	Count	2	15	80	100	197
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	25.0%	34.9%	59.3%	82.6%	
	Approachable:Would you describe your mathematics subject leader/coordinator as being	Count	4	23	96	101	224
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	50.0%	53.5%	71.1%	83.5%	
	Highly organised:Would you describe your mathematics subject leader/coordinator as being	Count	1	10	58	89	158
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	12.5%	23.3%	43.0%	73.6%	
	Good at paperwork:Would you describe your mathematics subject leader/coordinator as being	Count	1	21	47	71	140
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	12.5%	48.8%	34.8%	58.7%	
	Source of advice and support:Would you describe your mathematics subject leader/coordinator as being	Count	1	5	59	85	150
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	12.5%	11.6%	43.7%	70.2%	
	Good at using pupil	Count	3	11	62	78	154

performance data:Would you describe your mathematics subject leader/coordinator as being	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	37.5%	25.6%	45.9%	64.5%	
Good at maintaining pupil/student discipline:Would you describe your mathematics subject leader/coordinator as being	Count	2	11	61	84	158
	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	25.0%	25.6%	45.2%	69.4%	
Always ready to listen to staff:Would you describe your mathematics subject leader/coordinator as being	Count	4	8	60	82	154
	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	50.0%	18.6%	44.4%	67.8%	
Good team leader:Would you describe your mathematics subject leader/coordinator as being	Count	0	2	50	92	144
	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	0.0%	4.7%	37.0%	76.0%	
Innovator and source of fresh ideas:Would you describe your mathematics subject leader/coordinator as being	Count	0	1	27	50	78
	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	0.0%	2.3%	20.0%	41.3%	
Maintains high profile for the department/or for maths in the school or college:Would you describe your mathematics subject leader/coordinator as being	Count	1	4	45	77	127
	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	12.5%	9.3%	33.3%	63.6%	
A very hard	Count	3	16	71	91	181

	worker:Would you describe your mathematics subject leader/coordinator as being	% within Howwouldyourateyoursubjectleadercoordinatorinmaths	37.5%	37.2%	52.6%	75.2%	
	Ensures resources are available for you to do your job:Would you describe your mathematics subject leader/coordinator as being	Count	0	10	39	55	104
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	0.0%	23.3%	28.9%	45.5%	
Total		Count	8	43	135	121	307

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Leadership in science

How would you rate your subject leader/coordinator in science?

	Frequency	Percent	Valid Percent
Poor	9	2.1	3.1
Moderate	42	9.7	14.3
Good	119	27.6	40.5
Excellent	82	19.0	27.9
I am the subject leader/coordinator in science	42	9.7	14.3
Total	294	68.2	100.0
Missing	137	31.8	
Total	431	100.0	

No statistically significant differences based on:

By level of seniority

By School phase

Statistically significant differences based on:

By type of school

Crosstab

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
How would you rate your subject leader/coordinator in science?	Poor	Count	4	3	2	0	0	9
		% within Typeofschool	4.0%	4.1%	3.3%	0.0%	0.0%	3.6%
	Moderate	Count	18	17	6	0	0	41
		% within Typeofschool	17.8%	23.0%	9.8%	0.0%	0.0%	16.4%
	Good	Count	52	39	20	4	4	119
		% within Typeofschool	51.5%	52.7%	32.8%	57.1%	57.1%	47.6%
	Excellent	Count	27	15	33	3	3	81
		% within Typeofschool	26.7%	20.3%	54.1%	42.9%	42.9%	32.4%
Total		Count	101	74	61	7	7	250
		% within Typeofschool	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.020

By taught subject area

Crosstab

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
How would you rate your subject leader/coordinator in science?	Poor	Count	3	0	3	1	0	2	0	9
		% within Subject	3.2%	0.0%	8.6%	10.0%	0.0%	9.1%	0.0%	3.6%
	Moderate	Count	13	11	6	1	2	8	1	42
		% within Subject	13.7%	16.4%	17.1%	10.0%	9.1%	36.4%	100.0%	16.7%
	Good	Count	54	32	12	7	8	6	0	119
		% within Subject	56.8%	47.8%	34.3%	70.0%	36.4%	27.3%	0.0%	47.2%
	Excellent	Count	25	24	14	1	12	6	0	82

	% within Subject	26.3%	35.8%	40.0%	10.0%	54.5%	27.3%	0.0%	32.5%
Total	Count	95	67	35	10	22	22	1	252
	% within Subject	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.013

By teaching experience

Crosstab

			For about how many years have you been teaching?			Total
			0-5	6-10	11+	
How would you rate your subject leader/coordinator in science?	Poor	Count	1	4	4	9
		% within For about how many years have you been teaching?	1.4%	6.3%	3.4%	3.6%
	Moderate	Count	7	18	17	42
		% within For about how many years have you been teaching?	9.9%	28.6%	14.7%	16.8%
	Good	Count	39	24	54	117
		% within For about how many years have you been teaching?	54.9%	38.1%	46.6%	46.8%
	Excellent	Count	24	17	41	82
		% within For about how many years have you been teaching?	33.8%	27.0%	35.3%	32.8%
Total		Count	71	63	116	250
		% within For about how many years have you been teaching?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.047

By nation

Crosstab

			And in which nation is the school/college?				Total
			England	Scotland	Wales	Other	
How would you rate your subject leader/coordinator in science?	Poor	Count	6	3	0	0	9
		% within And in which nation is the school/college?	3.0%	8.1%	0.0%	0.0%	3.6%
	Moderate	Count	32	4	5	1	42
		% within And in which nation is the school/college?	16.2%	10.8%	50.0%	14.3%	16.7%
	Good	Count	93	21	4	1	119
		% within And in which nation is the school/college?	47.0%	56.8%	40.0%	14.3%	47.2%
	Excellent	Count	67	9	1	5	82
		% within And in which nation is the school/college?	33.8%	24.3%	10.0%	71.4%	32.5%
Total		Count	198	37	10	7	252
		% within And in which nation is the school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.030

By % of FSM

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
How would you rate your subject leader/coordinator in science?	Poor	Count	4	1	0	0	2	2	9
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	4.7%	3.1%	0.0%	0.0%	5.0%	4.0%	3.6%
	Moderate	Count	13	5	4	2	12	6	42

		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	15.1%	15.6%	17.4%	11.1%	30.0%	12.0%	16.9%
	Good	Count	30	16	9	13	22	28	118
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	34.9%	50.0%	39.1%	72.2%	55.0%	56.0%	47.4%
	Excellent	Count	39	10	10	3	4	14	80
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	45.3%	31.2%	43.5%	16.7%	10.0%	28.0%	32.1%
Total		Count	86	32	23	18	40	50	249
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.025

By rating teaching of science

Crosstab

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
How would you rate your subject leader/coordinator in science?	Poor	Count	3	2	3	1	9
		% within How would you personally rate the teaching of science in your school/college?	60.0%	5.7%	2.6%	1.1%	3.6%
	Moderate	Count	0	15	20	6	41

		% within How would you personally rate the teaching of science in your school/college?	0.0%	42.9%	17.4%	6.5%	16.5%
		Count	2	15	67	33	117
	Good	% within How would you personally rate the teaching of science in your school/college?	40.0%	42.9%	58.3%	35.5%	47.2%
		Count	0	3	25	53	81
	Excellent	% within How would you personally rate the teaching of science in your school/college?	0.0%	8.6%	21.7%	57.0%	32.7%
		Count	5	35	115	93	248
Total		% within How would you personally rate the teaching of science in your school/college?	100.0%	100.0%	100.0 %	100.0%	100.0%

Chi-square test, p=0.000

By science trajectory

Crosstab

			Would you say that the teaching of science in your school/college is				Total
			In decline	Staying the same	Improving slowly	Improving rapidly	
How would you rate your subject leader/coordinator in science?	Poor	Count	3	3	2	1	9
		% within Would you say that the teaching of science in your school/college is	60.0%	4.5%	1.4%	2.4%	3.6%

	Moderate	Count	1	17	21	3	42
		% within Would you say that the teaching of science in your school/college is	20.0%	25.8%	15.2%	7.3%	16.8%
	Good	Count	1	26	74	17	118
		% within Would you say that the teaching of science in your school/college is	20.0%	39.4%	53.6%	41.5%	47.2%
	Excellent	Count	0	20	41	20	81
		% within Would you say that the teaching of science in your school/college is	0.0%	30.3%	29.7%	48.8%	32.4%
Total		Count	5	66	138	41	250
		% within Would you say that the teaching of science in your school/college is	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

Would you describe your science subject leader/coordinator as being:

	Responses		Percent of Cases
	N	Percent	
Highly enthusiastic about teaching:	173	9.4	66.0
Highly enthusiastic about maths	58	3.1	22.1
Approachable	187	10.1	71.4
Highly organised	112	6.1	42.7
Good at paperwork	109	5.9	41.6
Source of advice and support	157	8.5	59.9
Good at using pupil performance data	129	7.0	49.2
Good at maintaining pupil/student discipline	144	7.8	55.0
Always ready to listen to staff	160	8.7	61.1
Good team leader	142	7.7	54.2
Innovator and source of fresh ideas	113	6.1	43.1

Maintains high profile for the department/or for maths in the school or college	104	5.6	39.7
A very hard worker	161	8.7	61.5
Ensures resources are available for you to do your job	98	5.3	37.4
Total	1847	100.0	705.0

By education phase

$ScienceLead*Whatphaseofeducationdoyouteachin Crosstabulation

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	9	20	141	170
		% within Whatphaseofeducationdoyouteachin	69.2%	71.4%	65.0%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	3	7	48	58
		% within Whatphaseofeducationdoyouteachin	23.1%	25.0%	22.1%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	12	21	150	183
		% within Whatphaseofeducationdoyouteachin	92.3%	75.0%	69.1%	
	Highly organised:Would you describe your science subject leader/coordinator as being	Count	3	16	90	109
		% within Whatphaseofeducationdoyouteachin	23.1%	57.1%	41.5%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	6	15	86	107
		% within Whatphaseofeducationdoyouteachin	46.2%	53.6%	39.6%	
	Source of advice and	Count	9	20	125	154

	support:Would you describe your science subject leader/coordinator as being	% within Whatphaseofeducationdoyouteachin	69.2%	71.4%	57.6%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	6	7	114	127
		% within Whatphaseofeducationdoyouteachin	46.2%	25.0%	52.5%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	7	15	119	141
		% within Whatphaseofeducationdoyouteachin	53.8%	53.6%	54.8%	
	Always ready to listen to staff:Would you describe your science subject leader/coordinator as being	Count	8	17	131	156
		% within Whatphaseofeducationdoyouteachin	61.5%	60.7%	60.4%	
	Good team leader:Would you describe your science subject leader/coordinator as being	Count	7	16	116	139
		% within Whatphaseofeducationdoyouteachin	53.8%	57.1%	53.5%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	5	14	91	110
		% within Whatphaseofeducationdoyouteachin	38.5%	50.0%	41.9%	
	Maintains high profile	Count	8	7	87	102

	for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	% within Whatphaseofeducationdoyouteachin	61.5%	25.0%	40.1%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	9	14	135	158
		% within Whatphaseofeducationdoyouteachin	69.2%	50.0%	62.2%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	7	12	78	97
		% within Whatphaseofeducationdoyouteachin	53.8%	42.9%	35.9%	
Total		Count	13	28	217	258

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By nation

$ScienceLead*Andinwhichnationistheschoolcollege Crosstabulation

			And in which nation is the school/college?				Total
			England	Scotland	Wales	Other	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	135	25	6	7	173
		% within Andinwhichnationistheschoolcollege	66.8%	61.0%	54.5%	87.5%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	50	6	0	2	58
		% within Andinwhichnationistheschoolcollege	24.8%	14.6%	0.0%	25.0%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	147	28	7	5	187
		% within Andinwhichnationistheschoolcollege	72.8%	68.3%	63.6%	62.5%	

Highly organised:Would you describe your science subject leader/coordinator as being	Count	91	14	4	3	112
	% within Andinwhichnationisthe schoolcollege	45.0%	34.1%	36.4%	37.5%	
Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	87	15	4	3	109
	% within Andinwhichnationisthe schoolcollege	43.1%	36.6%	36.4%	37.5%	
Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	122	22	8	5	157
	% within Andinwhichnationisthe schoolcollege	60.4%	53.7%	72.7%	62.5%	
Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	99	17	7	6	129
	% within Andinwhichnationisthe schoolcollege	49.0%	41.5%	63.6%	75.0%	
Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	108	26	7	3	144
	% within Andinwhichnationisthe schoolcollege	53.5%	63.4%	63.6%	37.5%	
Always ready to listen to staff:Would you describe your science subject leader/coordinator as being	Count	128	22	5	5	160
	% within Andinwhichnationisthe schoolcollege	63.4%	53.7%	45.5%	62.5%	
Good team leader:Would you describe your science subject leader/coordinator as being	Count	113	19	3	7	142
	% within Andinwhichnationisthe schoolcollege	55.9%	46.3%	27.3%	87.5%	
Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	89	18	0	6	113
	% within Andinwhichnationisthe schoolcollege	44.1%	43.9%	0.0%	75.0%	
Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	80	17	2	5	104
	% within Andinwhichnationisthe schoolcollege	39.6%	41.5%	18.2%	62.5%	
A very hard worker:Would	Count	128	22	6	5	161

	you describe your science subject leader/coordinator as being	% within Andinwhichnationisthe schoolcollege	63.4%	53.7%	54.5%	62.5%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	80	11	2	5	98
		% within Andinwhichnationisthe schoolcollege	39.6%	26.8%	18.2%	62.5%	
Total		Count	202	41	11	8	262

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By type of school

$ScienceLead*Typeofschool Crosstabulation

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	69	49	43	5	6	172
		% within Typeofschool	66.3%	65.3%	66.2%	71.4%	66.7%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	18	16	19	1	4	58
		% within Typeofschool	17.3%	21.3%	29.2%	14.3%	44.4%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	72	52	47	7	7	185
		% within Typeofschool	69.2%	69.3%	72.3%	100.0%	77.8%	

	Highly organised:Would you describe your science subject leader/coordinator as being	Count	48	26	32	1	5	112
		% within Typeofschool	46.2%	34.7%	49.2%	14.3%	55.6%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	45	25	30	3	6	109
		% within Typeofschool	43.3%	33.3%	46.2%	42.9%	66.7%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	64	36	45	4	7	156
		% within Typeofschool	61.5%	48.0%	69.2%	57.1%	77.8%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	52	37	32	2	6	129
		% within Typeofschool	50.0%	49.3%	49.2%	28.6%	66.7%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	63	34	37	4	5	143
		% within Typeofschool	60.6%	45.3%	56.9%	57.1%	55.6%	
	Always ready to	Count	63	39	46	5	6	159

	listen to staff:Would you describe your science subject leader/coordinator as being	% within Typeofschool	60.6%	52.0%	70.8%	71.4%	66.7%	
	Good team leader:Would you describe your science subject leader/coordinator as being	Count	53	38	42	4	5	142
		% within Typeofschool	51.0%	50.7%	64.6%	57.1%	55.6%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	42	27	37	2	5	113
		% within Typeofschool	40.4%	36.0%	56.9%	28.6%	55.6%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	39	21	34	3	7	104
		% within Typeofschool	37.5%	28.0%	52.3%	42.9%	77.8%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	62	46	41	4	7	160
		% within Typeofschool	59.6%	61.3%	63.1%	57.1%	77.8%	
	Ensures	Count	34	18	36	4	5	97

	resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	% within Typeofschool	32.7%	24.0%	55.4%	57.1%	55.6%	
Total		Count	104	75	65	7	9	260

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By level of seniority

$ScienceLead*Levelofseniority Crosstabulation

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	68	10	52	18	2	1	151
		% within Levelofseniority	63.0%	58.8%	66.7%	69.2%	50.0%	50.0%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	21	4	19	8	1	1	54
		% within Levelofseniority	19.4%	23.5%	24.4%	30.8%	25.0%	50.0%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	67	12	59	21	4	2	165
		% within Levelofseniority	62.0%	70.6%	75.6%	80.8%	100.0%	100.0%	
	Highly	Count	46	6	33	12	1	1	99

	organised:Would you describe your science subject leader/coordinator as being	% within Levelofseniority	42.6%	35.3%	42.3%	46.2%	25.0%	50.0%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	48	6	30	12	1	1	98
		% within Levelofseniority	44.4%	35.3%	38.5%	46.2%	25.0%	50.0%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	60	9	48	18	4	1	140
		% within Levelofseniority	55.6%	52.9%	61.5%	69.2%	100.0%	50.0%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	56	7	43	7	1	2	116
		% within Levelofseniority	51.9%	41.2%	55.1%	26.9%	25.0%	100.0%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	57	8	47	14	3	1	130
		% within Levelofseniority	52.8%	47.1%	60.3%	53.8%	75.0%	50.0%	
	Always ready to listen to staff:Would you describe your science subject leader/coordinator as being	Count	55	12	55	17	3	1	143
		% within Levelofseniority	50.9%	70.6%	70.5%	65.4%	75.0%	50.0%	
	Good team	Count	52	7	49	15	1	1	125

	leader:Would you describe your science subject leader/coordinator as being	% within Levelofseniority	48.1%	41.2%	62.8%	57.7%	25.0%	50.0%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	44	7	32	14	1	1	99
		% within Levelofseniority	40.7%	41.2%	41.0%	53.8%	25.0%	50.0%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	43	5	32	13	1	1	95
		% within Levelofseniority	39.8%	29.4%	41.0%	50.0%	25.0%	50.0%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	65	13	50	14	1	1	144
		% within Levelofseniority	60.2%	76.5%	64.1%	53.8%	25.0%	50.0%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	40	5	32	9	1	2	89
		% within Levelofseniority	37.0%	29.4%	41.0%	34.6%	25.0%	100.0%	
Total		Count	108	17	78	26	4	2	235

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By taught subject area

$ScienceLead*Subject Crosstabulation

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	52	62	21	7	14	16	1	173
		% within Subject	63.4%	70.5%	56.8%	70.0%	60.9%	76.2%	100.0%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	13	25	7	1	7	5	0	58
		% within Subject	15.9%	28.4%	18.9%	10.0%	30.4%	23.8%	0.0%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	46	69	27	8	19	17	1	187
		% within Subject	56.1%	78.4%	73.0%	80.0%	82.6%	81.0%	100.0%	
	Highly organised:Would you describe your science subject leader/coordinator as being	Count	33	43	9	5	13	9	0	112
		% within Subject	40.2%	48.9%	24.3%	50.0%	56.5%	42.9%	0.0%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	25	44	12	4	15	9	0	109
		% within Subject	30.5%	50.0%	32.4%	40.0%	65.2%	42.9%	0.0%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	35	57	23	8	18	15	1	157
		% within Subject	42.7%	64.8%	62.2%	80.0%	78.3%	71.4%	100.0%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	28	58	13	8	17	5	0	129
		% within Subject	34.1%	65.9%	35.1%	80.0%	73.9%	23.8%	0.0%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	39	52	16	9	15	12	1	144
		% within Subject	47.6%	59.1%	43.2%	90.0%	65.2%	57.1%	100.0%	
	Always ready to listen to	Count	33	63	25	7	17	14	1	160

	staff:Would you describe your science subject leader/coordinator as being	% within Subject	40.2%	71.6%	67.6%	70.0%	73.9%	66.7%	100.0%	
	Good team leader:Would you describe your science subject leader/coordinator as being	Count	35	58	15	6	17	11	0	142
		% within Subject	42.7%	65.9%	40.5%	60.0%	73.9%	52.4%	0.0%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	22	46	14	5	15	11	0	113
		% within Subject	26.8%	52.3%	37.8%	50.0%	65.2%	52.4%	0.0%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	20	41	20	7	13	3	0	104
		% within Subject	24.4%	46.6%	54.1%	70.0%	56.5%	14.3%	0.0%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	43	59	25	6	15	12	1	161
		% within Subject	52.4%	67.0%	67.6%	60.0%	65.2%	57.1%	100.0%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	15	44	16	4	11	7	1	98
		% within Subject	18.3%	50.0%	43.2%	40.0%	47.8%	33.3%	100.0%	
Total		Count	82	88	37	10	23	21	1	262

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % of FSM

$ScienceLead*Approximatelywhatpercentageofpupilsstudentsinyourschool Crosstabulation

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?					Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	
$ScienceLead[a]	Highly enthusiastic about	Count	63	19	17	15	26	140

	teaching:Would you describe your science subject leader/coordinator as being	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	67.7%	59.4%	63.0%	75.0%	72.2%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	24	9	4	5	7	49
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	25.8%	28.1%	14.8%	25.0%	19.4%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	71	22	23	15	24	155
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	76.3%	68.8%	85.2%	75.0%	66.7%	
	Highly organised:Would you describe your science subject leader/coordinator as being	Count	42	11	14	9	14	90
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	45.2%	34.4%	51.9%	45.0%	38.9%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	41	9	14	10	14	88
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	44.1%	28.1%	51.9%	50.0%	38.9%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	61	14	19	14	20	128
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	65.6%	43.8%	70.4%	70.0%	55.6%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	46	17	14	12	18	107
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	49.5%	53.1%	51.9%	60.0%	50.0%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	53	15	16	13	19	116
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	57.0%	46.9%	59.3%	65.0%	52.8%	
	Always ready to listen to	Count	62	16	21	12	22	133

	staff:Would you describe your science subject leader/coordinator as being	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	66.7%	50.0%	77.8%	60.0%	61.1%	
	Good team leader:Would you describe your science subject leader/coordinator as being	Count	54	14	18	9	15	110
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	58.1%	43.8%	66.7%	45.0%	41.7%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	47	12	9	7	13	88
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	50.5%	37.5%	33.3%	35.0%	36.1%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	46	7	10	10	9	82
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	49.5%	21.9%	37.0%	50.0%	25.0%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	58	17	15	15	23	128
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	62.4%	53.1%	55.6%	75.0%	63.9%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	41	9	10	7	14	81
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	44.1%	28.1%	37.0%	35.0%	38.9%	
Total		Count	93	32	27	20	36	208

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By science teaching rating

$ScienceLead*Howwouldyoupersonallyratetheteachingofscienceinyoursc Crosstabulation

	How would you personally rate the teaching of science in your school/college?				Total
	Poor	Moderate	Good	Excellent	

$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	1	22	77	71	171
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	66.7%	63.1%	71.7%	
	Highly enthusiastic about maths:Would you describe your science subject leader/coordinator as being	Count	1	3	27	27	58
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	9.1%	22.1%	27.3%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	1	20	85	79	185
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	60.6%	69.7%	79.8%	
	Highly organised:Would you describe your science subject leader/coordinator as being	Count	0	10	55	47	112
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	0.0%	30.3%	45.1%	47.5%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	1	9	52	46	108
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	27.3%	42.6%	46.5%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	1	14	77	65	157
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	42.4%	63.1%	65.7%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	1	9	64	53	127
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	25.0%	27.3%	52.5%	53.5%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	0	15	64	65	144
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	0.0%	45.5%	52.5%	65.7%	
	Always ready to listen to staff:Would you describe your science subject leader/coordinator as being	Count	0	17	71	70	158
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	0.0%	51.5%	58.2%	70.7%	
	Good team leader:Would	Count	1	11	67	62	141

	you describe your science subject leader/coordinator as being	% within Howwouldyoupersonallyrateteachingofscienceinyoursc	25.0%	33.3%	54.9%	62.6%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	0	8	47	55	110
		% within Howwouldyoupersonallyrateteachingofscienceinyoursc	0.0%	24.2%	38.5%	55.6%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	1	3	48	50	102
		% within Howwouldyoupersonallyrateteachingofscienceinyoursc	25.0%	9.1%	39.3%	50.5%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	1	17	74	66	158
		% within Howwouldyoupersonallyrateteachingofscienceinyoursc	25.0%	51.5%	60.7%	66.7%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	0	10	35	53	98
		% within Howwouldyoupersonallyrateteachingofscienceinyoursc	0.0%	30.3%	28.7%	53.5%	
Total		Count	4	33	122	99	258

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By science leader rating

$ScienceLead*Howwouldyourateyoursubjectleadercoordinatorinscience Crosstabulation

			How would you rate your subject leader/coordinator in science?				Total
			Poor	Moderate	Good	Excellent	
$ScienceLead[a]	Highly enthusiastic about teaching:Would you describe your science subject leader/coordinator as being	Count	2	12	71	62	147
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	28.6%	31.6%	65.1%	80.5%	
	Highly enthusiastic	Count	1	2	21	24	48

	about maths:Would you describe your science subject leader/coordinator as being	% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	5.3%	19.3%	31.2%	
	Approachable:Would you describe your science subject leader/coordinator as being	Count	1	22	76	63	162
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	57.9%	69.7%	81.8%	
	Highly organised:Would you describe your science subject leader/coordinator as being	Count	0	5	47	48	100
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	0.0%	13.2%	43.1%	62.3%	
	Good at paperwork:Would you describe your science subject leader/coordinator as being	Count	1	8	42	43	94
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	21.1%	38.5%	55.8%	
	Source of advice and support:Would you describe your science subject leader/coordinator as being	Count	1	8	62	63	134
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	21.1%	56.9%	81.8%	
	Good at using pupil performance data:Would you describe your science subject leader/coordinator as being	Count	0	9	54	49	112
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	0.0%	23.7%	49.5%	63.6%	
	Good at maintaining pupil/student discipline:Would you describe your science subject leader/coordinator as being	Count	2	14	57	50	123
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	28.6%	36.8%	52.3%	64.9%	

	Always ready to listen to staff:Would you describe your science subject leader/coordinator as being	Count	1	12	60	60	133
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	31.6%	55.0%	77.9%	
	Good team leader:Would you describe your science subject leader/coordinator as being	Count	0	5	52	64	121
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	0.0%	13.2%	47.7%	83.1%	
	Innovator and source of fresh ideas:Would you describe your science subject leader/coordinator as being	Count	1	6	41	46	94
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	15.8%	37.6%	59.7%	
	Maintains high profile for the department/or for maths in the school or college:Would you describe your science subject leader/coordinator as being	Count	1	5	39	45	90
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	13.2%	35.8%	58.4%	
	A very hard worker:Would you describe your science subject leader/coordinator as being	Count	1	12	65	60	138
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	31.6%	59.6%	77.9%	
	Ensures resources are available for you to do your job:Would you describe your science subject leader/coordinator as being	Count	1	4	30	45	80
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	14.3%	10.5%	27.5%	58.4%	
Total		Count	7	38	109	77	231

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Effective maths and science teaching

What factors do you think are most important in effective maths or science teaching?

	Responses		Percent of Cases
	N	Percent	
Well qualified teachers:	232	8.6	63.4
Enthusiastic teachers	345	12.7	94.3
Having pupils in appropriate sets	166	6.1	45.4
Support for pupils outside of lessons	163	6.0	44.5
Wide range of extra-curricular activities	76	2.8	20.8
Good relationships with pupils	326	12.0	89.1
Well equipped teaching rooms	219	8.1	59.8
Good materials and resources	276	10.2	75.4
Data tracking of pupils and target setting	150	5.5	41.0
Supportive governing body	71	2.6	19.4
Whole school ethos	234	8.6	63.9
Effective subject leader/coordinator	267	9.9	73.0
Effective head teacher	185	6.8	50.5
Total	2710	100.0	740.4

By education phase

$EfectTeach*Whatphaseofeducationdoyouteachin Crosstabulation

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	14	18	196	228
		% within Whatphaseofeducationdoyouteachin	70.0%	48.6%	64.5%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	19	33	288	340
		% within Whatphaseofeducationdoyouteachin	95.0%	89.2%	94.7%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	5	9	150	164
		% within Whatphaseofeducationdoyouteachin	25.0%	24.3%	49.3%	
	Support for pupils outside of	Count	11	13	138	162

lessons:What factors do you think are most important in effective maths or science teaching?	% within Whatphaseofeducationdoyouteachin	55.0%	35.1%	45.4%	
Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	3	8	64	75
	% within Whatphaseofeducationdoyouteachin	15.0%	21.6%	21.1%	
Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	16	29	277	322
	% within Whatphaseofeducationdoyouteachin	80.0%	78.4%	91.1%	
Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	10	20	185	215
	% within Whatphaseofeducationdoyouteachin	50.0%	54.1%	60.9%	
Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	16	32	225	273
	% within Whatphaseofeducationdoyouteachin	80.0%	86.5%	74.0%	
Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	6	15	127	148
	% within Whatphaseofeducationdoyouteachin	30.0%	40.5%	41.8%	
Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	5	4	62	71
	% within Whatphaseofeducationdoyouteachin	25.0%	10.8%	20.4%	
Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	6	24	199	229
	% within Whatphaseofeducationdoyouteachin	30.0%	64.9%	65.5%	
Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	14	22	226	262
	% within Whatphaseofeducationdoyouteachin	70.0%	59.5%	74.3%	
Effective head teacher:What	Count	7	21	156	184

	factors do you think are most important in effective maths or science teaching?	% within Whatphaseofeducationdoyouteachin	35.0%	56.8%	51.3%	
Total		Count	20	37	304	361

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By nation

$EfectTeach*Andinwhichnationistheschoolcollege Crosstabulation

			And in which nation is the school/college?					Total
			England	Northern Ireland	Scotland	Wales	Other	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	177	1	35	12	7	232
		% within Andinwhichnationistheschoolcollege	62.3%	100.0%	62.5%	92.3%	58.3%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	264	1	56	13	11	345
		% within Andinwhichnationistheschoolcollege	93.0%	100.0%	100.0%	100.0%	91.7%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	124	1	30	8	3	166
		% within Andinwhichnationistheschoolcollege	43.7%	100.0%	53.6%	61.5%	25.0%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	123	0	27	7	6	163
		% within Andinwhichnationistheschoolcollege	43.3%	0.0%	48.2%	53.8%	50.0%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	60	0	12	3	1	76
		% within Andinwhichnationistheschoolcollege	21.1%	0.0%	21.4%	23.1%	8.3%	

Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	250	1	50	13	12	326
	% within Andinwhichnationist heschoolcollege	88.0%	100.0%	89.3%	100.0%	100.0%	
Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	161	0	43	10	5	219
	% within Andinwhichnationist heschoolcollege	56.7%	0.0%	76.8%	76.9%	41.7%	
Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	210	1	45	10	10	276
	% within Andinwhichnationist heschoolcollege	73.9%	100.0%	80.4%	76.9%	83.3%	
Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	115	1	24	7	3	150
	% within Andinwhichnationist heschoolcollege	40.5%	100.0%	42.9%	53.8%	25.0%	
Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	50	0	12	6	3	71
	% within Andinwhichnationist heschoolcollege	17.6%	0.0%	21.4%	46.2%	25.0%	
Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	181	0	39	10	4	234
	% within Andinwhichnationist heschoolcollege	63.7%	0.0%	69.6%	76.9%	33.3%	
Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	214	1	31	12	9	267
	% within Andinwhichnationist heschoolcollege	75.4%	100.0%	55.4%	92.3%	75.0%	

	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	140	0	30	10	5	185
		% within Andinwhichnationistheschoolcollege	49.3%	0.0%	53.6%	76.9%	41.7%	
Total		Count	284	1	56	13	12	366

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By type of school

$EfectTeach*Typeofschool Crosstabulation

			Typeofschool					Total
			Local authority administered	Academy	Independent/ private school	General FE college	Sixth form college	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	93	66	55	7	9	230
		% within Typeofschool	64.1%	64.7%	62.5%	70.0%	75.0%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	140	97	80	10	12	339
		% within Typeofschool	96.6%	95.1%	90.9%	100.0%	100.0%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	62	54	42	3	3	164
		% within Typeofschool	42.8%	52.9%	47.7%	30.0%	25.0%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	63	45	41	4	7	160
		% within Typeofschool	43.4%	44.1%	46.6%	40.0%	58.3%	

Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	31	22	19	1	2	75
	% within Typeofschool	21.4%	21.6%	21.6%	10.0%	16.7%	
Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	129	92	79	9	10	319
	% within Typeofschool	89.0%	90.2%	89.8%	90.0%	83.3%	
Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	98	56	50	5	7	216
	% within Typeofschool	67.6%	54.9%	56.8%	50.0%	58.3%	
Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	111	72	69	7	10	269
	% within Typeofschool	76.6%	70.6%	78.4%	70.0%	83.3%	
Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	75	51	16	0	5	147
	% within Typeofschool	51.7%	50.0%	18.2%	0.0%	41.7%	
Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	31	20	12	1	5	69
	% within Typeofschool	21.4%	19.6%	13.6%	10.0%	41.7%	
Whole school	Count	109	66	47	3	6	231

	ethos:What factors do you think are most important in effective maths or science teaching?	% within Typeofschool	75.2%	64.7%	53.4%	30.0%	50.0%	
	Effective subject leader/coordinator: What factors do you think are most important in effective maths or science teaching?	Count	103	78	64	4	12	261
		% within Typeofschool	71.0%	76.5%	72.7%	40.0%	100.0%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	86	60	28	1	7	182
		% within Typeofschool	59.3%	58.8%	31.8%	10.0%	58.3%	
Total		Count	145	102	88	10	12	357

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By level of seniority

$EfectTeach*Levelofseniority Crosstabulation

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	104	14	71	18	7	3	217
		% within Levelofseniority	65.0%	66.7%	64.5%	60.0%	58.3%	100.0%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	151	21	105	28	9	3	317
		% within Levelofseniority	94.4%	100.0%	95.5%	93.3%	75.0%	100.0%	
	Having pupils in	Count	88	7	49	8	3	1	156

	appropriate sets:What factors do you think are most important in effective maths or science teaching?	% within Levelofseniority	55.0%	33.3%	44.5%	26.7%	25.0%	33.3%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	80	5	53	9	3	2	152
		% within Levelofseniority	50.0%	23.8%	48.2%	30.0%	25.0%	66.7%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	33	2	24	7	2	1	69
		% within Levelofseniority	20.6%	9.5%	21.8%	23.3%	16.7%	33.3%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	145	18	97	27	10	2	299
		% within Levelofseniority	90.6%	85.7%	88.2%	90.0%	83.3%	66.7%	
	Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	97	12	73	14	6	1	203
		% within Levelofseniority	60.6%	57.1%	66.4%	46.7%	50.0%	33.3%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	120	17	87	23	9	1	257
		% within Levelofseniority	75.0%	81.0%	79.1%	76.7%	75.0%	33.3%	
	Data tracking of	Count	62	7	52	17	1	1	140

	pupils and target setting:What factors do you think are most important in effective maths or science teaching?	% within Levelofseniority	38.8%	33.3%	47.3%	56.7%	8.3%	33.3%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	36	4	22	4	1	1	68
		% within Levelofseniority	22.5%	19.0%	20.0%	13.3%	8.3%	33.3%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	105	14	67	21	7	2	216
		% within Levelofseniority	65.6%	66.7%	60.9%	70.0%	58.3%	66.7%	
	Effective subject leader/coordinator: What factors do you think are most important in effective maths or science teaching?	Count	121	9	86	22	5	2	245
		% within Levelofseniority	75.6%	42.9%	78.2%	73.3%	41.7%	66.7%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	80	8	63	22	2	2	177
		% within Levelofseniority	50.0%	38.1%	57.3%	73.3%	16.7%	66.7%	
Total		Count	160	21	110	30	12	3	336

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By taught subject area

$EfectTeach*Subject Crosstabulation

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
$EfectTeach[a]	Well qualified	Count	103	63	24	9	19	14	0	232

teachers:What factors do you think are most important in effective maths or science teaching?	% within Subject	63.6%	62.4%	60.0%	75.0%	76.0%	56.0%	0.0%	
Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	152	97	38	11	25	21	1	345
	% within Subject	93.8%	96.0%	95.0%	91.7%	100.0%	84.0%	100.0%	
Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	87	37	16	11	8	7	0	166
	% within Subject	53.7%	36.6%	40.0%	91.7%	32.0%	28.0%	0.0%	
Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	79	44	13	6	12	9	0	163
	% within Subject	48.8%	43.6%	32.5%	50.0%	48.0%	36.0%	0.0%	
Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	31	29	2	1	7	6	0	76
	% within Subject	19.1%	28.7%	5.0%	8.3%	28.0%	24.0%	0.0%	
Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	137	95	37	12	23	21	1	326
	% within Subject	84.6%	94.1%	92.5%	100.0%	92.0%	84.0%	100.0%	
Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	78	68	32	8	19	14	0	219
	% within Subject	48.1%	67.3%	80.0%	66.7%	76.0%	56.0%	0.0%	
Good materials and	Count	114	82	28	7	22	22	1	276

	resources:What factors do you think are most important in effective maths or science teaching?	% within Subject	70.4%	81.2%	70.0%	58.3%	88.0%	88.0%	100.0%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	73	42	10	6	8	11	0	150
		% within Subject	45.1%	41.6%	25.0%	50.0%	32.0%	44.0%	0.0%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	32	23	6	1	7	2	0	71
		% within Subject	19.8%	22.8%	15.0%	8.3%	28.0%	8.0%	0.0%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	107	70	19	8	15	14	1	234
		% within Subject	66.0%	69.3%	47.5%	66.7%	60.0%	56.0%	100.0%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	118	84	23	9	20	12	1	267
		% within Subject	72.8%	83.2%	57.5%	75.0%	80.0%	48.0%	100.0%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	83	57	16	7	11	10	1	185
		% within Subject	51.2%	56.4%	40.0%	58.3%	44.0%	40.0%	100.0%	
Total		Count	162	101	40	12	25	25	1	366

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % of FSM pupils

$EfectTeach*Approximatelywhatpercentageofpupilsstudentsinyourschool Crosstabulation

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?					Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	
$EffectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	82	30	21	16	33	182
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	65.6%	69.8%	58.3%	66.7%	55.0%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	116	43	35	24	54	272
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	92.8%	100.0%	97.2%	100.0%	90.0%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	62	20	15	14	20	131
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	49.6%	46.5%	41.7%	58.3%	33.3%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	64	13	14	8	26	125
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	51.2%	30.2%	38.9%	33.3%	43.3%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	25	8	5	7	16	61
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	20.0%	18.6%	13.9%	29.2%	26.7%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	114	38	30	22	52	256
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	91.2%	88.4%	83.3%	91.7%	86.7%	
	Well equipped teaching	Count	70	25	20	18	30	163

	rooms:What factors do you think are most important in effective maths or science teaching?	% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	56.0%	58.1%	55.6%	75.0%	50.0%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	92	34	27	20	42	215
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	73.6%	79.1%	75.0%	83.3%	70.0%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	35	21	17	16	31	120
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	28.0%	48.8%	47.2%	66.7%	51.7%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	23	10	5	4	13	55
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	18.4%	23.3%	13.9%	16.7%	21.7%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	76	30	20	16	47	189
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	60.8%	69.8%	55.6%	66.7%	78.3%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	92	27	24	20	49	212
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	73.6%	62.8%	66.7%	83.3%	81.7%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	54	23	19	14	38	148
		% within Approximatelywhatpercentage ofpupilsstudentsinyourschool	43.2%	53.5%	52.8%	58.3%	63.3%	
Total		Count	125	43	36	24	60	288

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By science teaching rating

$EfectTeach*Howwouldyoupersonallyratetheteachingofscienceinyoursc Crosstabulation

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	4	23	98	85	210
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	66.7%	51.1%	60.1%	70.2%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	5	42	156	115	318
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	83.3%	93.3%	95.7%	95.0%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	1	22	75	50	148
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	16.7%	48.9%	46.0%	41.3%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	1	18	71	58	148
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	16.7%	40.0%	43.6%	47.9%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	0	11	33	29	73
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	0.0%	24.4%	20.2%	24.0%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	6	37	143	114	300
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	100.0%	82.2%	87.7%	94.2%	
	Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	3	25	96	81	205
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	50.0%	55.6%	58.9%	66.9%	
	Good materials and	Count	2	35	120	97	254

	resources:What factors do you think are most important in effective maths or science teaching?	% within Howwouldyoupersonallyratethete achingofscienceinyoursc	33.3%	77.8%	73.6%	80.2%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	2	28	64	42	136
		% within Howwouldyoupersonallyratethete achingofscienceinyoursc	33.3%	62.2%	39.3%	34.7%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	0	8	26	28	62
		% within Howwouldyoupersonallyratethete achingofscienceinyoursc	0.0%	17.8%	16.0%	23.1%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	4	32	95	78	209
		% within Howwouldyoupersonallyratethete achingofscienceinyoursc	66.7%	71.1%	58.3%	64.5%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	5	33	119	89	246
		% within Howwouldyoupersonallyratethete achingofscienceinyoursc	83.3%	73.3%	73.0%	73.6%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	5	28	76	60	169
		% within Howwouldyoupersonallyratethete achingofscienceinyoursc	83.3%	62.2%	46.6%	49.6%	
Total		Count	6	45	163	121	335

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By science leader rating

$EffectTeach*Howwouldyourateyoursubjectleadercoordinatorinscience Crosstabulation

			How would you rate your subject leader/coordinator in science?				Total
			Poor	Moderate	Good	Excellent	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	5	23	72	53	153
		% within Howwouldyourateyoursub jectleadercoordinatorinsci ence	55.6%	54.8%	61.0%	64.6%	

	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	7	41	113	76	237
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	77.8%	97.6%	95.8%	92.7%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	4	18	54	38	114
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	44.4%	42.9%	45.8%	46.3%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	4	20	53	33	110
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	44.4%	47.6%	44.9%	40.2%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	0	10	31	16	57
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	0.0%	23.8%	26.3%	19.5%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	8	37	109	72	226
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	88.9%	88.1%	92.4%	87.8%	
	Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	6	25	81	49	161
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	66.7%	59.5%	68.6%	59.8%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	5	29	92	67	193
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	55.6%	69.0%	78.0%	81.7%	

	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	5	14	53	29	101
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	55.6%	33.3%	44.9%	35.4%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	0	6	25	19	50
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	0.0%	14.3%	21.2%	23.2%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	5	24	81	49	159
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	55.6%	57.1%	68.6%	59.8%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	8	27	79	65	179
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	88.9%	64.3%	66.9%	79.3%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	6	23	60	38	127
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	66.7%	54.8%	50.8%	46.3%	
Total		Count	9	42	118	82	251

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By maths teaching rating

$EfectTeach*Howwouldyoupersonallyratetheteachingofmathsinyourscho Crosstabulation

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$EfectTeach[a]	Well qualified	Count	5	4	102	89	200

	teachers:What factors do you think are most important in effective maths or science teaching?	% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	100.0%	59.3%	68.5%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	5	4	165	123	297
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	100.0%	95.9%	94.6%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	3	2	77	66	148
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	42.9%	50.0%	44.8%	50.8%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	3	0	73	64	140
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	42.9%	0.0%	42.4%	49.2%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	2	2	34	30	68
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	28.6%	50.0%	19.8%	23.1%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	5	4	152	119	280
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	100.0%	88.4%	91.5%	
	Well equipped	Count	4	2	105	79	190

	teaching rooms:What factors do you think are most important in effective maths or science teaching?	% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	57.1%	50.0%	61.0%	60.8%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	5	2	137	97	241
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	50.0%	79.7%	74.6%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	3	3	74	43	123
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	42.9%	75.0%	43.0%	33.1%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	0	3	30	25	58
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	75.0%	17.4%	19.2%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	5	4	107	86	202
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	100.0%	62.2%	66.2%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	5	4	125	90	224
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	71.4%	100.0%	72.7%	69.2%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	4	3	89	66	162
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	57.1%	75.0%	51.7%	50.8%	

Total	Count	7	4	172	130	313

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By maths leader rating

$EfectTeach*Howwouldyourateyoursubjectleadercoordinatorinmaths Crosstabulation

			How would you rate your subject leader/coordinator in maths?				Total
			Poor	Moderate	Good	Excellent	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	10	32	88	79	209
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	76.9%	66.7%	63.3%	63.7%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	11	46	133	116	306
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	84.6%	95.8%	95.7%	93.5%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	7	22	59	63	151
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	53.8%	45.8%	42.4%	50.8%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	5	20	62	59	146
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	38.5%	41.7%	44.6%	47.6%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	3	7	35	26	71
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	23.1%	14.6%	25.2%	21.0%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	11	39	123	114	287
		% within Howwouldyourateyoursubjectleadercoordinatorinmaths	84.6%	81.2%	88.5%	91.9%	
	Well equipped teaching	Count	8	28	88	70	194

	rooms:What factors do you think are most important in effective maths or science teaching?	% within Howwouldyourateyour subjectleadercoordinat orinmaths	61.5%	58.3%	63.3%	56.5%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	9	38	98	98	243
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	69.2%	79.2%	70.5%	79.0%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	8	25	52	46	131
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	61.5%	52.1%	37.4%	37.1%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	3	11	26	24	64
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	23.1%	22.9%	18.7%	19.4%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	11	28	89	81	209
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	84.6%	58.3%	64.0%	65.3%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	12	38	94	93	237
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	92.3%	79.2%	67.6%	75.0%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	9	27	62	68	166
		% within Howwouldyourateyour subjectleadercoordinat orinmaths	69.2%	56.2%	44.6%	54.8%	
Total		Count	13	48	139	124	324

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

CPD

How important do you think subject-based teacher CPD is to actual teaching performance?

	Frequency	Percent	Valid Percent
Not very important	21	4.9	5.8
Quite important	152	35.3	42.1
Very important	188	43.6	52.1
Total	361	83.8	100.0
Missing	70	16.2	
Total	431	100.0	

<u>No statistically significant differences based on:</u>

By level of seniority

By subject taught

By nation

By teaching experience

By % of FSM

By science and maths teaching rating

<u>Statistically significant differences based on:</u>

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
How important do you think subject-based teacher CPD is to actual teaching performance?	Not very important	Count	3	0	18	21
		% within What phase of education do you teach in?	15.0%	0.0%	6.0%	5.9%
	Quite important	Count	10	11	130	151
		% within What phase of education do you teach in?	50.0%	30.6%	43.3%	42.4%
	Very important	Count	7	25	152	184
		% within What phase of education do you teach in?	35.0%	69.4%	50.7%	51.7%
Total		Count	20	36	300	356

	% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.044

By type of school

Crosstab

			Typeofschool					Total
			Local authority administered	Academy	Independent/ private school	General FE college	Sixth form college	
How important do you think subject-based teacher CPD is to actual teaching performance?	Not very important	Count	2	7	9	1	2	21
		% within Typeofschool	1.4%	6.9%	10.3%	10.0%	16.7%	5.9%
	Quite important	Count	54	41	41	7	6	149
		% within Typeofschool	38.0%	40.2%	47.1%	70.0%	50.0%	42.2%
	Very important	Count	86	54	37	2	4	183
		% within Typeofschool	60.6%	52.9%	42.5%	20.0%	33.3%	51.8%
Total		Count	142	102	87	10	12	353
		% within Typeofschool	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.010

About how many hours of subject-based CPD did you do last academic year (2011-12)?

	Frequency	Percent	Valid Percent
0-10	200	46.4	55.6
11-20	65	15.1	18.1
21-30	39	9.0	10.8
31+	56	13.0	15.6
Total	360	83.5	100.0
Missing	71	16.5	
Total	431	100.0	

No statistically significant differences based on:

By level of seniority

By subject taught

By School phase

By teaching experience

By % of FSM

By science and maths teaching rating

Statistically significant differences based on:

By nation

Crosstab

			And in which nation is the school/college?					Total
			England	Northern Ireland	Scotland	Wales	Other	
About how many hours of subject-based CPD did you do last academic year (2011-12)?	0-10	Count	166	1	12	12	9	200
		% within And in which nation is the school/college?	59.5%	100.0%	21.8%	92.3%	75.0%	55.6%
	11-20	Count	48	0	15	1	1	65
		% within And in which nation is the school/college?	17.2%	0.0%	27.3%	7.7%	8.3%	18.1%
	21-30	Count	31	0	6	0	2	39
		% within And in which nation is the school/college?	11.1%	0.0%	10.9%	0.0%	16.7%	10.8%
	31+	Count	34	0	22	0	0	56
		% within And in which nation is the school/college?	12.2%	0.0%	40.0%	0.0%	0.0%	15.6%
Total		Count	279	1	55	13	12	360
		% within And in which nation is the school/college?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By how important is CPD

Crosstab

			How important do you think subject-based teacher CPD is to actual teaching performance?			Total
			Not very important	Quite important	Very important	
About how many hours of subject-based CPD did you do last academic year (2011-12)?	0-10	Count	15	90	94	199
		% within How important do you think subject-based teacher CPD is to actual teaching performance?	71.4%	59.6%	50.3%	55.4%
	11-20	Count	1	28	36	65
		% within How important do you think subject-based teacher CPD is to actual teaching performance?	4.8%	18.5%	19.3%	18.1%
	21-30	Count	4	16	19	39
		% within How important do you think subject-based teacher CPD is to actual teaching performance?	19.0%	10.6%	10.2%	10.9%
	31+	Count	1	17	38	56
		% within How important do you think subject-based teacher CPD is to actual teaching performance?	4.8%	11.3%	20.3%	15.6%
Total		Count	21	151	187	359
		% within How important do you think subject-based teacher CPD is to actual teaching performance?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.061

How do you mainly get information about CPD in your subject area?

	Frequency	Percent	Valid Percent
from local authority or other local network	32	7.4	8.9
from school CPD leader	54	12.5	15.0
from subject leader/coordinator	84	19.5	23.3
own research	142	32.9	39.3
other	49	11.4	13.6
Total	361	83.8	100.0
Missing	70	16.2	
Total	431	100.0	

No statistically significant differences based on:

By subject taught

By teaching experience

By % of FSM

By science and maths teaching rating

By importance of CPD

By amount of CPD

Statistically significant differences based on:

By School phase

Crosstab

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
How do you mainly get information about CPD in your subject area?	from local authority or other local network	Count	1	9	22	32
		% within What phase of education do you teach in?	5.3%	24.3%	7.3%	9.0%
	from school CPD leader	Count	2	5	47	54
		% within What phase of education do you teach in?	10.5%	13.5%	15.6%	15.1%
	from subject leader/coordinator	Count	2	7	74	83
		% within What phase of education do you teach in?	10.5%	18.9%	24.6%	23.2%
	own research	Count	10	13	117	140
		% within What phase of education do you teach in?	52.6%	35.1%	38.9%	39.2%
	other	Count	4	3	41	48
		% within What phase of education do you teach in?	21.1%	8.1%	13.6%	13.4%
Total		Count	19	37	301	357
		% within What phase of education do you teach in?	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.045

By level of seniority

Crosstab

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
How do you mainly get information about CPD in your subject area?	from local authority or other local network	Count	13	4	8	2	1	0	28
		% within Level of seniority	8.1%	19.0%	7.3%	6.7%	11.1%	0.0%	8.4%
	from school CPD leader	Count	27	5	12	3	1	2	50
		% within Level of seniority	16.9%	23.8%	11.0%	10.0%	11.1%	66.7%	15.1%
	from subject leader/coordinator	Count	48	3	17	9	0	0	77
		% within Level of seniority	30.0%	14.3%	15.6%	30.0%	0.0%	0.0%	23.2%
	own research	Count	50	8	55	13	6	1	133
		% within Level of seniority	31.2%	38.1%	50.5%	43.3%	66.7%	33.3%	40.1%
	other	Count	22	1	17	3	1	0	44
		% within Level of seniority	13.8%	4.8%	15.6%	10.0%	11.1%	0.0%	13.3%
Total		Count	160	21	109	30	9	3	332
		% within Level of seniority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.043

By nation

Crosstab

			And in which nation is the school/college?					Total
			England	Northern Ireland	Scotland	Wales	Other	
How do you mainly get information about CPD in your subject area?	from local authority or other local network	Count	17	0	14	1	0	32
		% within And in which nation is the school/college?	6.1%	0.0%	25.5%	7.7%	0.0%	8.9%
	from school CPD leader	Count	36	0	12	1	5	54
		% within And in which nation is the school/college?	12.9%	0.0%	21.8%	7.7%	41.7%	15.0%

	from subject leader/coordinator	Count	68	1	9	5	1	84
		% within And in which nation is the school/college?	24.3%	100.0%	16.4%	38.5%	8.3%	23.3%
	own research	Count	120	0	14	5	3	142
		% within And in which nation is the school/college?	42.9%	0.0%	25.5%	38.5%	25.0%	39.3%
	other	Count	39	0	6	1	3	49
		% within And in which nation is the school/college?	13.9%	0.0%	10.9%	7.7%	25.0%	13.6%
Total		Count	280	1	55	13	12	361
		% within And in which nation is the school/college?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

Which types of subject based CPD do you think have an impact on teaching?

	Responses		Percent of Cases
	N	Percent	
Theoretical/pedagogic (eg theories of learning):	125	5.6	34.6
Technical information (eg use of Interactive Whiteboards)	145	6.5	40.2
Examination information (eg marking schemes, briefing form exam boards)	198	8.9	54.8
Meeting teachers in same subject from different schools/colleges to share ideas and good practice	278	12.5	77.0
Sharing ideas and practice with colleagues in own school	294	13.2	81.4
Seeing others teach	249	11.2	69.0
Being formally observed teaching and getting feedback	92	4.1	25.5
Being peer observed teaching and getting feedback	160	7.2	44.3
Learning about different teaching approaches to topics in the subject	237	10.7	65.7
Engagement in research	94	4.2	26.0
Delivery from subject experts at external events e.g. conferences, courses	144	6.5	39.9
Finding out about new resources for learning	196	8.8	54.3
Other (please specify)	11	0.5	3.0
Total	2223	100.0	615.8

By education phase

$CPD*Whatphaseofeducationdoyouteachin Crosstabulation

			What phase of education do you teach in?			Total
			Further education	Primary education	Secondary education	
$CPD[a]	Theoretical/pedagogic (eg	Count	4	8	111	123

	theories of learning):Which types of subject based CPD do you think have an impact on teaching?	% within Whatphaseofeducationdoyouteachin	20.0%	21.6%	37.1%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	11	9	122	142
		% within Whatphaseofeducationdoyouteachin	55.0%	24.3%	40.8%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	14	2	180	196
		% within Whatphaseofeducationdoyouteachin	70.0%	5.4%	60.2%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	16	28	231	275
		% within Whatphaseofeducationdoyouteachin	80.0%	75.7%	77.3%	
	Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	16	33	242	291
		% within Whatphaseofeducationdoyouteachin	80.0%	89.2%	80.9%	
	Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	11	29	206	246
		% within Whatphaseofeducationdoyouteachin	55.0%	78.4%	68.9%	
	Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	2	11	78	91
		% within Whatphaseofeducationdoyouteachin	10.0%	29.7%	26.1%	
	Being peer observed teaching	Count	6	20	133	159

	and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Whatphaseofeducationdoyouteachin	30.0%	54.1%	44.5%	
	Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	13	23	198	234
		% within Whatphaseofeducationdoyouteachin	65.0%	62.2%	66.2%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	4	6	81	91
		% within Whatphaseofeducationdoyouteachin	20.0%	16.2%	27.1%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	9	14	118	141
		% within Whatphaseofeducationdoyouteachin	45.0%	37.8%	39.5%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	11	22	161	194
		% within Whatphaseofeducationdoyouteachin	55.0%	59.5%	53.8%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	0	1	10	11
		% within Whatphaseofeducationdoyouteachin	0.0%	2.7%	3.3%	
Total		Count	20	37	299	356

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By nation

$CPD*Andinwhichnationistheschoolcollege Crosstabulation

			And in which nation is the school/college?					Total
			England	Northern Ireland	Scotland	Wales	Other	
$CPD[a]	Theoretical/pedagogic (eg	Count	99	0	17	6	3	125

theories of learning):Which types of subject based CPD do you think have an impact on teaching?	% within Andinwhichnation istheschoolcollege	35.2%	0.0%	31.5%	46.2%	25.0%	
Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	99	1	34	6	5	145
	% within Andinwhichnation istheschoolcollege	35.2%	100.0%	63.0%	46.2%	41.7%	
Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	143	1	36	11	7	198
	% within Andinwhichnation istheschoolcollege	50.9%	100.0%	66.7%	84.6%	58.3%	
Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	205	1	50	12	10	278
	% within Andinwhichnation istheschoolcollege	73.0%	100.0%	92.6%	92.3%	83.3%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	225	1	44	12	12	294
	% within Andinwhichnation istheschoolcollege	80.1%	100.0%	81.5%	92.3%	100.0%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	201	1	32	8	7	249
	% within Andinwhichnation istheschoolcollege	71.5%	100.0%	59.3%	61.5%	58.3%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	77	0	13	2	0	92
	% within Andinwhichnation istheschoolcollege	27.4%	0.0%	24.1%	15.4%	0.0%	
Being peer observed	Count	127	1	20	5	7	160

teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Andinwhichnation istheschoolcollege	45.2%	100.0%	37.0%	38.5%	58.3%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	180	0	37	11	9	237
	% within Andinwhichnation istheschoolcollege	64.1%	0.0%	68.5%	84.6%	75.0%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	76	0	13	3	2	94
	% within Andinwhichnation istheschoolcollege	27.0%	0.0%	24.1%	23.1%	16.7%	
Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	112	0	24	4	4	144
	% within Andinwhichnationist heschoolcollege	39.9%	0.0%	44.4%	30.8%	33.3%	
Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	148	0	34	9	5	196
	% within Andinwhichnation istheschoolcollege	52.7%	0.0%	63.0%	69.2%	41.7%	
Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	9	0	1	1	0	11
	% within Andinwhichnation istheschoolcollege	3.2%	0.0%	1.9%	7.7%	0.0%	
Total	Count	281	1	54	13	12	361

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By teaching experience

$CPD*Foraboutthowmanyyearshaveyoubeenteaching Crosstabulation

			For about how many years have you been teaching?			Total
			0-5	6-10	11+	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	40	29	56	125
		% within Forabouthowmanyyearshaveyoubeenteaching	44.4%	33.7%	30.8%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	41	23	81	145
		% within Forabouthowmanyyearshaveyoubeenteaching	45.6%	26.7%	44.5%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	47	41	109	197
		% within Forabouthowmanyyearshaveyoubeenteaching	52.2%	47.7%	59.9%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	67	57	154	278
		% within Forabouthowmanyyearshaveyoubeenteaching	74.4%	66.3%	84.6%	
	Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	75	65	152	292
		% within Forabouthowmanyyearshaveyoubeenteaching	83.3%	75.6%	83.5%	
	Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	68	66	113	247
		% within Forabouthowmanyyearshaveyoubeenteaching	75.6%	76.7%	62.1%	
	Being formally observed	Count	34	24	34	92

	teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Foraboutho wmanyyear shaveyoubeenteaching	37.8%	27.9%	18.7%	
	Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	43	37	79	159
		% within Foraboutho wmanyyear shaveyoubeenteaching	47.8%	43.0%	43.4%	
	Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	56	56	123	235
		% within Foraboutho wmanyyear shaveyoubeenteaching	62.2%	65.1%	67.6%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	26	20	47	93
		% within Foraboutho wmanyyear shaveyoubeenteaching	28.9%	23.3%	25.8%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	39	28	76	143
		% within Foraboutho wmanyyear shaveyoubeenteaching	43.3%	32.6%	41.8%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	51	41	104	196
		% within Foraboutho wmanyyear shaveyoubeenteaching	56.7%	47.7%	57.1%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	2	2	7	11
		% within Foraboutho wmanyyear shaveyoubeenteaching	2.2%	2.3%	3.8%	
Total		Count	90	86	182	358

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By type of school

$CPD*Typeofschool Crosstabulation

			Typeofschool					Total
			Local authority administered	Academy	Independent /private school	General FE college	Sixth form college	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	46	42	27	0	5	120
		% within Typeofschool	32.2%	41.2%	31.4%	0.0%	41.7%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	63	36	31	7	5	142
		% within Typeofschool	44.1%	35.3%	36.0%	70.0%	41.7%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	79	56	41	6	9	191
		% within Typeofschool	55.2%	54.9%	47.7%	60.0%	75.0%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	115	75	64	8	10	272
		% within Typeofschool	80.4%	73.5%	74.4%	80.0%	83.3%	
	Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	116	84	70	9	9	288
		% within Typeofschool	81.1%	82.4%	81.4%	90.0%	75.0%	
	Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	100	76	55	4	9	244
		% within Typeofschool	69.9%	74.5%	64.0%	40.0%	75.0%	
	Being formally observed	Count	34	34	20	0	4	92

	teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Typeofschool	23.8%	33.3%	23.3%	0.0%	33.3%	
	Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	65	53	32	2	6	158
		% within Typeofschool	45.5%	52.0%	37.2%	20.0%	50.0%	
	Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	101	70	47	5	9	232
		% within Typeofschool	70.6%	68.6%	54.7%	50.0%	75.0%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	38	31	17	1	3	90
		% within Typeofschool	26.6%	30.4%	19.8%	10.0%	25.0%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	63	37	31	4	6	141
		% within Typeofschool	44.1%	36.3%	36.0%	40.0%	50.0%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	85	55	42	5	7	194
		% within Typeofschool	59.4%	53.9%	48.8%	50.0%	58.3%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	4	3	3	0	1	11
		% within Typeofschool	2.8%	2.9%	3.5%	0.0%	8.3%	
Total		Count	143	102	86	10	12	353

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By level of seniority

$CPD*Levelofseniority Crosstabulation

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	53	8	38	14	3	2	118
		% within Levelofseniority	33.5%	40.0%	34.9%	46.7%	27.3%	66.7%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	68	12	38	11	7	1	137
		% within Levelofseniority	43.0%	60.0%	34.9%	36.7%	63.6%	33.3%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	84	10	67	15	6	1	183
		% within Levelofseniority	53.2%	50.0%	61.5%	50.0%	54.5%	33.3%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	114	16	87	22	9	3	251
		% within Levelofseniority	72.2%	80.0%	79.8%	73.3%	81.8%	100.0%	
	Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	130	11	90	27	9	2	269
		% within Levelofseniority	82.3%	55.0%	82.6%	90.0%	81.8%	66.7%	
	Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	107	13	79	25	5	2	231
		% within Levelofseniority	67.7%	65.0%	72.5%	83.3%	45.5%	66.7%	

Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	45	5	23	11	0	1	85
	% within Levelofseniority	28.5%	25.0%	21.1%	36.7%	0.0%	33.3%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	75	9	44	18	2	1	149
	% within Levelofseniority	47.5%	45.0%	40.4%	60.0%	18.2%	33.3%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	96	15	74	22	7	1	215
	% within Levelofseniority	60.8%	75.0%	67.9%	73.3%	63.6%	33.3%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	38	6	30	8	3	2	87
	% within Levelofseniority	24.1%	30.0%	27.5%	26.7%	27.3%	66.7%	
Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	70	7	44	8	4	2	135
	% within Levelofseniority	44.3%	35.0%	40.4%	26.7%	36.4%	66.7%	
Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	89	10	64	14	3	1	181
	% within Levelofseniority	56.3%	50.0%	58.7%	46.7%	27.3%	33.3%	
Other (please	Count	3	1	3	2	0	0	9

specify):Which types of subject based CPD do you think have an impact on teaching?	% within Levelofseniority	1.9%	5.0%	2.8%	6.7%	0.0%	0.0%	
Total	Count	158	20	109	30	11	3	331

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By taught subject area

$CPD*Subject Crosstabulation

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	64	34	14	3	6	4	0	125
		% within Subject	40.8%	33.7%	35.0%	25.0%	24.0%	16.0%	0.0%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	61	39	18	8	11	8	0	145
		% within Subject	38.9%	38.6%	45.0%	66.7%	44.0%	32.0%	0.0%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	81	60	26	10	19	2	0	198
		% within Subject	51.6%	59.4%	65.0%	83.3%	76.0%	8.0%	0.0%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	114	81	32	11	19	20	1	278
		% within Subject	72.6%	80.2%	80.0%	91.7%	76.0%	80.0%	100.0%	
	Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	130	84	31	7	22	19	1	294
		% within Subject	82.8%	83.2%	77.5%	58.3%	88.0%	76.0%	100.0%	
	Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	116	62	24	7	20	19	1	249
		% within Subject	73.9%	61.4%	60.0%	58.3%	80.0%	76.0%	100.0%	
	Being formally observed teaching and	Count	44	23	11	1	7	6	0	92

	getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Subject	28.0%	22.8%	27.5%	8.3%	28.0%	24.0%	0.0%	
	Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	78	42	13	3	9	14	1	160
		% within Subject	49.7%	41.6%	32.5%	25.0%	36.0%	56.0%	100.0%	
	Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	103	76	20	7	17	13	1	237
		% within Subject	65.6%	75.2%	50.0%	58.3%	68.0%	52.0%	100.0%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	45	23	8	4	8	5	1	94
		% within Subject	28.7%	22.8%	20.0%	33.3%	32.0%	20.0%	100.0%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	64	39	20	7	7	6	1	144
		% within Subject	40.8%	38.6%	50.0%	58.3%	28.0%	24.0%	100.0%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	79	57	24	6	14	15	1	196
		% within Subject	50.3%	56.4%	60.0%	50.0%	56.0%	60.0%	100.0%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	4	1	2	0	4	0	0	11
		% within Subject	2.5%	1.0%	5.0%	0.0%	16.0%	0.0%	0.0%	
Total		Count	157	101	40	12	25	25	1	361

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % of FSM

$CPD*Approximatelywhatpercentageofpupilsstudentsinyourschool Crosstabulation

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?					Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	
$CPD[a]	Theoretical/pedagogic	Count	42	15	10	10	23	100

(eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	33.9%	35.7%	27.8%	41.7%	38.3%	
Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	43	15	12	12	24	106
	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	34.7%	35.7%	33.3%	50.0%	40.0%	
Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	61	27	19	16	27	150
	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	49.2%	64.3%	52.8%	66.7%	45.0%	
Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	98	34	24	20	43	219
	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	79.0%	81.0%	66.7%	83.3%	71.7%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	103	33	25	21	50	232
	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	83.1%	78.6%	69.4%	87.5%	83.3%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	86	27	24	15	51	203
	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	69.4%	64.3%	66.7%	62.5%	85.0%	
Being formally observed	Count	33	8	7	7	21	76

	teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	26.6%	19.0%	19.4%	29.2%	35.0%	
	Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	53	17	15	14	36	135
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	42.7%	40.5%	41.7%	58.3%	60.0%	
	Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	76	28	23	17	42	186
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	61.3%	66.7%	63.9%	70.8%	70.0%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	25	13	8	7	25	78
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	20.2%	31.0%	22.2%	29.2%	41.7%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	40	25	9	12	24	110
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	32.3%	59.5%	25.0%	50.0%	40.0%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	65	20	24	16	29	154
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	52.4%	47.6%	66.7%	66.7%	48.3%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	2	2	0	0	3	7
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	1.6%	4.8%	0.0%	0.0%	5.0%	
Total		Count	124	42	36	24	60	286

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By science teaching rating

$CPD*Howwouldyoupersonallyratetheteachingofscienceinyoursc Crosstabulation

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	1	14	50	46	111
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	16.7%	31.1%	31.2%	38.3%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	2	15	65	50	132
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	33.3%	33.3%	40.6%	41.7%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	2	15	90	75	182
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	33.3%	33.3%	56.2%	62.5%	
	Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	6	31	121	93	251
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	100.0%	68.9%	75.6%	77.5%	
	Sharing ideas and	Count	6	40	123	100	269

practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	100.0%	88.9%	76.9%	83.3%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	6	37	101	82	226
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	100.0%	82.2%	63.1%	68.3%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	1	13	42	30	86
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	16.7%	28.9%	26.2%	25.0%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	1	21	65	57	144
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	16.7%	46.7%	40.6%	47.5%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	4	31	100	79	214
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	66.7%	68.9%	62.5%	65.8%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	1	15	35	33	84
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	16.7%	33.3%	21.9%	27.5%	
Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	0	15	62	52	129
	% within Howwouldyoupersonallyrateteheteachingofsciencei nyoursc	0.0%	33.3%	38.8%	43.3%	
Finding out about new	Count	2	23	84	71	180

	resources for learning:Which types of subject based CPD do you think have an impact on teaching?	% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	33.3%	51.1%	52.5%	59.2%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	0	1	5	5	11
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	0.0%	2.2%	3.1%	4.2%	
Total		Count	6	45	160	120	331

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By maths teaching rating

$CPD*Howwouldyoupersonallyratetheteachingofmathsinyourscho Crosstabulation

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	2	3	61	40	106
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	75.0%	35.9%	31.2%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	1	1	75	49	126
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	16.7%	25.0%	44.1%	38.3%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	6	2	87	76	171
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	100.0%	50.0%	51.2%	59.4%	
	Meeting teachers in same	Count	4	4	138	92	238

subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	66.7%	100.0%	81.2%	71.9%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	5	3	137	107	252
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	83.3%	75.0%	80.6%	83.6%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	4	3	124	84	215
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	66.7%	75.0%	72.9%	65.6%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	2	1	45	30	78
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	33.3%	25.0%	26.5%	23.4%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	2	2	81	58	143
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	33.3%	50.0%	47.6%	45.3%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	3	3	117	77	200
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	50.0%	75.0%	68.8%	60.2%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	3	2	45	27	77
	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	50.0%	50.0%	26.5%	21.1%	
Delivery from subject experts	Count	2	1	75	46	124

	at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	33.3%	25.0%	44.1%	35.9%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	4	2	106	59	171
		% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	66.7%	50.0%	62.4%	46.1%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	0	1	5	4	10
		% within Howwouldyoupersonallyrate theteachingofmathsinyoursc ho	0.0%	25.0%	2.9%	3.1%	
Total		Count	6	4	170	128	308

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By importance of CPD

$CPD*HowimportantdoyouthinksubjectbasedteacherCPDistoactua Crosstabulation

			How important do you think subject-based teacher CPD is to actual teaching performance?			Total
			Not very important	Quite important	Very important	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	2	50	73	125
		% within HowimportantdoyouthinksubjectbasedteacherCPDistoactua	9.5%	33.6%	38.8%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	6	54	84	144
		% within HowimportantdoyouthinksubjectbasedteacherCPDistoactua	28.6%	36.2%	44.7%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	16	88	93	197
		% within HowimportantdoyouthinksubjectbasedteacherCPDistoactua	76.2%	59.1%	49.5%	
	Meeting teachers in same subject from	Count	15	109	151	275

different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	71.4%	73.2%	80.3%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	15	127	149	291
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	71.4%	85.2%	79.3%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	10	98	138	246
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	47.6%	65.8%	73.4%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	2	38	52	92
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	9.5%	25.5%	27.7%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	5	59	95	159
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	23.8%	39.6%	50.5%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	9	90	135	234
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	42.9%	60.4%	71.8%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	2	29	62	93
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	9.5%	19.5%	33.0%	
Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	5	48	90	143
	% within Howimportantdoyouthinksubjectbasedteacher CPDistoactua	23.8%	32.2%	47.9%	
Finding out about new resources for	Count	8	66	120	194

	learning:Which types of subject based CPD do you think have an impact on teaching?	% within HowimportantdoyouthinksubjectbasedteacherCPDistoactua	38.1%	44.3%	63.8%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	1	3	7	11
		% within HowimportantdoyouthinksubjectbasedteacherCPDistoactua	4.8%	2.0%	3.7%	
Total		Count	21	149	188	358

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By amount of CPD

$CPD*Abouthowmanyhoursofsubjectbasedcpddidyoudolastacadem Crosstabulation

			About how many hours of subject-based CPD did you do last academic year (2011-12)?				Total
			0-10	11-20	21-30	31+	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	55	21	15	32	123
		% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	27.9%	32.3%	38.5%	57.1%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	74	24	16	30	144
		% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	37.6%	36.9%	41.0%	53.6%	
	Examination information (eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	Count	105	32	23	38	198
		% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	53.3%	49.2%	59.0%	67.9%	
	Meeting teachers in same	Count	149	49	31	45	274

subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	75.6%	75.4%	79.5%	80.4%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	155	55	35	45	290
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	78.7%	84.6%	89.7%	80.4%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	131	44	30	40	245
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	66.5%	67.7%	76.9%	71.4%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	39	20	10	22	91
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	19.8%	30.8%	25.6%	39.3%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	82	31	20	25	158
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	41.6%	47.7%	51.3%	44.6%	
Learning about different teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	Count	121	43	28	42	234
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	61.4%	66.2%	71.8%	75.0%	
Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	37	16	12	27	92
	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	18.8%	24.6%	30.8%	48.2%	
Delivery from subject	Count	66	26	19	32	143

	experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	33.5%	40.0%	48.7%	57.1%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	104	40	17	34	195
		% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	52.8%	61.5%	43.6%	60.7%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	4	2	1	4	11
		% within AbouthowmanyhoursofsubjectbasedCPDdidyoudolastacadem	2.0%	3.1%	2.6%	7.1%	
Total		Count	197	65	39	56	357

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By info source of CPD

$CPD*HowdoyoumainlygetinformationaboutCPDinyoursubjectarea Crosstabulation

			How do you mainly get information about CPD in your subject area?					Total
			from local authority or other local network	from school CPD leader	from subject leader/coordinator	own research	other	
$CPD[a]	Theoretical/pedagogic (eg theories of learning):Which types of subject based CPD do you think have an impact on teaching?	Count	12	18	26	53	15	124
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	38.7%	33.3%	31.7%	37.3%	30.6%	
	Technical information (eg use of Interactive Whiteboards):Which types of subject based CPD do you think have an impact on teaching?	Count	12	25	31	57	19	144
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	38.7%	46.3%	37.8%	40.1%	38.8%	
	Examination information	Count	14	28	50	80	25	197

(eg marking schemes, briefing form exam boards):Which types of subject based CPD do you think have an impact on teaching?	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	45.2%	51.9%	61.0%	56.3%	51.0%	
Meeting teachers in same subject from different schools/colleges to share ideas and good practice:Which types of subject based CPD do you think have an impact on teaching?	Count	27	40	59	107	42	275
	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	87.1%	74.1%	72.0%	75.4%	85.7%	
Sharing ideas and practice with colleagues in own school:Which types of subject based CPD do you think have an impact on teaching?	Count	23	44	72	108	44	291
	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	74.2%	81.5%	87.8%	76.1%	89.8%	
Seeing others teach:Which types of subject based CPD do you think have an impact on teaching?	Count	19	37	57	96	38	247
	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	61.3%	68.5%	69.5%	67.6%	77.6%	
Being formally observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	9	20	22	28	13	92
	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	29.0%	37.0%	26.8%	19.7%	26.5%	
Being peer observed teaching and getting feedback:Which types of subject based CPD do you think have an impact on teaching?	Count	16	23	38	54	28	159
	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	51.6%	42.6%	46.3%	38.0%	57.1%	
Learning about different	Count	22	30	52	92	39	235

	teaching approaches to topics in the subject:Which types of subject based CPD do you think have an impact on teaching?	% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	71.0%	55.6%	63.4%	64.8%	79.6%	
	Engagement in research:Which types of subject based CPD do you think have an impact on teaching?	Count	5	11	18	49	9	92
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	16.1%	20.4%	22.0%	34.5%	18.4%	
	Delivery from subject experts at external events e.g. conferences, courses:Which types of subject based CPD do you think have an impact on teaching?	Count	8	16	23	69	26	142
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	25.8%	29.6%	28.0%	48.6%	53.1%	
	Finding out about new resources for learning:Which types of subject based CPD do you think have an impact on teaching?	Count	19	19	44	81	33	196
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	61.3%	35.2%	53.7%	57.0%	67.3%	
	Other (please specify):Which types of subject based CPD do you think have an impact on teaching?	Count	0	0	3	4	4	11
		% within HowdoyoumainlygetinformationaboutCPDinyoursubjectarea	0.0%	0.0%	3.7%	2.8%	8.2%	
Total		Count	31	54	82	142	49	358

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Pupils progress

What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?

	Frequency	Percent	Valid Percent
0-10	39	9.0	17.3
11-25	56	13.0	24.8

25-50	53	12.3	23.5
51-70	39	9.0	17.3
More than 70	39	9.0	17.3
Total	226	52.4	100.0
Don't know/not applicable	129	29.9	
Missing data	76	17.6	
Total	205	47.6	
TOTAL	431	100.0	

No statistically significant differences based on:

By level of seniority

By nation

By teaching experience

By CPD importance

By CPD amount

Statistically significant differences based on:

By subject taught

Crosstab

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	24	12	1	1	1	0	0	39
		% within Subject	15.3%	12.4%	2.5%	8.3%	4.2%	0.0%	0.0%	11.0%
	11-25%	Count	31	10	6	1	5	3	0	56
		% within Subject	19.7%	10.3%	15.0%	8.3%	20.8%	12.5%	0.0%	15.8%
	25-50%	Count	20	11	11	4	6	1	0	53
		% within Subject	12.7%	11.3%	27.5%	33.3%	25.0%	4.2%	0.0%	14.9%
	51-70%	Count	18	10	3	2	4	2	0	39
		% within Subject	11.5%	10.3%	7.5%	16.7%	16.7%	8.3%	0.0%	11.0%
	More than 70%	Count	22	3	10	2	1	1	0	39
		% within Subject	14.0%	3.1%	25.0%	16.7%	4.2%	4.2%	0.0%	11.0%
	Don't know/not applicable	Count	42	51	9	2	7	17	1	129
		% within Subject	26.8%	52.6%	22.5%	16.7%	29.2%	70.8%	100.0%	36.3%
Total		Count	157	97	40	12	24	24	1	355

% within Subject	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By % of FSM

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	4	1	8	7	15	4	39
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	3.3%	2.3%	23.5%	29.2%	25.4%	5.8%	11.2%
	11-25%	Count	11	12	7	8	9	8	55
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	9.2%	27.9%	20.6%	33.3%	15.3%	11.6%	15.8%
	25-50%	Count	21	12	4	1	7	8	53
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	17.5%	27.9%	11.8%	4.2%	11.9%	11.6%	15.2%
	51-70%	Count	26	4	3	0	0	6	39
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	21.7%	9.3%	8.8%	0.0%	0.0%	8.7%	11.2%
	More than 70%	Count	23	2	1	1	1	11	39
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	19.2%	4.7%	2.9%	4.2%	1.7%	15.9%	11.2%
	Don't know/not applicable	Count	35	12	11	7	27	32	124
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	29.2%	27.9%	32.4%	29.2%	45.8%	46.4%	35.5%
Total		Count	120	43	34	24	59	69	349

	% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By maths teaching rating

Crosstab

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	3	2	19	4	28
		% within How would you personally rate the teaching of maths in your school/college?	50.0%	50.0%	11.2%	3.2%	9.2%
	11-25%	Count	0	0	34	15	49
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	0.0%	20.1%	11.9%	16.1%
	25-50%	Count	0	0	21	26	47
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	0.0%	12.4%	20.6%	15.4%
	51-70%	Count	2	0	15	18	35
		% within How would you personally rate the teaching of maths in your school/college?	33.3%	0.0%	8.9%	14.3%	11.5%
	More than 70%	Count	1	0	6	31	38
		% within How would you personally rate the teaching of maths in your school/college?	16.7%	0.0%	3.6%	24.6%	12.5%
	Don't know/not applicable	Count	0	2	74	32	108
		% within How would you personally rate the teaching of maths in your school/college?	0.0%	50.0%	43.8%	25.4%	35.4%
Total		Count	6	4	169	126	305
		% within How would you personally rate the teaching of maths in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By maths leader rating

Crosstab

			How would you rate your subject leader/coordinator in maths?				Total
			Poor	Moderate	Good	Excellent	
What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	5	8	11	8	32
		% within How would you rate your subject leader/coordinator in maths?	38.5%	17.0%	8.0%	6.6%	10.0%
	11-25%	Count	3	5	22	20	50
		% within How would you rate your subject leader/coordinator in maths?	23.1%	10.6%	15.9%	16.4%	15.6%
	25-50%	Count	1	7	22	20	50
		% within How would you rate your subject leader/coordinator in maths?	7.7%	14.9%	15.9%	16.4%	15.6%
	51-70%	Count	3	5	13	17	38
		% within How would you rate your subject leader/coordinator in maths?	23.1%	10.6%	9.4%	13.9%	11.9%
	More than 70%	Count	0	3	14	22	39
		% within How would you rate your subject leader/coordinator in maths?	0.0%	6.4%	10.1%	18.0%	12.2%
	Don't know/not applicable	Count	1	19	56	35	111
		% within How would you rate your subject leader/coordinator in maths?	7.7%	40.4%	40.6%	28.7%	34.7%
Total		Count	13	47	138	122	320
		% within How would you rate your subject leader/coordinator in maths?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.007

By effective teaching factors

$EfectTeach*Whatpercentageofpupilsstudentsinyourschoolcollegechoose Crosstabulation

			What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?					Total
			0-10%	11-25%	25-50%	51-70%	More than 70%	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	23	35	30	27	29	144
		% within $EfectTeach	16.0%	24.3%	20.8%	18.8%	20.1%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	38	53	50	37	37	215
		% within $EfectTeach	17.7%	24.7%	23.3%	17.2%	17.2%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	18	31	26	18	24	117
		% within $EfectTeach	15.4%	26.5%	22.2%	15.4%	20.5%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	20	20	25	22	22	109
		% within $EfectTeach	18.3%	18.3%	22.9%	20.2%	20.2%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	9	10	9	9	7	44
		% within $EfectTeach	20.5%	22.7%	20.5%	20.5%	15.9%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	38	48	49	36	35	206
		% within $EfectTeach	18.4%	23.3%	23.8%	17.5%	17.0%	
	Well equipped teaching rooms:What factors do you think are most important in effective maths or science teaching?	Count	20	35	35	24	22	136
		% within $EfectTeach	14.7%	25.7%	25.7%	17.6%	16.2%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	25	38	43	29	32	167
		% within $EfectTeach	15.0%	22.8%	25.7%	17.4%	19.2%	
	Data tracking of pupils and	Count	25	27	15	15	12	94

	target setting:What factors do you think are most important in effective maths or science teaching?	% within $EfectTeach	26.6%	28.7%	16.0%	16.0%	12.8%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	10	9	7	8	10	44
		% within $EfectTeach	22.7%	20.5%	15.9%	18.2%	22.7%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	30	31	32	27	25	145
		% within $EfectTeach	20.7%	21.4%	22.1%	18.6%	17.2%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	32	40	42	30	23	167
		% within $EfectTeach	19.2%	24.0%	25.1%	18.0%	13.8%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	24	26	24	18	17	109
		% within $EfectTeach	22.0%	23.9%	22.0%	16.5%	15.6%	
Total		Count	39	56	53	39	39	226

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?

	Frequency	Percent	Valid Percent
0-10	20	4.6	10.2
11-25	43	10.0	21.8
25-50	57	13.2	28.9
51-70	50	11.6	25.4
More than 70	27	6.3	13.7
Total	197	45.7	100.0
Don't know/not applicable	145	33.6	
Missing data	89	20.6	
Total	234	54.3	
TOTAL	431	100.0	

No statistically significant differences based on:

By level of seniority

By nation

By teaching experience

By CPD importance

By science leader rating

Statistically significant differences based on:

By subject taught

Crosstab

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	12	6	1	1	0	0	0	20
		% within Subject	8.5%	6.1%	2.5%	8.3%	0.0%	0.0%	0.0%	5.8%
	11-25%	Count	20	15	3	1	2	2	0	43
		% within Subject	14.2%	15.2%	7.5%	8.3%	8.0%	8.3%	0.0%	12.6%
	25-50%	Count	10	27	9	3	7	1	0	57
		% within Subject	7.1%	27.3%	22.5%	25.0%	28.0%	4.2%	0.0%	16.7%
	51-70%	Count	9	16	11	2	9	3	0	50
		% within Subject	6.4%	16.2%	27.5%	16.7%	36.0%	12.5%	0.0%	14.6%
	More than 70%	Count	7	5	10	3	1	1	0	27
		% within Subject	5.0%	5.1%	25.0%	25.0%	4.0%	4.2%	0.0%	7.9%
	Don't know/not applicable	Count	83	30	6	2	6	17	1	145
		% within Subject	58.9%	30.3%	15.0%	16.7%	24.0%	70.8%	100.0%	42.4%
Total		Count	141	99	40	12	25	24	1	342
		% within Subject	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By % of FSM

Crosstab

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?						Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	Not sure	
What percentage of	0-10%	Count	0	2	4	2	10	2	20

pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	0.0%	5.0%	12.1%	8.7%	17.2%	3.1%	6.0%
	11-25%	Count	8	7	9	7	6	5	42
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	6.8%	17.5%	27.3%	30.4%	10.3%	7.7%	12.5%
	25-50%	Count	24	10	6	5	6	6	57
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	20.5%	25.0%	18.2%	21.7%	10.3%	9.2%	17.0%
	51-70%	Count	23	6	6	1	3	11	50
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	19.7%	15.0%	18.2%	4.3%	5.2%	16.9%	14.9%
	More than 70%	Count	21	1	1	0	1	3	27
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	17.9%	2.5%	3.0%	0.0%	1.7%	4.6%	8.0%
	Don't know/not applicable	Count	41	14	7	8	32	38	140
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	35.0%	35.0%	21.2%	34.8%	55.2%	58.5%	41.7%
Total		Count	117	40	33	23	58	65	336
		% within Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By amount of CPD

Crosstab

			About how many hours of subject-based CPD did you do last academic year (2011-12)?				Total
			0-10	11-20	21-30	31+	
What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	15	0	2	3	20
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	8.0%	0.0%	5.3%	5.9%	5.9%
	11-25%	Count	30	6	2	5	43
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	16.0%	9.5%	5.3%	9.8%	12.6%
	25-50%	Count	36	14	5	2	57
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	19.1%	22.2%	13.2%	3.9%	16.8%
	51-70%	Count	22	15	4	9	50
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	11.7%	23.8%	10.5%	17.6%	14.7%
	More than 70%	Count	9	4	3	10	26
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	4.8%	6.3%	7.9%	19.6%	7.6%
	Don't know/not applicable	Count	76	24	22	22	144
		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	40.4%	38.1%	57.9%	43.1%	42.4%
Total		Count	188	63	38	51	340

		% within About how many hours of subject-based CPD did you do last academic year (2011-12)?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.002

By science teaching rating

Crosstab

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?	0-10%	Count	1	9	8	2	20
		% within How would you personally rate the teaching of science in your school/college?	20.0%	20.9%	5.0%	1.7%	6.2%
	11-25%	Count	1	8	21	12	42
		% within How would you personally rate the teaching of science in your school/college?	20.0%	18.6%	13.2%	10.2%	12.9%
	25-50%	Count	0	2	35	18	55
		% within How would you personally rate the teaching of science in your school/college?	0.0%	4.7%	22.0%	15.3%	16.9%
	51-70%	Count	0	2	20	27	49
		% within How would you personally rate the teaching of science in your school/college?	0.0%	4.7%	12.6%	22.9%	15.1%
	More than 70%	Count	0	1	4	21	26
		% within How would you personally rate the teaching of science in your school/college?	0.0%	2.3%	2.5%	17.8%	8.0%
	Don't know/not applicable	Count	3	21	71	38	133
		% within How would you personally rate the teaching of science in your school/college?	60.0%	48.8%	44.7%	32.2%	40.9%
Total		Count	5	43	159	118	325
		% within How would you personally rate the teaching of science in your school/college?	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-square test, p=0.000

By effective teaching factors

$EffectTeach*Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A Crosstabulation

			What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?					Total
			0-10%	11-25%	25-50%	51-70%	More than 70%	
$EfectTeach[a]	Well qualified teachers:What factors do you think are most important in effective maths or science teaching?	Count	11	32	35	26	23	127
		% within $EfectTeach	8.7%	25.2%	27.6%	20.5%	18.1%	
	Enthusiastic teachers:What factors do you think are most important in effective maths or science teaching?	Count	19	42	52	49	26	188
		% within $EfectTeach	10.1%	22.3%	27.7%	26.1%	13.8%	
	Having pupils in appropriate sets:What factors do you think are most important in effective maths or science teaching?	Count	9	17	25	23	13	87
		% within $EfectTeach	10.3%	19.5%	28.7%	26.4%	14.9%	
	Support for pupils outside of lessons:What factors do you think are most important in effective maths or science teaching?	Count	10	14	26	23	16	89
		% within $EfectTeach	11.2%	15.7%	29.2%	25.8%	18.0%	
	Wide range of extra-curricular activities:What factors do you think are most important in effective maths or science teaching?	Count	3	6	16	12	5	42
		% within $EfectTeach	7.1%	14.3%	38.1%	28.6%	11.9%	
	Good relationships with pupils:What factors do you think are most important in effective maths or science teaching?	Count	19	39	51	47	25	181
		% within $EfectTeach	10.5%	21.5%	28.2%	26.0%	13.8%	
	Well equipped teaching	Count	9	23	38	34	17	121

	rooms:What factors do you think are most important in effective maths or science teaching?	% within $EfectTeach	7.4%	19.0%	31.4%	28.1%	14.0%	
	Good materials and resources:What factors do you think are most important in effective maths or science teaching?	Count	14	28	46	36	20	144
		% within $EfectTeach	9.7%	19.4%	31.9%	25.0%	13.9%	
	Data tracking of pupils and target setting:What factors do you think are most important in effective maths or science teaching?	Count	16	16	21	17	8	78
		% within $EfectTeach	20.5%	20.5%	26.9%	21.8%	10.3%	
	Supportive governing body:What factors do you think are most important in effective maths or science teaching?	Count	6	4	11	5	6	32
		% within $EfectTeach	18.8%	12.5%	34.4%	15.6%	18.8%	
	Whole school ethos:What factors do you think are most important in effective maths or science teaching?	Count	17	23	36	31	16	123
		% within $EfectTeach	13.8%	18.7%	29.3%	25.2%	13.0%	
	Effective subject leader/coordinator:What factors do you think are most important in effective maths or science teaching?	Count	15	33	46	34	16	144
		% within $EfectTeach	10.4%	22.9%	31.9%	23.6%	11.1%	
	Effective head teacher:What factors do you think are most important in effective maths or science teaching?	Count	11	21	33	17	11	93
		% within $EfectTeach	11.8%	22.6%	35.5%	18.3%	11.8%	
Total		Count	20	43	57	50	27	197

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?

	Responses		Percent of Cases
	N	Percent	
Success at GCSE, Standard Grade or equivalent level:	290	23.4	82.2
Good teaching at earlier stages	258	20.8	73.1

Teachers with enthusiasm for their subject	303	24.4	85.8
Science or maths in the media	72	5.8	20.4
Extra-curricular activities in maths/science (eg external speakers, visits to museums)	78	6.3	22.1
A focus on career opportunities in maths/science	213	17.2	60.3
Other (please specify)	27	2.2	7.6
Total	1241	100.0	351.6

By % choosing to study maths at a higher level

$PupilProgress*Whatpercentageofpupilsstudentsinyourschoolcollegechoose Crosstabulation

			What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?					Total
			0-10%	11-25%	25-50%	51-70%	More than 70%	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	33	49	49	32	34	197
		% within Whatpercentageofpupilsstudentsinyourschoolcollege choose	84.6%	87.5%	92.5%	82.1%	87.2%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	25	38	37	29	32	161
		% within Whatpercentageofpupilsstudentsinyourschoolcollege choose	64.1%	67.9%	69.8%	74.4%	82.1%	
	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	34	44	45	34	37	194
		% within Whatpercentageofpupilsstudentsinyourschoolcollege choose	87.2%	78.6%	84.9%	87.2%	94.9%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	11	13	9	5	42
		% within Whatpercentageofpupilsstudentsinyourschoolcollege choose	10.3%	19.6%	24.5%	23.1%	12.8%	
	Extra-curricular activities in	Count	8	11	12	4	6	41

	maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose	20.5%	19.6%	22.6%	10.3%	15.4%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	20	41	33	27	18	139
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose	51.3%	73.2%	62.3%	69.2%	46.2%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	2	4	5	2	5	18
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose	5.1%	7.1%	9.4%	5.1%	12.8%	
Total		Count	39	56	53	39	39	226

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % choosing to study science at a higher level

$PupilProgress*Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A Crosstabulation

			What percentage of pupils/students in your school/college choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?					Total
			0-10%	11-25%	25-50%	51-70%	More than 70%	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	16	37	50	45	22	170
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	80.0%	86.0%	87.7%	90.0%	81.5%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	11	29	41	41	23	145
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	55.0%	67.4%	71.9%	82.0%	85.2%	
	Teachers with enthusiasm	Count	16	37	47	45	23	168

	for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	80.0%	86.0%	82.5%	90.0%	85.2%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	7	13	15	5	44
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	20.0%	16.3%	22.8%	30.0%	18.5%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	8	12	14	6	44
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	20.0%	18.6%	21.1%	28.0%	22.2%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	12	28	43	37	13	133
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	60.0%	65.1%	75.4%	74.0%	48.1%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	1	1	6	2	4	14
		% within Whatpercentageofpupilsstudentsinyourschoolcollegechoose_A	5.0%	2.3%	10.5%	4.0%	14.8%	
Total		Count	20	43	57	50	27	197

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By teaching experience

$PupilProgress*Foraboutho wmanyyearshaveyoubeenteaching Crosstabulation

	For about how many years have you been teaching?	Total

			0-5	6-10	11+	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	76	63	150	289
		% within Forabouthowmanyyearshaveyoubeenteaching	85.4%	76.8%	83.8%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	65	59	132	256
		% within Forabouthowmanyyearshaveyoubeenteaching	73.0%	72.0%	73.7%	
	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	75	68	159	302
		% within Forabouthowmanyyearshaveyoubeenteaching	84.3%	82.9%	88.8%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	20	18	34	72
		% within Forabouthowmanyyearshaveyoubeenteaching	22.5%	22.0%	19.0%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	24	22	30	76
		% within Forabouthowmanyyearshaveyoubeenteaching	27.0%	26.8%	16.8%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	57	50	105	212
		% within Forabouthowmanyyearshaveyoubeenteaching	64.0%	61.0%	58.7%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	7	7	12	26
		% within Forabouthowmanyyearshaveyoubeenteaching	7.9%	8.5%	6.7%	
Total		Count	89	82	179	350

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By % of FSM

$PupilProgress*Approximatelywhatpercentageofpupilsstudentsinyourschool Crosstabulation

			Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?					Total
			0-5%	6-10%	11-20%	21-30%	More than 30%	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	94	36	29	22	45	226
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	78.3%	83.7%	85.3%	91.7%	76.3%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	98	32	20	16	41	207
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	81.7%	74.4%	58.8%	66.7%	69.5%	
	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	107	36	29	20	49	241
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	89.2%	83.7%	85.3%	83.3%	83.1%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	27	7	5	6	16	61
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	22.5%	16.3%	14.7%	25.0%	27.1%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	30	6	5	6	21	68
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	25.0%	14.0%	14.7%	25.0%	35.6%	
	A focus on career	Count	80	18	22	19	31	170

	opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Approximatelywhatpercentageofpupilsstudentsinyourschool	66.7%	41.9%	64.7%	79.2%	52.5%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	11	2	4	2	4	23
		% within Approximatelywhatpercentageofpupilsstudentsinyourschool	9.2%	4.7%	11.8%	8.3%	6.8%	
Total		Count	120	43	34	24	59	280

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By level of seniority

$PupilProgress*Levelofseniority Crosstabulation

			Level of seniority						Total
			Teacher	AST	Subject lead	Senior manager	HE post	Other	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	128	18	93	20	7	2	268
		% within Levelofseniority	82.1%	94.7%	86.9%	66.7%	77.8%	66.7%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	113	15	81	22	7	1	239
		% within Levelofseniority	72.4%	78.9%	75.7%	73.3%	77.8%	33.3%	
	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	134	16	94	23	8	3	278
		% within Levelofseniority	85.9%	84.2%	87.9%	76.7%	88.9%	100.0%	
	Science or maths in the	Count	31	4	22	8	1	0	66

	media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Levelofseniority	19.9%	21.1%	20.6%	26.7%	11.1%	0.0%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	34	2	26	8	1	0	71
		% within Levelofseniority	21.8%	10.5%	24.3%	26.7%	11.1%	0.0%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	99	11	64	16	2	1	193
		% within Levelofseniority	63.5%	57.9%	59.8%	53.3%	22.2%	33.3%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	6	1	11	5	1	0	24
		% within Levelofseniority	3.8%	5.3%	10.3%	16.7%	11.1%	0.0%	
Total		Count	156	19	107	30	9	3	324

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By taught subject area

$PupilProgress*Subject Crosstabulation

			Subject							Total
			Maths	Science non-specific	Physics	Chemistry	Biology	Science and maths	Unspecified	
$PupilProgress[a]	Success at GCSE, Standard	Count	130	83	33	12	22	10	0	290

Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Subject	83.3%	86.5%	82.5%	100.0%	88.0%	43.5%	0.0%	
Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	105	75	33	10	19	15	1	258
	% within Subject	67.3%	78.1%	82.5%	83.3%	76.0%	65.2%	100.0%	
Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	133	85	32	11	23	18	1	303
	% within Subject	85.3%	88.5%	80.0%	91.7%	92.0%	78.3%	100.0%	
Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	27	26	10	2	5	2	0	72
	% within Subject	17.3%	27.1%	25.0%	16.7%	20.0%	8.7%	0.0%	
Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	22	31	10	1	7	6	1	78
	% within Subject	14.1%	32.3%	25.0%	8.3%	28.0%	26.1%	100.0%	
A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	89	67	22	5	22	7	1	213
	% within Subject	57.1%	69.8%	55.0%	41.7%	88.0%	30.4%	100.0%	
Other (please	Count	12	3	5	1	3	3	0	27

	specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Subject	7.7%	3.1%	12.5%	8.3%	12.0%	13.0%	0.0%	
Total		Count	156	96	40	12	25	23	1	353

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of maths teaching

$PupilProgress*Howwouldyoupersonallyratetheteachingofmathsinyourscho Crosstabulation

			How would you personally rate the teaching of maths in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	5	4	138	101	248
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	83.3%	100.0%	82.1%	81.5%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	5	2	121	99	227
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	83.3%	50.0%	72.0%	79.8%	
	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	5	4	146	110	265
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	83.3%	100.0%	86.9%	88.7%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	2	2	42	21	67
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	50.0%	25.0%	16.9%	
	Extra-curricular activities in	Count	2	2	38	24	66

	maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	33.3%	50.0%	22.6%	19.4%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	2	108	72	186
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	66.7%	50.0%	64.3%	58.1%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	0	1	14	11	26
		% within Howwouldyoupersonallyratetheteachingofmathsinyourscho	0.0%	25.0%	8.3%	8.9%	
Total		Count	6	4	168	124	302

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of science teaching

$PupilProgress*Howwouldyoupersonallyratetheteachingofscienceinyoursc Crosstabulation

			How would you personally rate the teaching of science in your school/college?				Total
			Poor	Moderate	Good	Excellent	
$PupilProgress[a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	2	29	131	104	266
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	40.0%	64.4%	81.9%	88.9%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	3	29	113	96	241
		% within Howwouldyoupersonallyratetheteachingofscienceinyoursc	60.0%	64.4%	70.6%	82.1%	

	Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	3	37	137	106	283
		% within Howwouldyoupersonally ratetheteachingofscienc einyoursc	60.0%	82.2%	85.6%	90.6%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	0	5	36	27	68
		% within Howwouldyoupersonally ratetheteachingofscienc einyoursc	0.0%	11.1%	22.5%	23.1%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	0	13	28	33	74
		% within Howwouldyoupersonally ratetheteachingofscienc einyoursc	0.0%	28.9%	17.5%	28.2%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	3	25	96	73	197
		% within Howwouldyoupersonally ratetheteachingofscienc einyoursc	60.0%	55.6%	60.0%	62.4%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	0	2	14	7	23
		% within Howwouldyoupersonally ratetheteachingofscienc einyoursc	0.0%	4.4%	8.8%	6.0%	
Total		Count	5	45	160	117	327

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of maths leader

$PupilProgress*Howwouldyourateyoursubjectleadercoordinatorinmaths Crosstabulation

		How would you rate your subject leader/coordinator in maths?				Total
		Poor	Moderate	Good	Excellent	
Success at GCSE,	Count	10	40	111	99	260

Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	76.9%	85.1%	81.0%	83.2%	
Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	10	31	102	93	236
	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	76.9%	66.0%	74.5%	78.2%	
Teachers with enthusiasm for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	10	40	122	104	276
	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	76.9%	85.1%	89.1%	87.4%	
Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	3	8	28	23	62
	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	23.1%	17.0%	20.4%	19.3%	
Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	10	35	22	71
	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	30.8%	21.3%	25.5%	18.5%	
A focus on career	Count	7	28	81	73	189

opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	53.8%	59.6%	59.1%	61.3%	
Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	0	5	8	11	24
	% within Howwouldyourate yoursubjectleaderc oordinatorinmaths	0.0%	10.6%	5.8%	9.2%	
Total	Count	13	47	137	119	316

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

By rating of science leader

$PupilProgress*Howwouldyourateyoursubjectleadercoordinatorinscience Crosstabulation

			How would you rate your subject leader/coordinator in science?				Total
			Poor	Moderate	Good	Excellent	
$PupilProgress [a]	Success at GCSE, Standard Grade or equivalent level:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	6	32	99	63	200
		% within Howwouldyourateyo ursubjectleadercoor dinatorinscience	66.7%	78.0%	85.3%	78.8%	
	Good teaching at earlier stages:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	7	27	74	69	177
		% within Howwouldyourateyo ursubjectleadercoor dinatorinscience	77.8%	65.9%	63.8%	86.2%	
	Teachers with enthusiasm	Count	6	35	97	70	208

	for their subject:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	% within Howwouldyourateyoursubjectleadercoordinatorinscience	66.7%	85.4%	83.6%	87.5%	
	Science or maths in the media:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	2	10	18	20	50
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	22.2%	24.4%	15.5%	25.0%	
	Extra-curricular activities in maths/science (eg external speakers, visits to museums):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	1	11	22	20	54
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	11.1%	26.8%	19.0%	25.0%	
	A focus on career opportunities in maths/science:What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	4	26	67	47	144
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	44.4%	63.4%	57.8%	58.8%	
	Other (please specify):What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grade or equivalent level?	Count	1	3	7	6	17
		% within Howwouldyourateyoursubjectleadercoordinatorinscience	11.1%	7.3%	6.0%	7.5%	
Total		Count	9	41	116	80	246

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

Appendix C: Notes on Interviews & Visits

Further notes on schools

School A	Mixed, Catholic Voluntary Aided, 11-18. Roll 1200, 20.5% FSM. Maths teaching school and works with 38 other schools in West Midlands as lead for the Teaching Schools Alliance. Currently engaged with an action research project under the theme 'What makes great pedagogy?', through which they also work with LCLL. Sponsors School B.
School B	Mixed academy, 11-18. Roll 923, FSM 27.6% Sponsor led (by School A), 11- 18, opened in January 2011 following closure of the predecessor school which was in special measures. Ofsted monitoring report in May 2012 noted outstanding progress 57% A* to C grades in 2011 (rise of 28% from the previous year), Ofsted said that 2012 results up further but data not yet published for this school
School C	Mixed, Foundation school, 11-18. Roll 1000, 18.6% FSM 35.9% EAL Described as a 'Secondary Modern' as it competes with local grammar schools who cream off the top 20%. Despite this, it introduced a sixth form in 2004 and has just had its first successful Oxbridge candidate. Although results do not look great on paper, this is clearly a school which is improving rapidly. Also using sixth form to introduce vocational subjects which previously students have left to do at College. The interviewee was certain that the Head had affected a massive turnaround by changing aspirations. Rather than being a 'Secondary Modern' it is now a good comprehensive, and yet the intake is little different. Several feeder primaries are in special measures.
School D	Mixed CTC, 11-18. Roll 1400, FSM 10% One of the few existing CTC so and has no admission rules. Ethnicity does not reflect the local community. Low on FSM compared to local schools. Admission process is an active process so might restrict some people from applying. Has to admit children that are naturally distributed in ability – bell curve. Use a CAT type test to check the proposed intake to "select" a comprehensive cohort.
School E	Mixed academy, 11-18. Roll 600, FSM 37.3% A non-selective 11-18 school in an area of very high deprivation in North West. While the sixth form does offer A levels, it is more successful in offering BTECs. Interviewee felt school had improved dramatically over the past few years.
School F	Mixed academy, 3-19. FSM 45.4% Previous school closed and reopened as a 'Fresh Start' Academy, sponsored by local motor company. Also moved into new buildings 3 years ago. Since then it has seen a rapid improvement in attainment and behaviour. Last year's maths GCSE was 47%, up from 8% in 2008. Those members of staff interviewed who were at the school in its previous form used words such as 'horrendous' about it. The Headship changes several times in one year and private security staff were called in to police corridors.
School G & H School K	Mixed academy, 11-18. FSM 30.9% Mixed academy, 11-18. FSM 26.0%

	Free school, 5-11 These schools are both part of a School Trust currently consisting of an FE College, two Academies and a primary Free School. There are another five academies in the process of being formed. The Trust, now a federation has an independent servicing organisation which does the back office functions for all the schools in the group. The two mature schools in the federation show huge gains in achievement. School G has lifted the number with 5 A*-C GCSEs by 78% since 2007 and 5 A*-C GCSE inc M&E has increased 38% since 2007, For School H the figures are 52% and 57%. This has taken the schools form being some of the poorest performing firmly into the top 10% in the country. Interviewed were the CEO of the Trust, a member of the Cross-Federation SLT, the deputy principal of the Primary Free school (School K), Head of Maths at School G and Head of Science at School H.
School I	Boys Independent, 11-18 Old direct grant Grammar school now independent Boys day school. Very good results in maths and science – this summer every pupil got an A or A* at GCSE. Huge percentage of boys do Maths/science AS and A levels, and have a very good record of Oxbridge entrance in maths and Science.
School J	Mixed Community, 5-11, in South West. Roll 700, FSM 11% 92% L4 or above in Maths; 52% Level 5 in Maths 21011
School L	Mixed Secondary, 12-8. Roll 1800 pupils, FSM 6.9% High achieving school (5 or more SQCF 72%) Interviewees reported a recent rapid improvement.
School M	Mixed Secondary, 12-8. Roll 1800 pupils, FSM 3.8% High achieving school (5 or more SQCF 73%)
School N	Mixed Secondary, 12-8, FSM 23.7% Smaller Scottish School (5 or more SQCF 21%) The Head estimates that more pupils are eligible than claim – he estimates about a third are eligible.
School O	Scottish Primary School, 5-12. Roll 193, FSM 23%
School P	Scottish Primary School, 5-12. Roll 360, FSM 4%
School Q	Mixed Community, 11-16, FSM 31.3% 11-16 school in the deprived part of Swansea. Described as in a deprived area but not a deprived school. A new head in 2007 has changed the school and new buildings cemented the changes. Says that the school 10 years ago the school was very poor, not somewhere anyone wanted to go.
School R	Catholic (non-selective) 11-18, FSM 35.5% This is a small boys Catholic Secondary Modern in Northern Ireland. The top 25% are creamed off by the local Grammar school (perhaps one person per year actually passed the Transfer Test) and as a boys school they have an entry cohort (in year 8 in NI) which is very poor indeed. The Science teacher further pointed out that the pressure on the primary schools is focussed on the TxTest so very little if any science is done there and boys arrive with very low self-esteem. It is also a school in an area of extreme social disadvantage.

	Despite this, they have very good success rates in both subjects and they are seen as a beacon of excellence by the NI Inspectorate. (In science single Science is on the NI Average, and Double science is 90%, maths is above the NI average). Interesting to note that the Principal decided that all boys would do science, though this is not a requirement, which in itself means that success rates are lower than they could be. He feels the aspiration must be for all boys to succeed in at least single science. Separate interviews were carried out with the Heads of Maths and Science.

Further notes on colleges

College 1	A small English college. Offers maths as GCSE re-sit, A level or as Functional Skills for lower abilities. Has about 100 learners doing FS and 150 doing GCSE re-sits. In science do A levels and BTEC in Applied Science.
College 2	Medium sized English college. Head of maths came to College 12 years ago from a Sixth Form College. College 2 Maths is very academic in outlook and has 14 A level groups. They have a wide variety of mathematics courses, including the A+FARM GCSE/As level bridge. They routinely take students with B at GCSE for A level and in individual cases C as well, though they would probably do FARM as a condition before going to AS.
College 3	Very large college in West Midlands. Spoke to Head of faculty. Her responsibilities include – Teacher training, Additional needs and support, ESOL, Sixth form college, Functional Skills, Post 19 English & maths, Maths and Science BTEC, access to FE. <u>Qualifications offered:</u> • GCSE retakes • FS • AS & A2 • BTEC level 3/diploma Results: AS 72%, A2 96% - both above national average Success rate improving, as are university entrance progressions. FS (16-19) English/maths combined 69.6% (national average 62%) Serious problem with Level 2 FS Maths. Many just can't do it.
College 4	Scottish college with 750 staff, 12,000 enrolments, 3 sites. In the process of amalgamating with another college. Interview conducted with Curriculum Manager Maths (F) and Head of Science & Maths Faculty (D).
College 5	Large (by Scottish standards) regional college with about 15,000 students. Has 3 campuses at Falkirk, Aloha and Stirling. Used as a model for the current project of regionalisation in Scotland. Cohorts are the school re-sits and access groups doing L5/6 leading towards higher and HNs and those who gained Highers at school and are doing HNs en route to University. Interview with Heads of chemistry, Life Sciences and Maths & computing. College does not offer maths as a standalone subject but only as support to other subjects.
College 6	Scottish college contacted largely in order to gain understanding of

	Scottish FE system and qualifications. <u>Qualifications offered:</u> • Intermediate (SL4) • Maths to support science (SL4) • Applied science Intermediary 2 (SL5) • The mainly Biology/Chemistry do elements of Physics and those focussed on Chem/Physics do Biology modules. • Applied Science Higher (SL6) • Applied Science Advanced Higher (SL7) • HNC (HE route) Little demand for standalone maths.
College 7	The college is medium sized for Scotland (about 8,500 students) and is part of the University of the Highlands network, a large catchment area and a number of campuses. As such it delivers some degree courses as well as the usual FE subject areas and levels. They cater for some groups under 16 – either as one day a week vocational classes, provision for school 'refusers' or some start in the January of Year 12 on full time vocational courses. The interviewee is responsible for mathematics and science – but not numeracy which comes under the Core Skills department. Courses delivered to 15-19s include: • Intermediate 1 or 2 for those with no science • L5 NC • Highers in sciences and maths • Stand alone units for those on Intermediates or Highers • Apprenticeship in medical science • HNC Applied sciences • Engineering science degree modules Maths is similar, but numeracy is offered to every9one enrolling in college. Those without a certificate are given BKSB assessment and do numeracy courses embedded or contextualised to their vocational course. For those who have good numeracy, there are open learning courses for Intermediate 2 and higher maths. It was remarked that numeracy is getting worse in the Scottish intake and very noticeable how much better the numeracy is of east Europeans students.
College 8	Small Scottish college (8000 students) to west of Glasgow. Maths offers senior level courses or servicing courses for the whole college. <u>Qualifications offered:</u> At senior level • Highers <u>Servicing dept</u> • Maths in support of vocational subject

	eg 11 x Engineering maths for HNC support • Intermediate 2 (2 day classes, 1 evening) Even students on NC courses may still need some numeracy skills
College 9	In essence, the Welsh FE offer is broadly similar to the English one. College has cohorts re-taking GCSE Science and maths as well as Level 3 BTEC, AS and A2 cohorts looking towards University. College has 8 campuses though focussed on two major ones.

Subject leader career
Secondary Schools

School M	Science	PT for Physics. 10th year of teaching. 5 yrs in previous school and 5th year as PT. Leadership encouraged in previous school even before promotion. Given lots of opportunities to prepare eg running projects, developing resources. Given feedback and review. Supported by colleagues but no formal training although does do CPD to others now.
School L	Science	PT for Chemistry. Been at school since 1984. Has turned down opportunity to be promoted to Dh as he would do less teaching. No formal training for PT role, but lots of support from both current and previous school.
School L	Maths	Entered teaching in 1980 and became PT 3 years ago. Has done some in-service training for PT role.
School N	Maths	Always had a passion for maths. Been teaching 12 yrs been PT for 4 years. Did leadership preparation course at Strathclyde Uni. Found the preparation course useful – especially in leading teams of people. Currently providing opportunity for a member of her team to shadow her in the role as part of their leadership development.
School A	Maths	Has PhD in maths, did some tutoring then trained as a maths teacher. Has been HoD for 4 years. Mostly informal training. 'I come from a family of teachers, so, basically I know how to talk to people.'
School A	Science	Environmental science degree. Been teaching 13 years and HoD for 4 yrs, subject area at the school chemistry. Came to B.C. from a science specialist school and did some leadership training through the SSAT which he found useful.
School D	Maths	Bed [1984 – 88] in Maths at St Paul and St Marys Taught for 3.5 years in Swindon then to TT. Was i/c KS3 the i/c KS4 then was doing the HoF role and when the existing HoF left was given the role. One 3hr course on how to run a fac. Learnt on the job. In role for 8 years to date and 19 at the school.
School C	Science	Took a degree in Human Ecology, spent a year working on conservancy projects before taking PGCE. Became Head of science at School C after only 5 years, then left to gain experience and returned as he found School C a better school. Had no training at the time, though has done leadership courses subsequently.

School E	Science	Has been teaching for 11 years, and has been Head of Science for 5 years. Is currently seconded to SLT. Did a National College leadership course. Obtained job accidentally having applied for a lower grade one!
School Q	Maths	Economics graduate, did PGCE 10 yrs ago and worked at FE before going into schools. Was 2nd in dept for two years and now in second year as head.
School B	Maths	Physics graduate, grew up and educated locally from a family of teachers, wanted to join the Army, but failed physical requirement. Trained at School A where he was spotted for leadership potential and transferred to JHN when academy started. HOD left in summer 2011 and SLT decided to offer him the HOD role rather than seeking an external appointee. In his third year of teaching.
School F	Maths	Two leaders here – Michelle who was HoF and Benn who is now taking over. But they have clearly been a team since they both arrived 4 years ago and other staff could not state who was the leader. Benn was teaching in an 'easy, leafy successful school' and wanted more challenge. Michelle moved down to Swindon after her husband retired but wasn't ready to give up on her career. They both thrive on challenge.

Subject leader career
Primary

School P	Maths	The Headteacher: Ch has been a HT for about 12 years, 7 of them at School P. She shares the role of maths coordinator (and literacy coordinator) with her deputy head (DH). She takes the lead in maths but DH also attends meetings and INSET as well. There is a new scheme where the school is being asked to appoint a maths champions and she will do this from within the school later this year, so relinquishing her responsibility. She already knows who she will appoint. CH emphasises that the school is more interested in teaching and learning rather than subject areas and therefore it didn't matter who attended curriculum meetings etc as they would be sharing this with the management team – she says we take a wider view of the curriculum in general. She and her Deputy Head have been maths coordinators for the 7 years since she has been at the school From this November the HT has appointed a 'maths champion', LL whom is principal teacher and part of the SLT (HT, DH and LL) – A champion is different from a maths coordinator – their task is to promote the subject and raise it's importance and profile
School O	Science	The Headteacher (also planning to talk to a 'science champion', not yet appointed, when I visit on 1 Nov) Began teaching in 1989 (23 years); HT for 6 years at the school I met and interviewed the new science champion, AG. (See above about champions.) She had been teaching for 8 years and as she was keen to develop her career she had asked the HT if she could be science champion. She has science background. She had just returned from a 3-day residential course, which she found very

		good and useful. It had given her lots of ideas and resources and £4000 to spend on science before June 2013. AG was going to give teachers a questionnaire, asking them what they wanted in terms of developing their science teaching. The course had also covered coaching, mentoring and resources.
School J	Maths	The Assistant Headteacher: teaching about 20 years – taught at 2 schools, became a maths coordinator – she has a degree where maths formed a large component – at the time the national numeracy strategy was coming out about 1995ish. Realised how much she loved teaching maths, Been at School J 12 years. DW also makes the point that the school does not have subject leaders, it has subject teams (or 5 people) and this is where the collective expertise resides. Therefore the effect of one member of staff leaving (say the subject leader) is ameliorated
School J	Science	Been a teacher 8 years and been at School J for 3 years. Previously was an engineer. In his first school he was humanities coordinator (his degree is in history). But has always had a passion for science and was delighted to be appointed coordinator when he arrived at School J. He teachers Y4

Subject leader career
Colleges

College 4	Maths	F manages all Essential skills. Maths degree & PGCE. Been teaching in FE since 1997 and CM since2009.
College 1	Maths & Science	Maths degree, MSc in statistics, worked in IT, taught in schools and then FE after a few years out with children.
College 2	Maths	School teacher, sixth form college then 'became' Head of Department. Has a Maths degree from Oxford and did PDCE at a direct grant grammar school.
College 5	Maths & Science	All are new appointments. 2 have been lecturers/teachers before becoming CMs, and one has a PhD and has worked for 10 years in the chemicals industry. She had received management training previously and all are currently doing training related to their new roles.
College 6	Maths & Science	Head of Science, which means Chemistry, Biology, Physics and maths.
College 8	Science & Maths	Head of maths, but offers just a few higher courses as stand alone.
College 7	Science & Maths	Head of mathematics and science (+ sport, hair & Beauty, forestry...) but NOT Numeracy, which falls to the Core Skills leader. Feels that staff needed for degree level maths are not the same as for those struggling with Intermediate 1 or 2.

Key successes
Secondary Schools

School M	Science	Implementing Curriculum change. A lot of change and attainment continuing to improve. Measurable attainment success.

		Evaluation reviews of department very successful, implementing new courses good team working together.
School L	Science	Keeping Chemistry as one of the most popular and successful subjects in a high achieving school
School L	Maths	• Improved results already • Pupils enjoying maths more
School N	Maths	• Improvement in attainment and more pupils choosing elective maths for Highers, so have had to increase the number of groups from five to six • Implementation of new curriculum
School A	Maths	• Attainment • A level standards • Ethos – confirmed at visit, very strong collegiality and sense of shared values, high ambition and respect for pupils within the maths team. This is reinforced by use of display in the maths area to celebrate pupils' work and to present a strong maths identity for the area.
School A	Science	• More of a coherent unit • Built links with Universities and Science learning Centre, including running Science Learning Centre courses as part of the teaching school • Improving standards across the board. • Developed triple science
School D	Maths	1. 99% C+ at GCSE – exceeded the target of RoL 2. A/L grown in numbers with students within and outside the school. 3. The development of the maths team – a real team. 4. Teach in depth using innovative and a range of activities.
School C	Science	GCSE results consistently improving across the range of abilities, Introduced A level sciences, gaining success in A levels, widening choice through BTEC science, led investment in new labs and prep rooms.
School I	Maths & Science	Slightly different question – How do you maintain such high standards? • Pride – Refusal to see standards slip • Attention to detail. If you let one slip in standards go unnoticed, what about the next and the one after that? Suddenly you have a failure where you should have had a success. • Targets yes. Current maths was to have no B grades at GCSE. Have just done that so need another target! • Terms are important. A time to reflect and renew beginning. Teachers need that break.
School E	Science	• Exam results – initially science GCSE A*-C was in 20% region but has now reached 60%. • Introducing BTECs which have 70% success rate. • Has created a strong and stable staff team
School Q	Maths	Welsh create a 'family of schools' a dozen from across Wales with similar intake characteristics. In Level 2 is in first quartile of the family, and at L1 has exceeded Welsh averages. GCSE results

		improving rapidly; up 45% A*-C and driving towards 50%. Recent Ofsted put them into Band 1.
School R	Maths & Science	Very good success rates in both subjects and they are seen as a beacon of excellence by the NI Inspectorate. (In science single Science is on the NI Average, and Double science is 90%, maths is above the NI average). Nonetheless a recent inspection report found no weaknesses in the Maths department only strengths, and they were commended for their hard work, quality of teaching, great leadership use of wide variety of approaches to teaching maths. The science department self evaluation is attached
School G/School H	Maths & Science	As with any failing schools, the achievement is from transforming a failing school into a genuinely successful school. The transformation is clearly remarkable.
School B	Maths	The HOD, subject teachers and the HT agree that the key success in the last year has been to build a cohesive team, with shared values, commitment and consistency in approach.
School F	Maths	Results, clearly, a spectacular 39% rise in maths in 4 years, but most important has been creating a coherent, stable, enthusiastic team.

Key successes
Primary Schools

School P	Maths	School has traditionally done very well in terms of maths attainment in local and national test It was judged by the last HMI inspection (around 2009) to be the best performing primary school in Scotland There has been a general improvement in maths A review team from the Local Authority (East Renfrewshire) visited the school in the summer for 3 days and they found the teaching and learning of maths to be very good and found the children were very engaged Levels that have been assessed have been high and have improved The school has different assessment methods in place LA uses the standardised assessment tests which take place in February at stages 3 (aged 7), stage 5 (9 yrs) and 7 (11 yrs) (in primary school) – that's the big benchmark Traditional maths tests – paper based but also includes a mental component as well This data is used internally to compare attainment against other schools in the LA We use other assessments including teacher judgements (sometimes based on class tests) –teachers also use their professional judgment and also look at way the children use maths. The children are assessed by the teachers in how they can apply maths, as well as complete computational skills Standard Assessments Tests are shared within the LA but not

		with the whole of Scotland In particular, they share data with the local cluster of 5 schools – 3 primary, 1 nursery and 1 High School New initiative called The Curriculum of Excellence (came in about 3 years ago and replaced the 5-14 framework) This provides benchmarks of attainment which schools are expected to reach. The HT said she think Curriculum for Excellence is good – giving teachers more autonomy. The outcomes are defined but they way they are achieved is left to the teachers. She actually thought the school was doing this anyway
School O	Science	We work very closely with our cluster schools (two other primaries; a nursery and local secondary) and our cluster, of which I am a leading science coordinator, was leading the science review and development in the LA (which is very small – East Renfrewshire). Science was recently given a priority for 2 years. This is linked to The Curriculum for Excellence. We have introduced a programme of skills and assessments that has moved away from the over-reliance on textbooks. The approach is much more about problem solving and investigations and also emphasises cross-curricular links. Also concentrates on basic core skills and on teaching and learning and assessment. Came up with a series of activities that would use these skills and used examples of good lesson plans as examples. This process was transmitted at school on in-service days for whole staff (sharing strategies, what worked and did not etc) but information is also cascaded down from school coordinators. Secondary science teachers have visited the school and shown various practical lessons. A national internet resource called GLOW has been set up where teachers can talk to each other and share resources.
School J	Maths	First thing I did was to introduce the primary strategy (around 2000) to develop children's mathematical thinking, their mental strategies and then their computational calculations come later. This was big achievement to get the staff on board – teachers understood what it was about. I was involved with NCTM, looking at the way teachers can work collaboratively to develop their maths understanding. We used 'lesson study' (based on a Japanese study) to help teachers see that how important understanding is. This involves three Year group teachers: first of all they meet to decide the focus (it is usually decided by them but sometimes DW tells them what to look at. Two of the teachers then peer observe the other one; the three then meet again and reflect on what went well and how things could be improved further; the same teacher, or one of the other two, then teaches this and is observed again. This cycle happens once a year; the two teachers' classes (on both occasions) are covered by a supply teacher for the morning. DW thinks it is very valuable and the school has been doing this in maths (only) for the last 3 years. An example of the focus is better use of (maths) language. DW is also a big fan of using research studies (articles, reports)

		and shares these with the staff. NCETM is a good source as is google scholar – she seems to have built up quite a resource DW says we have changed teachers thinking and their practice (eg teachers now much better with problem solving expressed in words). The biggest success has been with Y5 and Y6 teachers- it has really changed their thinking and their practice. Y3 and Y4 are a little behind in this process. However, it is not so much that these teachers resist – they have so much on that it is more difficult for them to cope with change. We have 3-form entry and each year group always plan together. The lesson study involves teachers planning together; one teacher teaches the lesson and the other two observe and then all three meet to reflect on how it went. There has been a big move away from worksheets to getting the children really thinking mathematically – move away from procedures to problem solving
School J	Science	The main thing is how school teaches SC1 (investigations – accounts for 60% of the curriculum assessment – 2 other science areas SC2 and SC3) and how this has developed. When subject lead arrived there was lots of this is what we are doing and this is how we will do it; lots of teacher demonstrations and not much of the children actually doing the investigations themselves. This has really been turned around. So school has changed practice, right across the school. We are pretty well resourced.

Key successes
Colleges

College 4	Maths	Keeping the department afloat through a time of intense change ie 5 campuses and 33 staff to 21 staff in 2 campuses. Also development of IT resources eg IWB and changes to funding and qualifications.
College 1	Maths & Science	• Increased participation – both Maths and science A level • Introduced college wide policy that everyone does Functional Maths if they don't have a Grade C GCSE • Increased success rates • Increased student satisfaction ratings.
College 2	Maths	Making maths available to a large number of students many of whom have gone on to University. Introducing a wide variety of courses/modules. Instilling enthusiasm for maths in students.
College 5	Maths & Science	Early days, so building teams and identifying good and weak points in staff have been priorities together with getting a grip on changing curriculum.
College 9	Maths & Science	Improvement in A level outcomes, Becoming top college in Wales, 7% increase in student enrolments.

Management style
Secondary Schools

School M	Science	Credibility and leading by example. Starts in your own classroom. You need to be delivering at the highest quality. This gives you credibility with pupils, parents and staff.
School L	Science	Appointing staff that fit dept, giving team ownership of crucial decisions, leading by example.
School L	Maths	• Knowing teachers • Getting pupils into correct course (not qual) • Look for everyone to make a contribution
School N	Maths	• Introduced changes slowly with agreement of staff • Good communication • Introduce consistent methodology • Improve monitoring • Knowing your subject team very well – their strengths • Introducing new systems and consistent processes Other interviews confirmed all of the above and that the PT is 'incredibly well organised', 'really on the ball so she knows what is coming up before it happens', high expectations communicated in department handbook and professional development review (PRD) process and CPD expectations, has developed leadership capacity within the team by providing opportunities for responsibility and whole- school roles.
School A	Maths	• Largely by example • Work hard, take the toughest group etc. • Collegiate leadership – lots of talking & conversation This was all confirmed in discussion with the staff team, who emphasised his approachability, hard work and ability to maintain outside links. Proactive in undertaking additional action research work for NCETM – just about to start a project about understanding misconceptions and just completed a project about encouraging girls into A level.
School A	Science	• Lots of collaboration, departments meeting, cross department meetings • Support, high expectations, availability and approachability confirmed in discussion with other staff and through observation – how staff approached him with 'quick queries' in the corridor etc
School D	Maths	1. Collaborative CPD 2. HoF does non PM observations and gives feedback and then teams colleagues with the same issues to work together. 3. In house training – very little external training; very occasional outsider comes in. 4. School staff development web site 5. West Mid consortium of school share some cpd.
School C	Science	Conversations. In science he is constantly in and out of others' lessons and quickly sees issues. Believes in a team spirit, good relationships between teachers and early advice and support.
School I	Maths & Science	Leadership style: Maths leader more laid back than Science! But few differences. Main method is constant informal monitoring. Seeing, observing,

		talking. Very early intervention should anyone not be seen to be failing. Always demanding of more from teaching staff.
School E	Science	Can be authoritative if necessary, but generally looks to a collegiate model of leadership. Feels he listens to all points of view, but there is no doubt that he makes the final decision.
School Q	Maths	• Hard work and leading by example. • Great team of young, energetic ambition teachers • Have been able to appoint teachers who fit into the team • Great team spirit and ethos. QA rigour, lots of observations. Also quite clearly, she uses Charisma to great effect. Was about to be filmed by Welsh Standards Unit.
School R	Maths & Science	The departmental leadership is very collegiate, based on constant exchange of information, being in and out of each others lessons and so on. Observations take place regularly both by peers and from SLTs. There are regular meetings and communication is two way. The essence is that there needs to be a climate of support not fear.
School G/School H	Maths & Science	There was a marked similarity of approach from Trust senior management through school heads, middle managers to pupils. This was based on respect and leading by example. The CEO told of asking the (unreformed) teaching staff to take Saturday maths lessons and being met with a blank refusal, so he ran them himself until the staff came on board. Much was about self discipline and self knowledge, letting staff and pupils take responsibility for their own progress.
School B	Maths	The HOD was very clear about what he had done to enable this. He had set very clear expectations, in team discussions as a whole and in individual meetings as a whole. His team said that he is also efficient, works hard, provides structure, 'helps you to survive' and makes decisions (this comment was contrasted with the teacher's experience in training where 'no one would make a decision'). Consistency in behaviour management was underpinned by support from SLT if needed. The HOD has ensured that common schemes of work are in use, with a clear outline of exactly what is to be taught and when. He has supported teachers individually in planning and they also work together to plan. A department handbook was produced, so that systems and processes were consistent and transparent.
School F	Maths	Very soft and subtle. Leading by example, open doors and deep communication. They want teachers who will be honest and open about strengths and weaknesses and who are part of the team. They demand a lot and give a great deal. M stated that creating a team was her principal aim when she came in to the school.

Management style
Primary

School P	Maths	CH uses teachers who are well trained and who are interested in child development as a whole Most new teachers come from Glasgow University which has a course that trains Catholic teachers – almost all the teachers that are appointed are newly qualified and well trained CH mainly appoints new teachers from the uni Data is entered in an LA tracking Data Base, which enables detailed tracking to be analysed. Results can be tracked by gender or particular classes or by areas such as measurement, shape and space etc. Detailed percentages show how much pupils are progressing (or not) in each area and between each of the Standardised Tests at 7, 9 and 11 Planning is important but it is not too prescriptive; teachers are given 'autonomy with accountability' – they have flexibility CH mentions core mathematical concepts that have to be taught but application is key There is very little teaching to the test The children are relatively well off; the school is in a relatively affluent catchment area although the school is not full Max class in Primary 1 is 18 At higher stages it is 33 There is a lot of emphasis on formative assessment. Children meet with teachers individually or in small groups – such meetings happen at least once a week – where they identify targets and individual learning goals LL (the new maths champion) and CH thought there were a number of factors that were important in the continuing progress/development of maths: 1. It is a very reflective school – both pupils and staff are encourage to continually re-appraise their teaching and learning 2. The LA review and the action plan that it resulted in (this was compiled collaboratively between LA and school 3. The tracking system – time consuming because it is detailed but thought worth it 4. The introduction of a teaching method devised by Dylan Wiliam called Tapestry – lots of formative assessment 5. Very supportive parents – they want their children to have a 'rounded' education 6. The culture of the school (see below) which is one of high morals and respect for each other. The is also a culture where everyone (pupils and teachers) feel that they can ask other colleagues for help/support 7. Opportunities for CPD – every teacher has to attend 35 hours of CPD a year – can choose what they want to do 8. A good management structure. There are department meetings every week between the lower and upper school, lasting about 50 mins. These happen while HT takes assembly by herself. There is a SLT of the HT, DH and the Principal teacher 9. Cluster group system (see details elsewhere)– this is

		supportive but not as tight as the one at School O (see below) 10. Peer observations – these happen around once a month – staff have a chance to observe good practice from other teachers 11. SLT also observes teachers – this is part of the quality assurance and issues are picked up. Recently they have realised that the school needs to develop formative assessment and do more work on teachers asking better questions 12. The school is well resourced
School O	Science	Covered above AG put down the development of science teaching to: 1. Curriculum for Excellence (teachers found it challenging at first but now really liked it) 2. The cluster group – very tight and supportive 3. Time given by HT for staff development, including staff time where AG can lead on science 4. Good management system (HT, DH Principal teacher) Tracking
School J	Maths	Covered above – we are creative with our time for inset outside staff meeting time, Debbie has run bespoke sessions just for 5 teachers, say on fractions. There is a maths team of 5 teachers, which meets once a term, and messages from these meetings can be fed back into their Year group meetings. Debbie is currently helping 2 teachers each week – they came to her and asked for help One of the key reasons for staff development is that the school has a culture where the pupils or the staff do not have a fear of failure – there is always someone who is going to be better than you at something so if you need help or advice ask and we will provide support and guidance in real, practical terms. There are no judgements of failure, the ethos is to support. DW also makes the point (covered above) that the school does not have subject leaders, it has subject teams (or 5 people) and this is where the collective expertise resides. Therefore the effect of one member of staff leaving (say the subject leader) is ameliorated
School J	Science	We sat down as a science team (consists of 5 members) and looked at each other's planning and saw there was too much teacher doing and not enough children doing. I reported this back to the SMT and began to focus my monitoring visits on looking at SC1. Asked for staff meeting time (they had 3 – 1.5 hrs each) and did also did demonstration lessons that teacher watched, some of them during staff meetings. We made the staff meetings interactive and gave them loads of ideas. They enjoyed them and it made science fun. We had books like '5 Minute Investigations', which was very useful. We showed the staff that science could be fun and quite easy to teach, we took away the worry of changing practice

Management style
Colleges

College 4	Maths	• Leads by example eg always takes a difficult group • Listen to staff • Consult widely with staff at similar level.
College 1	Maths & Science	• Work hard • Support and help staff • Lead by example • Work with staff in collaborative way
College 2	Maths	Very informal style. Leadership based on lots of contact with teaching staff. Very hands-on – has a nearly full teaching timetable.
College 5	Maths & Science	• Shared vision approach • Hands on • Staff need ownership of initiatives
College 3	Maths & Science	Need to empower staff and allow them freedom to inspire. Non hierarchical style.
College 7	Science & Maths	Doesn't like the word manager; sees herself as an 'enabler' supporting the experts, who are the teachers. She leads on curriculum change and policy matters and supports staff in their jobs.

High performance
Secondary Schools

School M	Science	One that punches above its weight. Ie does better in attainment than 'expected' to. Exceeding targets even as bar gets raised. Other high performing schools are those where difficult social catchments may not get such good results, but they exceed expectations. Could be a reduction of exclusions, for instance. Not just exam results. They do attainment analysis cf other subjects and across authority. So constantly monitor attainment.
School L	Science	Having large numbers of enthused pupils (numbers matter), results (you have to deliver) data analysis of Chemistry cf other subjects in school.
School L	Maths	Every pupil should have the opportunity to achieve their full potential. So high achieving school sees the most pupils fulfilling their potential.
School N	Maths	• Give pupils transferable skills & high order thinking skills • Deliver results Interviews with other members of the team confirmed a broad view of performance 'every pupil reaching and exceeding their potential, at whatever level, students are problem- solvers and able to apply their learning General consensus that 'everyone wants the best for the pupils'
School A	Maths	• Attainment across the board (ie not just high level) and a focus on each child as an individual

		• Providing a passion for maths • Inspiring a generation of mathematicians • Confirmed that these values are held by all in the department
School A	Science	• Regular observation of teachers • Outstanding T&L • Students encouraged to always do their best and treated as individuals, all students not just the higher attainers • Having more choice of course means being able to get right level (ie single science, double science, triple science)
School D	Maths	Quality of teaching that is good or better in Ofsted terms. Enabling all students to progress to their best.
School C	Science	Results and achievement. This is what matters. Also values a close working team, good quality teaching and learning and engendering enthusiasm for science (as reported in *pupil voice*).
School I	Maths & Science	Very achievement oriented. Results, early achievement, hard work, pushing everyone to achieve their maximum. However, taken with other responses it is clear that this is a means towards educating mathematicians and scientists. So early achievement of GCSEs is to allow pupils time to study non-syllabus and more challenging material.
School E	Science	• Good progress from all pupils, not just the academically able • High levels of pupils opting to take science subjects • Range of extra curricula activities eg clubs, outside speakers, visits.
School Q	Maths	Within context, does feel they are high –performing. • Good results given little encouragement form home environment • Good quality staff • Exceptionally high expectations for everyone, regardless of level • A very good relationship with children • Pupils who want to progress • Use data to facilitate early intervention • Can react very rapidly to problems • Motivated leadership
School R	Maths & Science	They both listed the factor they felt mattered and insisted that it was the whole package that made the difference not just one element of it: • Inspirational Principal and SLT • No Blame culture • Departmental Action Plans linked to school action plans • CPD linked to Action Plans • Very open to listening to problems and sharing good practice • Observations both peer and by SLT • Implementing new curriculum

		• Trips to science centres, STEM events • Excellent career guidance linked to all subjects • After school science and maths clubs • Close contact with parents • Individualised target setting and monitoring coupled with early intervention which starts with the parent • One-to-one numeracy programme provision • Mentors for under-achievers • Start GCSE classes a year earlier than most schools. In maths Martine cited Malcolm Swan as her overriding influence and inspiration.
School G/School H	Maths & Science	• All teachers are good • High expectations for every pupil • All pupils achieving at least their target • Staff prepared to go the extra mile to make it happen • Non threatening environment – again staff and pupils • Pupils show enthusiasm • Displays are fresh and ever changing • Range of extra-curricular activities, clubs, visits etc.
School B	Maths	• high performance was seen as helping all to achieve at or beyond their potential and to make rapid progress. High performance in maths was about enjoyment and seeing its relevance. The senior leader's view of high performance in science encompassed 'scientific literacy.
School F	Maths	• Results of course but... • Pupils with enthusiasm for maths • Or at least not threatened by maths! • Mathematically literate pupils able to use functional maths in everyday life

High performance
Primary

School P	Maths	See above under Q2. Ultimately this is judged by the grade pupils attain in maths when they leave High School but CH is very keen on the application of maths – they do lots of problem solving which they call active maths; it is work that is challenging. Practising maths is important but only one part. Use/application is emphasised. The pupils have something called outdoor learning. This is part of the curriculum for Excellence. The school takes opportunities to make maths more relevant by, for example, taking the pupils to do vehicle counts, looking a Fibonacci numbers in flowers in the park etc
School O	Science	We concentrate on teaching and learning and meet the needs of all the different learners – differentiation ensures that all learners are challenged and developed. (The cluster looked at setting across and within classes but have not come up with an end of year grading/assessment yet: this has been put on the back burner for the moment.) We judge performance in terms of staff

		confidence and the links with other curricular areas such as maths – no hard data for science. No standardised test for science – only maths and language. We also ask some children for feedback and they are enjoying it. Teachers also record pre and post skills and knowledge when working on a new topic and enter this onto a tracking data base – so these are internal assessments/ Also science staff talk at cluster group meetings and compare what pupils are doing and how they are performing. See the three-coloured system of assessment at School P. The HT showed me on her computer. It looked impressive but it was noticeable that whole classes (all the pupils) were generally in one colour only
School J	Maths	We know our performance is judged on numbers or L4s and L5s and we want to be in the top 20%. High performance is all about children's understanding – they can get L4 just by learning procedures but I want them to be mathematical thinkers and problem solvers – understanding and application is key. I feel that I may have been too pre-occupied with Y6 results but I think some concepts and skills need to be introduced earlier on. DW is very aware that written answers do not give the whole picture and often do not reveal the maths thinking
School J	Science	High performance is all about children's abilities in carrying out investigations - can they investigate and draw conclusions from what they have found. A high performing teacher is one to can enthuse and give children the skills to investigate. They have to have good subject knowledge but they have to make it fun. There are no end of block teaching assessments. We are currently trialling assessments using a high, middle and low ability child from each Year group and assessing their science knowledge before and after a block (eg on electricity) is taught. – see later as well. RB says he would like to make the assessment as close to that in the early years foundation classes, where it is mainly based on observation of processes.

High performance
Colleges

College 4	Maths	• Performance indicators ie success & progression rates • Reducing staff turnover • Reducing fear of maths and replacing with enjoyment • Good, clear student-centred T&L
College 1	Maths & Science	• Allowing students to select the right course for them. Good advice and guidance and interviewing all students. If they select the right course, then they will be more motivated, will not drop out and will succeed.
College 2	Maths	Clearly results – qualifications gained, particularly A level, and retention. Also enthusiasm for subject, having a wide variety of mathematics options and allowing as many students as possible to take the subject.

<table>
<tr><td>College 5</td><td>Maths & Science</td><td>Academically
good HNDs leading to university success
Local business
providing the right training to get students into work
Finding and exploiting apprenticeship opportunities
Wider community
voluntary and community work
Schools link programme
Success in Science Baccs
Sharing resources</td></tr>
<tr><td>College 6</td><td>Maths & Science</td><td><u>Aims & objectives of college:</u>
Develop courses for a) employment and b) university entrance
Achieve highly in those courses

Achieve around 60% for those hoping to go to University and 75% into employment.
Very focussed on these objectives, but finding it hard to engage sufficiently with local employers.</td></tr>
<tr><td>College 8</td><td>Science & Maths</td><td>College has many PIs for all departments.
SL success is results/achievements
Higher courses are all benchmarked to national achievements.</td></tr>
<tr><td>College 3</td><td>Maths & Science</td><td>For her college:
Results in line with minimum targets for colleges ie in excel of 80%
Attendance rates over 88%
Wide offer eg introducing BTEC medical applied science.
College should be recognised as outstanding
I suggested that this was quite narrow, and the reply was that her principal wouldn’t see it like that.

However, also felt that for those on lower level courses, improved self confidence and other soft skills were important, and felt that these should be recorded as well.</td></tr>
<tr><td>College 9</td><td>Maths & Science</td><td>Her idea of high achieving is purely based on outcome. So % A*-B GCSEs, success rates, attainment, completion, attendance etc and how they do relative to other colleges.

In the recent Learner Outcomes Report from the Welsh Government NPTC was the best for Maths and Science of all 21 Welsh colleges. She has records of progression to University but not for the GCSE group who essentially disappear into Vocational courses or just leave.</td></tr>
<tr><td>College 7</td><td>Science & Maths</td><td>Not on how many As, Bs etc are achieved. She prefers to look at Distance Travelled, aiming to get everyone to progress, either within numeracy, or from numeracy to mathematics or through to higher level mathematics. This includes an evening class she has started – Maths for the Terrified. Runs a Science festival with speakers and workshops, is constantly looking at new courses a WBL Introduction to Stats for instance to get people to learn and progress from whatever level they start at.</td></tr>
</table>

Teaching team
Secondary Schools

School M	Science	21 teachers in science, all of highest quality who work incredibly hard. Quality of staff is key. If it is for the benefit of pupils, staff always prepared to do it. **In Scotland all have to be graduates in physics and have a one year post graduate qualification**. Mix of staff in terms of experience and age. About half are new to school. Allows for lots of mentoring and sharing of skills and knowledge.
School L	Science	All keen chemistry graduates, a good mix of men and women, ages and experience.
School L	Maths	20 maths teachers, with a mix of ages and experience.
School N	Maths	9 maths teachers with a mix of ages and experience. A good, hard working team. 3 have been recruited in the last four years since the PT took up her post, observation and interviews confirmed that the team as a whole is youthful, have outgoing personalities and good communication skills, are enthusiastic about teaching 'I just love teaching' and about their subject 'I've always just loved maths' and willing to learn. There is a strong sense of shared values and constant highly professional dialogue about students and teaching.
School A	Maths	Wide variety of staff in age and experience, including NQT. Some staff seconded to Henry Newman. Most are not maths graduates although staff interviewed had degrees in engineering. Trainee mentioned with an economics degree who is working on subject knowledge through self study, supported by an NQT.
School A	Science	12 teachers, 8 F/T 4 P/T. 4 Biology, 2 Physics, 4 PhDs. So have good quals but not evenly spread across the three sciences. Staff are experienced, with many being at the school when the HOD took up post, with a few new appointments.
School D	Maths	12 f/t teacher [3 NQTs] 1 GTP Range of degrees most with a maths element but not essential. Mechanical engineer, Economics, Mathematical Science. Want them to have a decent level of maths but must have the ability to teach. HoF can teach the maths but not able to turn a \`non teacher\` into a teacher.
School C	Science	8 teachers and 4 technicians. 1 teacher is a non-specialist, being more a maths person. Others have science degrees and PGCEs – 3 doing those at School C.
School I	Maths & Science	This was a discussion on qualities of first class science and maths teachers: • Need to have absolute mastery of subject & know how to relate to pupils. • Find it increasingly hard to find top quality teachers • Prefer to take untrained teachers. Those form Teacher training organisations seem to concerned with entitlement culture, ie what support can I have rather

		than what do I need to do to contribute to department. • Want teachers who can teach not who 'deliver learning'. • There is a worry from both that teachers gain recognition more easily for what they do outside of classroom. Both were concerned that it is teaching of their subject that is essential and which should be recognised. Just because the boys achieve so well there may be a temptation to ease up and concentrate on other areas.
School E	Science	8 teachers, 3 with Masters quals, 3 NQTs and 2 shares with SLT. A huge mix of experience. All those that teach A level teach to their degree subject, but all teachers asked to do the Triple science course. Are unable to offer Physics as they do not have a suitably qualified member of staff.
School Q	Maths	4 F/T, 1 P/T, + a member of SLT and a TA. Mix of maths, maths and another subject and economics.
School R	Maths & Science	Maths 3 FT, Science 3 FT + 2 technicians. Both the maths and science staff have been at the school for some years.
School G/School H	Maths & Science	Both academies were fully staffed – for the first time in memory. Both heads now happy with the staff in their departments, with a range of experienced and newly qualified staff, including recently appointed PGCEs.
School B	Maths	This is a youthful, committed department of enthusiastic subject teachers. The HOD is in his third year of teaching, trained at BC, where, according to the senior leader, his leadership potential was spotted. He was appointed about 11 months ago, following the promotion of the previous postholder to another school. He is being mentored in his role by an experienced member of staff who teaches part-time in the department as well as being supported by SLT. He did do some officer/ leadership training at University as an Army cadet and thinks that helped to make him aware of the importance of building a team and 'protecting' his team members. He comes from a family of teachers and is a physics graduate. One of the other teachers is a former BC student and was taught by the SLT member. 3 of the 6 full- time subject team are NQTs (one of these as the second year of TeachFirst), one is in training through TeachFirst and the remaining team member is also in his third year and came to the school through TeachFirst. I asked the current TeachFirst trainee if she had been attracted by teaching, or the scheme and she said the former. Not all of the subject team have degrees with high mathematical content. One is a politics graduate and another geography and they teach in key stage 3 only.
School F	Maths	I met the 2 'leaders', D a previous HoF and veteran of 30 years in the school, 3 new teachers all of whom had done their teaching practice in the school and the HLTA. There is, I think, just one teacher I didn't meet. Although relatively inexperienced as a team, they have all positively chosen to work in a challenging environment and have the passion to succeed. Dave explained that 6 years ago almost 75% of his staff were on long term sick leave! He also said that he

		would have retired by now if it weren't for the simple enjoyment of working with the current team of teachers.

Teaching team
Primary

School P	Maths	n/a to primary but teachers all have a PGCE and are well trained. No teacher in the school has a maths degree This comprises of the HT, DH and the Principal teacher. All have been on various leadership courses throughout their careers. LL's was at another school but she said she found it very helpful and was still applying many of the lessons
School O	Science	Teachers have different levels of knowledge and skills and there are opportunities for individual CPD. Two staff have been on a 2 day residential course in science and there is a science centre. Can also visit the secondary school and some NQT will shadow other teachers in the school. One teacher has a science degree
School J	Science	5 members of the science team: one has a biology degree, another a science related degree – I don't feel at a disadvantage not having a science degree. The team meets every term formally but quite a few informal meetings. One is a reception teacher

Teaching team
Colleges

College 4	Maths	Maths dept: Of 7 maths/numeracy staff, 3 F/T, 2 75% and 2 P/T. 5 have maths degrees and 2 engineering degrees. Good range of staff, but teachers have generally done something else first.
College 1	Maths & Science	All permanent staff have maths or science degrees and PGCEs. She does have some temporary staff with only maths/Science A levels. Did have quite a few staff in later career, but after a bout of retirements, has a more mixed staff in terms of age. Did appoint a mathematician last year without a teaching qual, and they did it at Selby. This worked well.
College 2	Maths	About 8 staff, all with Maths (or similar) degrees and PGCEs (mostly school based). Mixed gender, but mostly over 50 yrs old.
College 5	Maths & Science	Across the three departments they have about 40 staff. Most have appropriate degrees or higher (over 5 have PhDs) but others have extensive experience in industry (mostly the oil industry). All but one have a teaching qualification (one is training in house - TQFE).
College 6	Maths & Science	4 teachers with degree level science and teaching quals and one with engineering degree. Most also have industry experience.
College 8	Science & Maths	3 teachers, largely from engineering backgrounds.
College 3	Maths & Science	Maths: GCSE/A level – 32 staff, all with high level maths quals FS P/T & sessional staff Science: 4 highly qualified teachers.

		She noted that overall she is responsible for over 500 staff!
College 9	Maths & Science	All Maths and science is delivered by the same teaching team, whatever the level. She has 19 teachers ranging from recent PGCE students to experienced staff joining from industry.
College 7	Science & Maths	Maths 2 FTE, Science 5FTE (includes sessional staff) thinks Numeracy is about 3 or 4 FTE. Happy to have engineers teaching Physics or Chemists teaching maths.

Was it difficult to recruit staff?
Secondary Schools

School M	Science	Last advert had 35-40 applicants and a strong panel for interview. Though a few years ago would have got 60-70. There are a lot of teachers who do not yet have a full time position. However also get experienced staff who are attracted to the school.
School L	Science	No. But likes to appoint staff on a temporary basis at first so they can prove themselves. Last open advert produced 40 applicants.
School L	Maths	Not at all
School N	Maths	Easy to appoint – of the two interviewed, one had done her probationary year at the school and the other had also done probation in S. Lanarkshire and then recruited to school via the S Lanarkshire 'pool' system
School A	Maths	Not really applicable. They try to 'grow their own' and appoint temporary or training staff. Exemplified by teachers observed or interviewed.
School A	Science	Very difficult recruiting for Physics – easier for Biology.
School D	Maths	Have had to recruit recently. Difficult to recruit. TT is quite quickie and the ads might make people few unable to meet its high standards. Have re-advertised three times to get a field. Frighten people off.
School C	Science	It is difficult, but was easier last year than previously. Dislikes appointing unknowns and prefers home-grown teachers, and has had great success. That said, appointed two teachers in summer and one failed to show at the start of term. Would like to appoint a physics teacher but so far has failed to find a suitable candidate.
School I	Maths & Science	Very hard. Few come up to expectations. Astonished at what trained teachers do in trial lessons. Have particular difficulty recruiting applied maths teachers; there seem to be very few despite fact that top universities regard applied modules as the most important. We should note that School I can offer far better pay and conditions than the state sector but still feel calibre is not there.
School E	Science	Used to be quite easy, but recently become very difficult to find right level of staff. Recruiting Physics has proved impossible and Chemistry is also difficult. Feel they have recruited well, but largely through luck! Feel that teaching in an area of high deprivation does not appeal to the limited number of good

		science teachers available.
School Q	Maths	Very pleased with staff appointed, so happy. Most staff have been known to school, through teaching practice or recommendation. Most important is that they will fit with the existing team. The one unknown was recruited for her data knowledge and has been very successful.
School R	Maths & Science	When the science head went on maternity leave 2 years ago they could not find a good enough science teacher to cover. So they went for an exceptional teacher, who happened to be Geography. She sat in on some lessons and then used the Scheme of Work (which is clearly quite exacting) to great success.
School G/School H	Maths & Science	All agreed that with the enhanced status around an improving school, recruitment was far easier than it used to be. Science: with the exception of physics – and they are currently training up a member of staff internally to help with Physics, the science head felt that it was now fairly easy to appoint good staff. Maths: Much less happy. Thinks finding good maths teachers is very difficult, even with the better status of the school. Are establishing links with a range of teacher training organisations with he aim of 'growing their own' teachers whenever possible.
School B	Maths	No – not hard, but opportunity to recruit from TeachFirst has made a real difference (SLT also made mention of the HOD in English who is also in her 3rd year and a TeachFirst graduate)
School F	Maths	All staff in the past few years have been in the school through teaching practice (and one who was a TA who did GTP). They have other teachers who want to join when there is an opportunity.

Was it difficult to recruit staff?
Primary

School P	Maths	There is a relatively high turnover of staff but CH says it is easy to recruit teachers. About half the staff are either in their probationary year or on one-year contracts. This makes things harder
School O	Science	About 200 people apply for each post. So not a problem. I don't look for a background in science particularly
School J	Maths	We tend to recruit NQTs that we see leadership potential in and we can mould. Some have done teaching practice at School J, others in other local schools that they find out about. More difficult to appoint good people to SMT for maths. Working with Exeter Uni to see if we can recruit more people with maths degrees

Was it difficult to recruit staff?
Colleges

College 4	Maths	Very difficult at present. Finding staff with a maths degree and

		any teaching experience is hard. Try to find staff internally if possible.
College 1	Maths & Science	Lots applications but few of good quality. Physics is hardest, but finding good experienced maths staff is also difficult.
College 2	Maths	Very difficult. Even though city is an attractive place to come to to teach, it is hard to find candidates of sufficient quality,. Luckily staff is very stable and recruitment is rare.
College 5	Maths & Science	Depends on subject – Biology fairly easy, but more industry specific areas very hard to recruit.
College 8	Science & Maths	Finds it quite easy to recruit staff. However prefers training up his own staff. ie having part time staff that can be 'grown' into full time staff.
College 3	Maths & Science	Very easy for maths, both GCSE & FS
College 9	Maths & Science	Most sciences quite easy, but finding good maths and physics teachers is a struggle.
College 7	Science & Maths	No problem at all, though is more flexible than school staffing. Likes engineers who are used to the practical side and people who have worked in commercial laboratories. Finds it hardest to recruit technicians.

How do you set pupils?
Secondary Schools

School M	Science	Do set, but difficult as they do not get all of year group at one time. So in Upper school out of 100 pupils only 40 do class at same time. So can only set the 40 in two groups of 20. However, groups adjusted by gender as well as ability. In lower school has larger groups (80 at a time) and setting is more traditional. All teachers are able to teach any group. Try to ensure that all staff have as varied a timetable as possible Os if a teacher's 4th year class is top ability will make sure 3rd year class has a greater mix of ability. Tends to give himself the most challenging classes to show that he is leading from the front. Use a member of SLT who has expertise in data management, and check classes with him before finalising.
School L	Science	Don't set in first year, but do for year 2. Setting is revisited for year 3 and stay in place thereafter. Staff take a mixture of classes.
School L	Maths	'Broadbanded' to S4 ie sets of 90.
School N	Maths	Set initially on basis of P7 data. NQTs only teach in lower school. Evidence seen at interview of a teacher whose CPD record included self- study to prepare for teaching Higher level ... working through past papers etc.
School A	Maths	Yr 7/8: classes set for English not maths, so top set not necessarily best maths group. Thereafter set for maths by ability (8 classes)
School A	Science	Whole school set for KS3. Set for science in KS4. Year 10: 2 groups doing triple science, 3 doing double science and 2 doing single science.

School D	Maths	Yr7 from just after Oct half term. 7 sets. Start KS 4 at yr9 KS 3 is shared by all in a "fair" way Ks 4 weak teachers in the middle sets; stronger in the top and bottom sets. Match the skills of the teacher to the set.
School C	Science	In Year 7 SLT set classes on received data. SP regards the groups as too big for science (31). The setting can be tweaked at Christmas then again at end of year. SP believes in moving pupils up asap if results justify it.
School E	Science	Pupils set by combined English maths science into two streams, and he then sets for science within those streams. Sometime sets for non-academic criteria eg social or behavioural reasons, gender mix etc.
School F	Maths	Vertically and horizontally. So there is a non-academic banding and setting is limited within that.

How do you set pupils?
Primary

School P	Maths	There are no maths sets. CH stopped it as it was thought to be working and it was difficult to make a judgement about ability. Grouping happens within classes – generally 3 groups per class. There is lots of fluidity within these sets for movement (eg some children might be moved up or down depending on the areas of maths) – yes, a pupil will often be in a different class group, depending on the maths area being studied
School O	Maths	No. Within class setting only – school is too small
School O	Science	No. Not even within class but still differentiate by giving slightly different tasks. Generally teach to the class. Differentiation by outcome.
School J	Maths	Yes in KS2 – 3 groups in Y3 and 4, in Y5 and Y6 we usually have 3 or 4. Every morning for 1 hour. Teachers seem to like setting – I wonder if we should set in Y3. Lots of flexibility between sets – both up and down. We also base some it on how children feel about maths – their levels of confidence. We use optional SATs and APP for teacher assessments to assess which set children are assigned to. We continue to review setting though. Seems to really benefit the high achievers, L5 and above – we had 5 children gaining L6 last year. DW says it is also beneficial for the lower ability groups as they are in smaller classes of 23 (as opposed to over 30) and have two TAs helping. Sometimes the TAs can be a hindrance as they sometimes tell the pupils what to do and discourage them from being independent learners. I observed one of these lessons. It was very good and it was taken by DW, the best maths teacher (quite unusual). The pupils were engaged and enjoyed maths. DW says that within each of the 4 maths sets there are still within set grouping – usually 3 per set.
School J	Science	No. Within class often we will have mixed ability groups but sometimes higher ability children are put together but it depends on task

How do you set students?
Colleges

College 4	Maths	They do a little bit of setting in the University entrance group.
College 1	Maths & Science	Don’t set at all.
College 2	Maths	No
College 5	Maths & Science	Most are not set, but 2 Chemical engineering classes are set by Maths ability and 2 Life sciences classes are set by Chemistry knowledge.
College 9	Maths & Science	Kelly finds it quite easy to recruit staff in sciences such as biology, but very difficult to find good teachers of physics and maths.

Strengths and areas for development of your team?
Secondary schools

School M	Science	Developing: Did major evaluation of lower school science (parents students, other staff etc) which has produced a range of recommendations. Looking to redevelop some materials, parents fed back usefully on improvements for homework, preparation for tests (eg GLO website for all teaching materials as an archive – now give parents access) – holding information evening for parent now. Upper school development challenge is about the new curriculum and qualifications. Intermediate 1 and 2 becoming National 4 and 5. Enormous amount of work needed by June when it all comes in.
School N	Maths	observation and interviews confirmed that the team as a whole is youthful, have outgoing personalities and good communication skills, are enthusiastic about teaching ‘I just love teaching’ and about their subject ‘I’ve always just loved maths’ and willing to learn. There is a strong sense of shared values and constant highly professional dialogue about students and teaching. Developmental areas appear, from the two records seen, to be identified in PRD and to figure in CPD – closely matched to career stage. Eg teacher in second year had developed more interactive materials and end of year exam for the S3 year group for the department and was on both a whole school ICT working group and attended a network group looking at learning skills.
School A	Maths	Very cohesive team that work well together and communicate well. They share common values and a passion for doing the best for every pupils and for maths as a subject – confirmed in discussion with staff, senior leaders and through observation.
School A	Science	St: Highly qualified, highly motivated, committed & professional. Only problem is lack of balance between disciplines. Confirmed through discussion with subject teacher and senior leaders.
School D	Maths	Strength: they are one team and support each other. Work for the best of each other. Give hours of time free to the students and school.

		Areas for dev: greater range of teaching styles and activities for the sixth form. The development of the three NQTs and GTP
School E	Science	Has two excellent members of staff, but the others lack experience and knowledge of course specifications. Hopes to keep staff and train them to higher levels.
School Q	Maths	A great team. Only problem is prone to burn out.
School B	Maths	Youthful, but reflective teaching team, willing to learn and extremely cohesive and hard- working
School F	Maths	As above – young and inexperienced, but passionate and hard working.

Strengths and areas for development of your team?
Primary

School P	Maths	Staff are well trained and understand what is good teaching and learning. It is a very reflective school; teachers are encouraged to ask for help
School O	Science	One teacher has a science background; one teacher attend cluster meetings; one teacher has been on the 2-day residential. But staff also benefit from strong links to secondary school.
School J	Maths	We are not so good at making cross curricula links – need to develop this. Try to link skills to particularly science and geography. Very varied team in terms of their knowledge and skills and their maths pedagogical knowledge
School J	Science	Quite varied – 2 with science degrees, but many others have gained a lot in conference. However there are still a few teachers who are resisting change.
School K	Maths & Science	Free school converted from a fee-paying school. As such teaching styles have been very different, and the focus entirely on passing the grammar school entrance exam. Staff who remain need intensive work on mapping progress and achievement to national standards. It was pointed out that not all teachers WANT the challenge of working in a difficult school. Have to accept that some will opt for an easier option.

Strengths and areas for development of your team?
Colleges

College 1	Maths & Science	Very hard working and highly qualified.
College 2	Maths	Staff are not ambitious. So hard to get them to take on responsibilities or take an interest in innovative ideas or approaches. Very professional and prepared to take however much time is needed with students.
College 5	Maths & Science	Strengths: Flexibility, student focussed, ready to innovate, ready to go the extra mile, put in extra time whenever needed. Weaknesses: Essentially there are a few who are not like that.

CPD
Secondary Schools

School M	Science	Statutory requirement 35 hours per year in Scotland. His staff do well over this figure. Most Mondays there are leadership of learning groups to showcase ideas that work. Most meaningful CPD are ones staff can apply immediately to their own learning. So CPD activities related to implementation of National 4 and 5 is most useful. But also do a great deal of CPD with Primary schools via transition unit. All teaches are peer observed, and he himself was paired up with a PT in English which was a meaningful ad challenging process. Gave idea to bring into science from different subject area. A lot of inter-departmental sharing of courses and expertise. There is some external CPD, but most is within the school. LA courses are very good for NQT.
School L	Science	Usually after school and organised internally. Most effective are those that are most relevant. Eg how to use Smartboards once they are in place, preparation for PT etc.
School L	Maths	Most tends to be internal eg How exam papers are marked, use of technology. LA do good courses as well.
School N	Maths	Do after school courses usually organised in house. If staff attend external courses these are cascaded internally. Most effective are those concerning sharing good practice. Sample records seen were comprehensive and varied and linked to a rigorous PRD process. Includes individual research and curriculum development, writing an exam paper, representing the dept on a whole- school working group, peer observation, networks with other schools with all completed in non-teaching time or teachers' own time (eg conference attended was on a Saturday)
School A	Maths	OTP/ITP programmes In house courses NEI subject staff confirmed that much CPD is inhouse, although they do go out if a course is identified as useful and then share this with the rest of the team – much CPD comes through sharing practice in informal discussion which is frequent and ongoing. Most useful CPD is practical and teaches you more about learning, or show different approaches.
School A	Science	Have done SLC course of Physics for non-specialist teachers. Have been conducting skills audit and looking at CPD to address issues. Offer science learning centre courses as part of the teaching school.
School D	Maths	Show and tell Observations and feedback PM type/review meeting to set targets etc As things come up Not for the head of fac to lead everything.
School C	Science	Tries to get as many staff out to exam specification courses as possible. Currently trying to get everyone on courses concerning controlled assessment. Also getting staff trained in the BTECs.

		Those with leadership ambition/potential do NCSL leadership courses. Does not see much value in general stuff – has to be focussed.
School I	Maths & Science	Very important but it has to be right. What works best are focussed, pragmatic sessions. These may be aimed at classroom practice, or could be specific to a teaching module. Must be focussed on improving teaching. Can and do offer individualised help to specific teachers.
School E	Science	Peer buddying is effective, and most other CPD is in-house. CPD effective if focussed on the issues in his school – national 'handed down' CPD rarely much use.
School Q	Maths	Cpd really important. School always looking to develop leaders and help staff progress. All of team have specific responsibilities and can do training to enhance these. Mixture of in-house/peer support, county-run CPD, external courses, peer observations and SLT observations.
School R	Maths & Science	Do some external courses which are then cascaded, but most is internal and based on the Action Plans. As an example, the Maths Department has recently had an Action Pan on Effective questioning, leading to a 'no hands' approach with only mini-whiteboards used, and a drive on using open questions in maths. She mentioned a staff meeting when the discussion was on whether students get rough time to talk about maths concepts in class. In Science, it was explained that there had been a school wide Action plan on note taking. The start was internal CPD from the English Department for all science teachers. Also have an internal Action research group, currently looking at assessment.
School G/School H	Maths & Science	The federation regard training as one of the key drivers of change. However, with the whole group of schools to work with, most CPD is internal to the group if not to the school. So the Heads interviewed conduct both group and one to one training with members of staff in other schools in the federation. Where training is bought in – from exam boards for instance – it is shared between all members of the federation.
School B	Maths	Most of the professional development in maths is done as a team and he has tried to use as much time as possible for shared working, to support the development and collaborative working of the team. With the two teachers with, respectively, Geography and Politics degrees, he spends time discussing the best pedagogic approach. Content knowledge issues are minimised by deploying these teachers in key stage 3 only, but he believes that wanting to teach is more important than very high subject qualifications. Subject teachers agree that working together and sharing practice has been the most helpful form of CPD and that 3 of them are also working, with BC, on and NCETM project on understanding misconceptions in algebra, which they

		are finding very useful.
School F	Maths	Seemed to be extensive and range from theoretical materials (Blooms Taxonomy was mentioned) through to technological training. All were keen supporters of IWBs and preside the training they had for it. IWB is a central part of the teaching experience.

CPD
Primary

School P	Maths	Sometimes CH will attend INSET and cascade information back to staff Sometimes, CH or DH will attend cluster groups. There is a productive liaison with the Secondary School. Teachers come and teach children algebra There are also opportunities for individual staff to attend LA courses, particularly if they are less experienced. There is the equivalent of a maths advisor called the quality improvement officer Each teacher has to do (not sure what this means) 35 hours of CPD per year and they can choose what to do There seems to be a number of course available in the LA – some are run by private companies
School O	Science	Covered in other answers above– local CPD; residential courses. When the science champion officially starts (in 2013 I think) they will have a 5-day training course and will act as a mentor for the other teachers Each teacher has to do (not sure what this means) 35 hours of CPD per year and they can choose what to do There seems to be a number of course available in the LA – some are run by private companies
School J	Maths	We no longer have maths advisors but Debbie has a role where she trains teachers and they cascade info back to their staff. Have clusters (3-4 schools) and most meet once a term (I don't think they just talk about maths though) See above for personal training Debbie does. Has also produced a video of children working with manipulative materials for other teachers to use and discuss
School J	Science	See above and notes – not much peer observation. We have a cluster of schools for science –once a term there are course for the coordinators run by the Science Learning Network. The person who led science used to attend all three meetings but now we (the 5 of them) all take turns to attend and then they come and feed back to the team. CPD – had 3 staff meetings in the last 2 years looking at SC1 (1.5 hours each). There is also a lot of talk in the staffroom about science- lots of change comes about informally – teachers talking about good ideas and things that have worked in their classes and other teachers want to share these

CPD
Colleges

College 4	Maths	Unlike in the schools, there is no mandatory CPD requirement in FE. CPSD tends to be a) concerning statuary requirements run by LA or FEC and b) Concerned with curriculum or technology and run by department or SQA.
College 1	Maths & Science	Individual CPD needs arise from appraisal process. CPD needs may also arise from lesson observations. CPD is a mixture of college level provision, department level and external. They have training days and cascade from external events.
College 2	Maths	Not much focus on CPD. Staff are not interested, there are few opportunities for doing courses outside of college and what there is is in-house. May need to do some GCSE level courses soon if GCSE re-sits rise on account of Wolf. Very much gained the impression no-one is bothered much about CPD.
College 5	Maths & Science	Budgets for CPD have been hit in recent years, so most CPD is in-house. If CPD comes from outside, then it has to be argued for and done by an individual who can cascade it to other staff.
College 3	Maths & Science	Believes in lots of staff development. The only way to stay on top! Has retrained most of the old Key Skills workforce.

Do you have any support staff included in your team?
Secondary Schools

School M	Science	Do have support staff – just done a class with a pupil support teacher and a pupil support assistant and a 6th year peer tutor. Bring in support based on pupil needs. Both professional teachers and non-qualified teachers eg a maths teacher is also a Science support teacher. Does consider them as part of science department and do plan lessons with them - but admits that perhaps CPD is not as well developed for them. Considers this a possible action point for school
School L	Science	Support staff come from a separate department and follow the pupil. No support staff specifically allocated to dept.
School A	Maths	Not as such. But do have a 1:1 programme for early intervention.1-1 tuition programme, funded externally, was mentioned by one of the subject team and this had been thought to be valuable. Funding has now stopped.
School A	Science	Lab Technicians. All given CPD opportunities and have performance management.
School D	Maths	There are no attached maths LSAs only ones attached to a statement or SA+. Can be creative and if the LSA not needed with an individual might move to support elsewhere. Happens to be for the first time a LSA with a maths qual – this is luck not policy.
School C	Science	Entirely integrated into department. Technicians have their own

		career structure and are also offered training courses.
School E	Science	Has 2 technicians. They are part of the team, attend meetings, are offered CPD and indeed one has joined teaching staff.
School Q	Maths	No
School R	Maths & Science	1 science, 1 ICT. Feels support staff are a crucial part of both science team.
School B	Maths	SLT member says that they have introduced 'graduate coaches' to work with small groups in maths. Also have additional support from psychology graduates working with some students 1- 1 to address barriers to learning.
School F	Maths	There is one HLTA who takes the intervention classes. She was clearly entirely integrated. Zoe used to be a TA in the department before training to become a teacher.

Do you have any support staff included in your team?
Primary

School P	Maths	There are some but I did not see any in the class I observed on 1/11/12
School P	Science	There are quite a few (I saw them in the staff room) but I did not see any in the three classes that I observed on 1/11/12
School O	Science	They work in class, supporting children (eg helping them write out a report). Are not included in training –much of this takes place after school so it is not possible. Did not attend day training either
School J	Maths	Work in class – there is one key TA that D meets with once a week and she feeds back messages to others TAs
School J	Science	Did not ask

Do you have any support staff included in your team?
Colleges

College 4	Maths	Not as part of department, but there are support staff involved in their lessons. Was unclear how effective communication was between teacher and support staff.
College 1	Maths & Science	Support staff are separate, but try to maintain regular communication and coordination with support staff.
College 2	Maths	No
College 5	Maths & Science	4 technicians, who are included in staff meetings and discussions and considered part of the teaching team.

What do your team expect from you?
Secondary Schools

School M	Science	Inspire confidence, not panic under pressure. Staff don't

		necessarily understand how many different things leaser is doing. Need to juggle things so everyone gets what is needed from you. Helping out staff at short notice means they are more likely to help you out in similar circumstances. Need to be organised, make sure everyone knows when meetings are, what the agenda are, what their timetables are, what their targets are..... collegiality is probably the word, You have to take on board their opinions and views, Staff need to be listened to. So it is a collegiate plan.
School L	Science	Support when needed, subject matter excellence, teaching excellence, strategy & vision.
School L	Maths	High expectations, support, leadership & vision, look after their development needs.
School N	Maths	Good leadership, strategic approach, organised, consistent. confirmed by the team as are high expectations and wanting the best for the students
School A	Maths	Clarity, structure, support, approachability. High expectations, modelling the behaviours he expects from the team – all confirmed by his team members and through observation of his own teaching.
School A	Science	Leadership, decisions, take responsibility, support, advice and feedback (observation) approachability, high expectations, professionalism – all confirmed by team member
School D	Maths	To manage, lead, mentor, support, advise and know what is going on.
School C	Science	All the answers! To be organised and on top of all the issues, to know stuff – education and science – and be prepared to support/coach/mentor as necessary.
School E	Science	Everything! Behaviour issues, direction & leadership, set schemes of work, personal support, career development and to be managed as they wish.
School Q	Maths	• Be supportive • Have appropriate knowledge & expertise • Work hard • Take the flack
School B	Maths	Support, approachability, hard work, leading by example
School F	Maths	Leadership, support, hard work

What do your team expect from you?
Colleges

College 4	Maths	• To know how things work • Understand the paperwork • Listen to them and support them • Be organised
College 1	Maths & Science	• Information and decision making • Monitor students and deal with disciplinary measures • Take an overall view of students • A link to SLT

College 2	Maths	To do all administration and policy matters. Team are not interested in taking responsibility, so she has to do everything that is not focussed on teaching.
College 5	Maths & Science	Support & consistency
College 3	Maths & Science	Support & leadership eg bringing in external consultant to look for more improvement
College 7	Science & Maths	Knowledge, organisation, support.

Improving student learning
Secondary Schools

School M	Science	Rigour, structure, organised everything in place so pupils see structure, have timelines in place so know all the lessons through to May. Everyone knows what they are expected to do every week. For pupils it is preparation and good teaching. Being on top of everything all the time. Homework and personal study are also regular, meaningful and regularly marked. Must give feedback reliably and punctually. The pupils see how hard the teachers are working and respond positively. We go the extra mile so good students become outstanding ones. We squeeze that last bit out of them. We have experience to know where they are going to get to and how they can get there. Communicate between themselves on who is performing and not performing, will call parents if homework is not given in or performance is trailing off. Aim for an adult relationship, treat pupils with respect and you will get that respect returned.
School L	Science	Lower school: Hands on practical approach, investigatory techniques. Upper school: Peer marking, data monitoring, study skills, making presentations.
School L	Maths	• Being on the right course • monitoring progress • always ready to help • supported study – after school study sessions often attract 100 pupils • Co-op teachers who can intervene at first signs of difficulty with 1-1 support.
School N	Maths	Good delivery, consistent monitoring, field trips, active learning. Lessons observed showed very good match of challenge to where students were, so that they were engaged and challenged in their learning. Behaviour was excellent and students were comfortable about contributing in an atmosphere of mutual respect and tempered by humour. Very good accommodation for maths, use of ICT in all lessons – those seen also showed how learning linked to what was likely to come up in the external exam for which they were being prepared. Extensive use of

		'pupil voice' to get feedback on the teaching and what helps them learn– via pupil questionnaires (these are on the school website) and class discussion. PT says that they aim to show the students where the maths is going, what it is leading to.
School A	Maths	• Maths drop in sessions • G&T for feeder primaries • UKMT • STEM Cross-curriculum clubs for different ages • 1:1 support in Yr 9 • Field trips • G&T sessions for year 7-9 • Paris study tour • Study session (Yr 10/11) • Celebration of pupil learning and strong maths identity of dept supported through display, pupils mentioned enjoying maths trip
School A	Science	Constructive homework using past papers High quality T&L Multiple pathways (ie range of courses) Science clubs, external speakers, science trips, Celebration of pupil learning and strong science identity of dept supported through display
School D	Maths	1. accessibility of staff for students out of lesson times 2. range of activities used in lesson – discussion, treasure hunts, etc 3. extra support lessons 4. \`Spare\` teaching time in the timetable – used to split groups, extra y11 class, withdraws small groups, extra yr 8 class.
School C	Science	They have a year 7 science club which is very successful. They also have a partnership with a local pharmaceutical company which provided 20 work placements last year, and allows some access to commercials labs. Do try to arrange trips, but do less now because a) hassles of organising and b) students and their families less willing to fork out money for school activities.
School I	Maths & Science	This is muddled up with Ethos discussion: Key is Challenge. The harder the work the better boys respond. Best thing they have done was more to the more rigorous iGCSEs. Results immediately improved. 80% pass GCSE Maths early which gives time to do harder, more interesting topics that may not be on any syllabus. Both Heads see their job as training mathematicians/scientists and the qualifications are a necessity but not the focus. You teach topics which they need regardless of whether they are in the exams.
School E	Science	Does not feel that school is high performing in science. Thinks it has declined in past couple of years, largely because of staff changes. Features of outstanding schools: • Outstanding teachers • Enthusiasm for subject • Good assessment & feedback

		• Understanding of progression routes • Clubs & visits Wishes school had science more as a central commitment, but maths and English are the core of the school. Feels that if the ethos was different, science could achieve much more. Pupils spend less time on science than they did 5 years ago.
School Q	Maths	• Using rich, interactive, thinking activities • Good use of IT/mobile technologies • Good feedback to assessment • Trips/quizzes/county STEM activities • Student voice – listen!
School R	Maths & Science	As noted previously: • Inspirational Principal and SLT • No Blame culture • Departmental Action Plans linked to school action plans • CPD linked to Action Plans • Very open to listening to problems and sharing good practice • Observations both peer and by SLT • Implementing new curriculum • Trips to science centres, STEM events • Excellent career guidance linked to all subjects • After school science and maths clubs • Close contact with parents • Individualised target setting and monitoring coupled with early intervention which starts with the parent • One-to-one numeracy programme provision • Mentors for under-achievers • Start GCSE classes a year earlier than most schools.
School G/School H	Maths & Science	• Provide good teachers • Instil a belief in pupils' ability to learn • Clubs and activities provide wider curriculum • Work hard • Track data • Celebrate successes, all the time
School B	Maths	Consistency was the factor that the HOD mentioned in improving learning for pupils, particularly in relation to staffing, so that classes had the same teacher as in the previous year where possible. It was also clear, in the teaching observed that pupils were being taught very well, with high expectations, challenge, skilful questioning and appropriate and interesting tasks (e.g. good use of a bit of video on the IWB to draw out understanding of conditional probability). In response, the pupils were engaged and working hard. The SLT member mentioned a number of intervention strategies that the school as a whole is using. They have employed 'graduate coaches' who work with small groups of four or a pair on literacy or numeracy skills (he commented that if the economy were better he would perhaps not be able to find graduates prepared to work at a teaching assistant's pay)

		and two psychology graduates to work one- to- one with pupils on barriers to learning (they do have learning mentors, but this is considered more rigourous).
School F	Maths	Stable staff, consistent approach, good enthusiastic teaching, acknowledge success, extras such as clubs and visits (they do a weekend at a maths activity centre). A shared vision from all staff is key.

Improving student learning
Junior

School P	Maths	Formative assessment – very big on this Individual targets for pupils; regular meetings with teachers often on a 1:1 basis (see above) Children have a dialogue with teachers. Flexibility in the curriculum –not too prescriptive The school teaches maths for 6.5 hours per week (out of 25). Literacy is also timetabled for 6.5 hrs so these two subjects take up half the week *Curriculum for Excellence* is very good Maths Review team from LA spend three days in school last May – very helpful Visits from high school Teachers have 3 periods non-contact time a week: one of these is used for planning maths (It's called McCroan time (spelling) as the person who brought this in) Teacher are trusted and given autonomy They have peer visits – sometimes use their non-contact time for this – in order to see examples of good practice Teachers know the individual child and work is differentiated accordingly

Improving student learning
Colleges

College 4	Maths	• Student centres T&L • My Maths software • Refining courses and support classes • Practical maths (eg gardening) • Bringing in a new diagnostic tool for recruitment
College 1	Maths & Science	• Listen to students – student voice is important with regular focus groups and other feedback processes • Assess students very early and aim to hit the floor running. • Have drop-in study • Extra curricula includes: • UK Team Maths challenge • Physics Olympics • workshops for support

		• Mentoring for 1 to 1 help for some students • University support sessions • External speakers
College 2	Maths	Range of courses. They use data monitoring, but not on a large scale. Will review all learners in November and February to check they are settled in and making progress.
College 5	Maths & Science	Inside classroom, insist on very high standards, supported by high quality teaching. Getting them on the right level of course. All students interviewed to ensure they make the correct options. Outside is probably more important: Support for all students, particularly those from deprived backgrounds Main issue is to help them stay in college. If they do, they succeed. <u>Also:</u> Work and industry visits, work placements, opportunities for apprenticeships.
College 8	Science & Maths	Supported levelling workshops. Anyone in whole college can book half hour 1:1 maths sessions. Currently booked 3 weeks in advance. Students ask for them from all levels. SLT disapprove as it is not really economically costed, but FMcM feels they are extremely well worthwhile.
College 3	Maths & Science	Asked about monitoring: Use dashboard/proachieve/SEIS/etracker Monitor attendance/success rates/teacher comments She knows in depth how every student is performing. <u>Discussion</u>: Suggested this was at odds with allowing teachers to inspire and have freedom. She agreed that bureaucracy was impeding good teaching. Feels there is a great deal of box-filling and that teachers are straight-jacketed by expectations. Feels 'old fashioned' negotiated ILPs were better.
College 7	Science & Maths	Mostly a wide range of courses and constant encouragement.

What sorts of things do you do to encourage your students to continue to study your subject after the age of 16 at advanced level and to help them do well?
Secondary Schools

School M	Science	Most stay on anyway. Only loose very small numbers or pupils, and numbers doing science advanced Higher is increasing. Feel it is treating them sell, being organised and getting results, they well like the subject and want to take it further. So no short term sales, just good successful department throughout the school career. Also have good career guidance and students realise that science is an important element for many jobs and university courses. Do encourage moderate students to go further, but

		recognise it as a challenge. Would have support strategies and parents would be made aware of how hard it might be. And will reassess progress half way through first year of higher – may for instance do higher over two years instead of one.
School L	Science	Good reputation throughout school means pupils and parents want to do Chemistry.
School L	Maths	General reputation. Always accept pupils onto Highers, even if they know they will struggle.
School N	Maths	Nothing specific. Other team members said that they believed that if students achieved well and enjoyed the subject they would continue to Highers, subject needs to be made relevant to them, negative image of maths needs to be challenged by offering positive models
School A	Maths	Have recently been involved with a NCETM project encouraging females to go for Maths A level. Do have a problem with people wanting to do A level but not really up to it. Try to encourage anyway. All A level teachers offer extra support after school, algebra the main issue.
School A	Science	Nothing specifically. Feel they do well. Have tried a level 3 BTEC in Medical Science for lower performers, but has not been a success. A level physics numbers good and includes several girls – believe that this comes from the overall approach which treats every student as an individual who can succeed.
School D	maths	1. Early entry in yr 10 for gcse 2. Early start on a/l content in yr 11 – ahead of the game when join into yr 12. 3. Advert in local paper that entry into sixth form is open.
School I	Maths & Science	Boys see these subjects as hard, prestigious, interesting and challenging. Current figures are: 109 0f 139 boys are doing Maths As, 61 are doing Physics AS. 99 of 149 are doing Maths A2 and 54 Physics A2.
School E	Science	Works very hard to encourage students to stay with science – small groups talks, one-to-one conversations, emphasis on employment opportunities of scientists, arrange talks etc. Have option of BTEC (Level 3 Forensic science) for weaker students who wish to carry on with science. Essentially A/A* students leave for surrounding colleges so have to do their best with B students and below.
School Q	Maths	11-16 school – however, the few A/A* students do go on to do further maths at Gower College or Neath College.
School G/School H	Maths & Science	The sixth forms in Schools G & H are only recently established, so the culture of expecting to stay on rather than go to FE is still being established. They feel it is a matter of establishing aspiration and showing pupils that they can achieve. Once one cohort has succeeded, then this

		becomes the minimum aspiration for following cohorts. Very keen to get any pupils that go on to University to come back and talk to current pupils.
School B	Maths	Very small (3 students) doing A level maths – hope to grow this by showing students they can achieve in and enjoy maths
School F	Maths	The sixth form is in its infancy. When the leaders arrived there were 2 pupils doing A level maths now there are 20 and they hope to increase this number rapidly from now on. Improving take up is a matter of improving confidence, aspiration and expectations.

Transitions between phases
Secondary Schools

School M	Science	Transition unit – junior come to school in June. Every 2 years there is a science fair, and feeder primary school pupils are all invited. Get 500 or so to visit the school. Primary 7 science club. This involves pupils from junior getting invited to a series of science lessons after school. Perhaps90-100 come to these out of 250 potential. In April we set feeder schools a challenge to research DNA. Science staff go down with equipment and work at the feeder schools to do practical work with them. Then they visit secondary school for a related lesson. Works very well.
School L	Maths	Have cluster of primary schools who meet regularly to ensure all use same language and methodology. Primary pupils come into school preceding May to work.
School N	Maths	Use the Primary cluster to ensure have similar approaches. Numeracy booklet used throughout the school too to support consistent approach to teaching across the curriculum such as graphs etc, monitored by whole school working party.
School A	Maths	Have a member of dept specifically responsible for transition. Fund a transition project B.C. students lead G&T sessions for primary pupils as part of Young Leader programme
School A	Science	Lots of practical work in Y7 to encourage engagement and enjoyment of the subject ‘the knowledge can come later’
School D	Maths	Very little is done – well over subscribed. As a CTC the admission rules like sibling or distance don’t apply. 30+ primary schools feed TT. No fixed feeder schools There are two induction days for yr 6/7 children. Maths does a 3 hr slot of fun maths. Ad in the paper. Have to complete an applic form and return it.
School E	Science	Very good programme of transition activities. Usual taster days in science, also have primary students into science labs during year 5. However there is no time allocated to this programme and it is increasingly difficult to staff it.
School R	Maths & Science	Difficult given that most who go to the school didn’t wish to ie have failed the Tx Test.

School G/School H	Maths & Science	One reason for looking to establish the Trust primary schools is to build a continuing ethos and approach. Currently they feel that they waste a lot of time in Year 7 bringing pupils' round to the Trust's level of expectation. With School K, and subsequent primaries, they hope to ensure seamless transition between primary and secondary, with physical exchanges between pupils and staff (currently those responsible for science in the primary are teaching in the secondary and vice versa) and they are designing processes to ensure that staff in each school have absolute trust in data – ie to stop the waste of re-assessing pupils when they enter secondary school.
School F	Maths	There is a School F Junior school, which staff said had the most challenging pupils - other primaries were far easier! The maths team teach in the junior school quite regularly and they take Year 5 and Year 6 Maths clubs. The other primaries have a more traditional 'study day' when they come up to the secondary school. There is clearly some way to go in getting the School F junior fully integrated with the secondary school approach.

Transitions between phases
Colleges

College 1	Maths & Science	College meets regularly with about 9 feeder schools. College attends school events and subject days to interchange of students and staff in the summer. There is a dedicated team dedicated to this transition.
College 2	Maths	Tasters sessions, open evenings etc. Every applying student is interviewed.
College 5	Maths & Science	They have many links with secondary schools, including delivering the school-based Science Bacc. Most Higher science students also do their practical work a the College. Most science students are familiar with the college before they arrive.
College 3	Maths & Science	Lots of activity with 14-16 group including: • Taking on the school refusers group • Taster days • Girls only science days • Schools use facilities etc.
College 9	Maths & Science	They have major 'Taster' sessions with feeder schools, with trial sessions for all A level subjects provider for pupils form all 11 feeder schools.
College 7	Science & Maths	Have links with many secondary schools and offer places on vocational courses to them before they reach 16.

How do you see your role in contributing to the development of mathematicians and scientists for the future?
Secondary Schools

School M	Science	Have science back, another qual for STEM students at Adv

		Higher – a separate project done with a local college and university. Also pupils studying physics can do engineering development trust where pupils go to local companies to do design or other realistic projects for business. 3 last year went to Rolls Royce as a gap year, trips for lower school to university and for competitions. Pupils can apply to work with Nasa scientists and Strathclyde........ Also academics, working scientists come into school to give talks to pupils – recently got a high flyer female engineer to talk to the girls in school. Also careers fairs...
School L	Maths	Purely a by-product. Aims to create enthusiasm for maths as a primary aim. All else follows.
School N	Maths	Always stress connections between maths and real life. Importance of relevance emphasised by HT – needs to be relevant to the children in this community, big thrust for improving learning in every area and he believes it is the same for maths and science
School A	Maths	Very much.
School A	Science	Physics teacher believes that there could be more opps for career related activity to show the range of careers that use maths and science, role for policy makers
School D	Maths	Staff are open and discuss with students the value of maths. They keep up to date with maths challenge and univ courses Direct students to the careers dept.
School I	Maths & Science	A very important part of the role and one they feel they are succeeding in. 7 or 8 into Oxbridge to read Mathematics i.e. we are inspiring the boys to want to take the subject to its highest level and giving them the tools, the expertise and knowledge to be able to do it.
School Q	Maths	Despite difficult cohort, she does see inspiring an interest in and potential future employment in maths as something aspired to. Feels trips and external speakers are the key to this.
School G/School H	Maths & Science	I felt (and this is a personal opinion) that the Maths teacher saw her role very much in terms of achieving exams while the science teacher was much more concerned with career structure, and creating a knowledge and enthusiasm for science in general. He was keen on his clubs and extra curricular on getting ex pupils back to talk about their scientific career either at university or in industry.
School B	Maths	Extra-curricular and enrichment has not been a first priority – needed to establish team and get results up first, will look at this next year perhaps
School F	Maths	More concerned with ridding the community of its fear of maths to create a community which can cope with the necessary maths of everyday life and work.

Ethos of school & Department
Secondary schools

School M	Science	Important. Credibility and high standard teaching is part of ethos of school – so how staff speak to pupils, how they dress, are they listening, do they work hard. Ethos is same as Science faculty,

		rigour, hard work, being prepared, respect, doing everything to best of ability. All should have a similar ethos and at his school they do. Objective is to get pupils to fulfil their full potential.
School L	Science	Crucial. New head came in and transformed nature of school. Head works hard, backs up teachers, sets high standards for discipline, has a clear vision for the school and asks everyone to take responsibility for their actions. This is manifest through SLT, PTs and teachers. All sing from the same handbook.
School L	Maths	Department ethos is: Never let a small problem become a big one. School: Only your best is good enough. That applies to everyone from the Head downwards.
School N	Maths	Very important: • Catholic values • Good relationships at all levels • Head is chief role model ' the core of everything we do' according to the HT – shared values about the importance of every child reaching or exceeding their potential, relentless focus on learning and being challenged, listening to the pupil voice, developing a collaborative culture and excellent communication among the staff, across departments and subject areas through X- curricular projects, encouraging teacher leadership to develop new ways of teaching using 'what if' questioning to think about how to do things differently. HT models energy, commitment and constant communication with pupils and staff, highly visible in the school on the day visited.
School A	Maths	Most important aspect: A haven of excellence Everyone will go the extra mile and has a passion for maths Inspirational targets for everyone. Very hard working. Confirmed through interviews with staff team, senior leaders and observation – model set by the HT
School A	Science	Very important. Essentially a catholic ethos of caring for everyone. Teacher want best for every student. Ethos comes through leadership. Confirmed through interviews with staff team, senior leaders and observation – model set by the HT
School D	Maths	School: To maximise student potential – atmosphere, ethos, positivity, achievement, progress, celebration. Students work every where and pictures of their success. Building in good condition – soft chairs in class. Faculty: Head sets the tone that HoF and staff positive and support.
School C	Science	The ethos of the school is very focussed on achievement and aspiration. Very clear that this comes from the Head. Also describes the massive turnaround since this Head arrived. Described Head as working with existing staff and creating structures which support his ethos. Believes key is aspiration – when Head arrived 27% achieved GCSE A-C, he demanded 40% to the disbelief of staff. Now they are over 50%, have a sixth form and improving A level results and University entry. It is a different school.

School I	Maths & Science	Ethos vital. • Aspiration • Achievement • Challenge
School E	Science	Ethos of school is very important. It is set by the Head and SLT and continued through teachers. School specialises in sport, but emphasises maths and English. Science team do their best to lead and promote science, and external speakers and visits are good for this, but feels it is an uphill challenge without more SLT support for science. Staff turnover does not help. A constantly changing set of teachers is viewed negatively by pupils.
School Q	Maths	Feels the ethos is central to the school and is created by the Head and SLT. Need to be a Whole School ethos School moto is: If you believe it, you can achieve it. This leads to a school which passionately tried to raise expectations and aspirations. This is the key to change.
School R	Maths & Science	Both teachers cited the School R Brothers ethos of respect and support as central together with the exceptional Principal. Ethos is vital and is vibrant. It is about Catholic values, support and brotherhood, about no blame, listening and encouraging everyone to achieve their maximum potential. As an example, the maths teacher took a year out to teach in the South and noted the lack of autonomy in Southern schools. She described much of the teaching as babysitting. The Science teacher told how when she arrived at the schools she only knew about shouting at pupils to keep them in order, as that was the rule in the schools she had taught in. No one shouts at DLS. That isn't how things are done. Ethos is central and the Principal is what makes the difference.
School G/School H	Maths & Science	There was much discussion about what was ethos and what was vision! The vision is: *"To be Britain's highest performing Federation, where customer and community needs are met, students are happy, successful, and reach their full potential".* However, it was agreed that the ethos sits behind this, the desire to make the schools of Luton better and help children achieve their potential. Asked about the motivation for continuing to increase the Federation, the answer was that they wanted to take away the 'blame culture' that suggests that poor schools are the fault of poor children, allow all children progression routes which they can succeed on and in doing that lift the whole local community. All agreed that one of the keys to the success of the group is that every teacher in every school is familiar with this vision and is working to make it happen.

School B	Maths	Ethos was considered by all to be very important. The SLT member, who has worked in a number of schools, believes that the main reason schools are poor is because they lack an ethos which supports learning and achievement. He also believes (as a non- Catholic who has worked in Catholic and non-denominational schools) that in Catholic schools there is 'more a sense of community; High expectations, matched by high support, are at the heart of a good ethos. The role of the Headteacher was recognised as vital in setting the ethos for the school – both she and the SLT member said that the subject leadership role was similarly vital, to promote the outstanding T&L needed to improve.
School F	Maths	They would call it vision and it was a rare example of the maths team being clear of their own vision regardless of the rest of the school. All teachers sharing common and coherent aims was a central part of M's plan to turn round the department.

Ethos of school & Department
Junior

School P	Maths	It's a Catholic school where we have mutual respect for each other. Like the children to be happy. It's not just an academic journey; we have a wider, balanced, curriculum; concentrate on teaching and learning in general CH said that when maths teaching was too prescriptive (under the 5-14 initiative) she saw some teachers lose confidence – see earlier re morals etc. It has a distinctive atmosphere – they really work on manners and making people feel welcome
School O	Science	We have engaged learners and there are no disciplinary issues; we all help each other; pupils and teachers do not feel that they are ever placed in a position where they can fail; always looking to improve; emphasise self reflection and evaluation; lots of support available; people can always ask for help. So a supportive ethos where teaching and learning thrives
School J	Maths	School motto is *excellent and enjoyment in a learning environment*. Focus is on learning –ongoing – for children and for teachers/TAs – continuous improvement- use each others expertise – learn collaboratively
School J	Science	Science is fun; skills rather than knowledge; lots of experiments and the aim is to get the children to inquire, find out for themselves. Moved away from steering the children down a route whereby they carry out experiments where we know what results they will get. We will let them take risk and devise an experiment where we don't know what they are going to find out – its about teachers having the confidence to let them do this

Ethos of school & Department
Colleges

College 4	Maths	• Inclusive • High quality learning • Encourage ownership of learning (taking responsibility) • Ethos is led from the top.
College 1	Maths & Science	• Right Student, right course • Every student should have an opportunity to gain a good English or Maths GCSE. • Need all staff on board, both senior and junior.
College 2	Maths	Maths department has a very academic ethos. Much more like a sixth form college. They have pioneered acceptance of a more academic feel to college eg now have an A level faculty. Feels this is important, for parents as well as students.
College 5	Maths & Science	College ethos is of high quality teaching and learning. Also have the phrase: We expect respect. Feel this links to the CfE emphasis on responsibility.
College 8	Science & Maths	Ethos of excellence. Achievement is 17% higher than national average, and it counts. They get 1000 applicants for 300 places.
College 3	Maths & Science	Very important. Have developed formal visions and value statements, from bottom up. Servicing the 'community' an important element. Students involved in agreeing ethos Feels that ethos helps to retain staff However also commented that when ethos is disseminated back down it doesn't always feel the same as it did on the way up.
College 9	Maths & Science	Ethos is similarly outcome focussed – students should strive for maximum potential. The ethos derives from the Strategic Plan and is disseminated downwards by SLT. However, in turn SLT do take account of the Learner Voice, so there is a bottom up side as well.
College 7	Science & Maths	Ethos of College: High quality learning for the needs of the community – it is the last bit that is important. Ethos of Dept: Increase numeracy and mathematical ability for all students. This is led by her team and only succeeds if the team are fully behind it. They aim to have no barriers and no exclusions and allow any student onto any course. Even those on non-science courses with decent numeracy are encouraged to gain at least a level in numeracy or maths during their time at college.

Support from SLT
Secondary schools

School M	Science	A great deal of support from HT and SLT, especially when new to school. Faculty is recognised as high performing, so get a different type of support from other faculties. Now challenged to raise the bar ever higher. Each year we exceed ever higher expectations.
School L	Maths	Very good support for department.

School N	Maths	Organise teacher observations, support discipline, assist provision of CPD to meet career aspirations high expectations around shared values,
School A	Maths	A positive and continual dialogue with SLT. They don't interfere!
School A	Science	Has a good relationship and finds them supportive. Suggests best to go to SLT not with problems but with suggested solutions.
School D	Maths	They Set Targets: Personal Targets; Faculty Targets Gave extra staffing [a little extra in English but not as much] Head is hands off.
School C	Science	Has a direct 'Link Manager' to SLT. But is generally left to get on with it. Very aware that if things start to go wrong, they will let you know. Feels his concerns are listened to. However, overall has a very good relationship with SLT.
School I	Maths & Science	Academic leader commented that departments are run as mini-fiefdoms, focussed on their own area. They set the structure, the ethos and provide the resources. They will ask questions, changing focus making sure all areas are covered. That done, they largely leave you to get on with it unless there are problems. Where departments fail to come up to expectations SLT will intervene strongly and rapidly with regular monitoring, meetings,
School E	Science	Does not feel adequately supported – see below
School Q	Maths	• Very helpful. • Supportive of new ideas • Meet every two weeks.
School R	Maths & Science	Not explicitly talked about, but clearly SLT is very supportive. The decision to have science as a compulsory subject when this would probably have a detrimental effect on the school results is an example. Also both talked about the inspirational quality of the Head.
School G/School H	Maths and Science	The key is openness, honesty and transparency. SLT are constantly looking at all teaching across all the schools, and are ready and able to respond to any need. There seems to be little in the way of onerous over-view, although SLT organise all observations. It was pointed out that decisions are reached very quickly. If a change is needed, change it now.
School B	Maths	Very supportive – teacher said 'they will always find time to have a chat'
School F	Maths	Although I didn't ask, it was clear that the Maths team worked with great autonomy perhaps because they were equally perceived to be an outstanding department within the school.

Support from SLT
Colleges

College 4	Maths	Works as a team. Aim to have distributed leadership; so SLT looks at the strategic while CM makes sure everything works properly at the departmental level.
College 1	Maths &	Good support and communication. But does feel she has a

	Science	voice.
College 2	Maths	Generally OK, unless they need more money!
College 5	Maths & Science	All are new to roles, but there is a good process of meeting with SLT in a constructive way. Feel they do have a voice.

What might the senior leadership team do to help you do your job as subject leader even better?
Secondary schools

School M	Science	SLT expect same as your staff – whatever asked to do, done to best quality you can, lead by example, set high standards etc. Ethos can be applied to all groups
School L	Science	Nothing – they are very supportive
School L	Maths	No, it is excellent.
School N	Maths	No
School A	Maths	No
School A	Science	No
School D	Maths	Extra time so can do less teaching to lead the faculty.
School C	Science	Not really
School I	Maths & Science	The science leader commented that all pearls need a bit of grit, and SLT provide that.
School E	Science	Curricular time for science reduced in KS4, leading to reduced practical work and less teaching time. As well as problems with science staff turnover, SLT has also had a great deal of turnover, which 'has not helped'.

What does the senior leadership team expect from you?
Secondary schools

School M	Science	Feel very well supported by SLT. Just need some more time!
School L	Maths	Subject expertise and organisation
School N	Maths	High academic standards, and meet targets
School A	Maths	Just the wider picture. Derail left to dept.
School A	Science	Maintained standards
School D	Maths	SLT: Do the job and maintain standards – get to Outstanding
School R	Maths & Science	Sees Principal once a year and has to justify herself in a 4/5 page document.
School G/School H	Maths and Science	Flexibility, achievement and enthusiasm. The sense of a real team did come through very strongly.
School B	Maths	Recognition that continuing to improve GCSE results essential for this turnaround school
School F	Maths	Continued delivery of improved results.

What does the senior leadership team expect from you?

Colleges

College 4	Maths	That the department delivers as expected.
College 1	Maths & Science	Manage staff and get good results. Keep accurate data and use it appropriately.
College 2	Maths	A great deal. Far too much in the way of data and admin, so it gets in the way of teaching. Hard to spend as much time with students as she wishes and respond to demands of SLT.
College 5	Maths & Science	Job done. Left to it essentially.
College 8	Science & Maths	Achievement – all PIs met, national benchmarks met. Works as a business. If there is no demand for a course they don't run it.
College 3	Maths & Science	• To know the detail about everything • Monitor all challenges across the school • Motivate staff • Drive up standards.

What do parents expect?
Secondary schools

School L	Maths	That pupils receive a consistent experience, regular homework, enjoyable teaching.
School N	Maths	Enough information at the right time from teacher interview, they also expect to be listened to, for their children to be taught well
School A	Science	Listened to and able to respond
School D	Maths	Parents: High standards of teaching and good progress in a sympathetic environment.
School F	Maths	The answer to that is probably far too little. Dave talked of teaching the parents of his current class and they hated maths and were afraid of it too. Raising parent expectations is the next task fro the team.

What do parents expect?
Junior

School P	Maths	A rounded education – both parents and their children have high expectations. The children are articulate and have good vocabularies
School O	Science	The parents are supportive, although there is a very varied cross section – some are very poor
School J	Maths	Parents are supportive but some vocal ones (a minority) moan there is too much homework – 45 mins per week for maths. DW is not convinced about the benefits of homework, think it should be for consolidation only

What do parents expect?

Colleges

College 4	Maths	Success – only really see parents when something goes wrong.
College 1	Maths & Science	Doesn't feel that most parents are aware of her management role. Only if there is a complaint of some type.
College 2	Maths	Parents are aware of her role and do know her and seek her out, both for complaint and to thank.
College 5	Maths & Science	Only really engage with parent when there are problems.

What do students expect?
Secondary schools

School L	Maths	Consistency and fairness.
School N	Maths	Someone to go to who will listen to them. From interviews, to be listened to, to be challenged and to enjoy their lessons.
School A	Maths	Respect and not to be put down for being wrong, they trust the teachers to do their best for them
School A	Science	Listened to.
School D	Maths	Good teaching and support.

Partnerships/networks
Secondary schools

School M	Science	PT Physics network run by LA 3 times a year. Opportunity to find out what is happening in other schools and sharing information. Have good links with other schools on a more informal way, including sharing staff.
School L	Science	PT Network in LA.
School L	Maths	PT Network in LA. Meet termly to discuss shared issues Transition clusters (as above)
School N	Maths	• Transition cluster • PT network in LA • Education Scotland • Cross school networks involve other teachers in the dept too.
School A	Maths	Lots mentioned throughout interview.
School A	Science	Lots
School D	Maths	There is a family of schools and they share CPD activities and share ideas.
School C	Science	They were part of a group of school 'under' a Grammar, but no longer feel they gain from this.
School E	Science	Is part of a network of academies, the LA has been disbanded. When LA was still operating, heads of science use to meet regularly. There is an opportunity for the Head of science in the academy to meet, but they don't. Feels other school in group are too different to make meeting useful. Thinks the Academy

		group may be useful at SLT level but not at Head of Dept level.
School Q	Maths	Meet as a ‘Family’ once a term to share good practice. Finds these important and motivating.
School R	Maths & Science	There is some cooperation between community schools with sixth forms across the board area. Also recently attended a careers event (CEIAG) at local integrated school
School G/School H	Maths and Science	The federation aims to create a genuine family of schools. The Head of maths knows all the maths teachers in all the schools as odes the Head of Science. There is competition and cooperation between departments across the schools, shared CPD, sharing of staff and expertise and good practice. The federation is an very active, very tangible participatory network for all. Interestingly when I asked the Heads of department if they worked for their school or the federation they both instantly replied the federation.

Partnerships/networks
Junior

School P	Maths	Yes, strong – covered in other answers. All the schools in the 5-school cluster group at RC
School O	Science	Yes – very strong links (cluster schools, including secondary– see above
School J	Maths	Yes – cluster group – see above

Partnerships/networks
Colleges

College 4	Maths	Have formal links with local schools. Visit and explain courses etc
College 9	Maths & Science	Clearly has a good relationship with 11 feeder schools.
College 7	Science & Maths	Didn’t discuss explicitly, but clearly have well developed links with a range of local schools as well as other Colleges and HEIs through the University of the Highlands.

What do you hope to accomplish for your subject area in the next year at this school?
Secondary schools

School M	Science	Implement changes arising from the evaluation review process.
School L	Maths	Continue getting pupils to full potential
School N	Maths	Continue seeing pupils results improve Give even more pupils opportunity to do well in maths
School A	Maths	• 90% A-C • Meet the needs of every child

		• Obtain more higher grade GCEs – not satisfied with a C, need more As and Bs. • Excellence at every level
School A	Science	Continue improving numbers and grades of Triple science and A levels.
School D	Maths	100% GCSE C+ in mathematics – target from the headteacher. Hit the target grades for all in A/L
School C	Science	Aim to introduce triple science and BTEC Level 3. This will increase the choice of science subjects, so more pupils will find a direct fit to their interests/ability. Would like to introduce A level Physics.
School E	Science	Manage GCSE changes, continue to improve T&L and keep building on successful results.
School Q	Maths	• Wants to get GCSE A*-C above 50% • Introduce new courses BTEC L2 and Entry Passways (?) for EL. • Evaluating introducing November entry of exams. Embedding Numeracy at Work • Hopes to be first Welsh school to achieve Excellence in Mathematics.
School g/School H/School K	Maths and Science	<u>Maths</u>: • Achieve exam targets • Qualify as ASD <u>Science</u>: • Get new curriculum leader trained up and up to speed <u>Primary school</u>: • Get the school running as planned asap <u>CEO</u>: • Add four more academies to federation • Hit all budgets.
School F	Maths	More of everything; to break through 60% maths passes, more A level recruits, more enthusiasm for maths from all pupils, more expectations from parents.... Getting parents involved is an emerging issue at present. Z & R are going to focus on improving independent learning by pupils over the next year.

What do you hope to accomplish for your subject area in the next year at this school? Junior

School P	Maths	See earlier Maintain and improve pupil attainment and engagement Need to develop formative assessment and better questioning from teachers
School O	Science	There is a curriculum review of science in Oct and Feb and I'll see what issues need to be addressed and see if any staff want and need any CPD. We need to do more work on assessment so I would like to develop this. I want the teachers to be able to really assess children's knowledge and understanding and how to

		record this in a meaningful way. Teachers need to establish where children are at the starting point as well as at the end.
School J	Maths	Want to develop more cross curricular links but our first priority is to review our calculation policy – learn so much working at a National Level with NCMT – looking at algorithmic calculations including use of manipulative materials – eg Diennes Blocks (influence of other countries like Japan and Singapore). How do you measure if it's succeeding?? – trialling assessments with Y3 pupils. Before teaching with manipulative materials and then after to see how their thinking has developed. We have pupil conferencing and ask them how they worked the sum out? We need to do more of this type of questioning in the general class teaching
School J	Science	Gone a long way in embedding SC1 across the school but assessment is our next big push (see above). Some of the best assessments happen in the Foundation Stage and KS1 and we need to spread this practice. One of the science team is a reception teacher. More difficult to assess SC1 with pencil and paper. The piloting techniques include releasing teachers to work with a small group to ask them what they know in an in-depth way. But has resource implications. Good to use small groups as representative samples though. Have also been trialling the use of cameras. Entered for the PSQM = Primary Science Quality Mark at Silver.

What do you hope to accomplish for your subject area in the next year at this College?
Colleges

College 4	Maths	• Successful introduction of Curriculum for Excellence • Improve use of IT in delivery
College 1	Maths & Science	• Be better. Keep students even more motivated, more engaged and better results!
College 2	Maths	No specific aims. Just more of the same.
College 5	Maths & Science	• Getting new structure working • Successfully introducing new CfE qualifications • Support continued expansion of apprenticeships
College 9	Maths & Science	Her aims for the coming year are to see NPTC as the first choice for A level maths and science students in South Wales, to be the best learning provider in Wales and be viewed as a leading college for Teaching and learning.
College 7	Science & Maths	Just the challenges!

What are the main challenges you face in the next year or so?
Secondary schools

School M	Science	New qualifications.
School L	Science	New qualifications. But we know the challenges from previous changes. Are well advanced in preparations.

School L	Maths	Introducing new qualifications
School N	Maths	Curriculum for Excellence implementation PT believes that this has been both a help and a hindrance to improvement – very bureaucratic, but it has released resources for schools to use in curriculum development and CPD
School A	Science	Changes suggested to GCSEs
School D	Maths	Managing the biggest A/L group ever – support and challenge. They are a mixed group in ability – all got at least a B at GCSE.
School C	Science	3 new members of staff to bed in, new courses to bed in, new rules and processes for GCSEs.....
School E	Science	The removal of modularity at GCSE is a challenge. So many of the pupils have poor backgrounds, low aspirations and low levels of literacy. Feel it will be hard to motivate them to work towards the one-off exam.
School Q	Maths	Ensuring pupils remain on track.
School R	Maths & Science	Clearly the school has played the qualifications well, going for unitised exams, allowing their marginal pupils to do things a bite at a time, and (in science) preferring multiple choice questions as poor literacy is less of a problem. These options are now being withdrawn and they anticipate a dip in results.

What are the main challenges you face in the next year or so?
Junior

School P	Maths	To keep new teachers in the loop Keep staff (there has been a relatively high turnover) – see earlier – half the staff are either in their first year or are one-year contracts
School O	Science	Nailing assessment – see above
School J	Maths	Same as above and keeping the momentum going and keeping the staff on board – they are busy and under pressure. It's about changing habits and practice. I want teachers to use more links to see how they do maths in other countries
School J	Science	Same as above – best way of introducing assessment; and getting more staff away from this is what we are investigating today and this is how we are going to do it – still got some teachers who say this is the way we have always done it and we don't want to change.

What are the main challenges you face in the next year or so?
Colleges

College 4	Maths	Merging with another college Merging assessment processes & staff New funding processes being introduced.
College 1	Maths & Science	3 of the 8 combined staff are new this year, so it will be a challenge to integrate them.
College 2	Maths	Is worried that Wolf may lead to too much time being spent teaching maths to those who do not wish to do it and have little

		interest at the expense of those who can succeed and progress.
College 5	Maths & Science	Budget restraints. FE receives less money as it is expected to achieve ever more success.
College 3	Maths & Science	<u>Aims & Challenges muddled up:</u> <u>External:</u> Rising of Participation Age. This is likely to reduce the number of students coming to college post 16. Feels the most important thing is to get the offer right for those studying A level. There will be more competition for schools. <u>Internal:</u> Strive to be outstanding, so have to improve results, improve progression and develop T&L. <u>Potential growth area:</u> HE in FE as the college is so much more competitive in price.
College 9	Maths & Science	Challenges include a forthcoming merger with Powys College next year, with all the disruption that will entail, and implementing the Welsh Qualifications and curriculum review which makes the Welsh Bacc compulsory. As I understand it the Welsh Bacc is the opposite of the English Bacc in being the inclusion of soft skills such as Work experience and community practice within areas of academic study.
College 7	Science & Maths	Introducing the new Nationals exams. Feels these qualifications have been focussed on schools and have ignored FE. Nonetheless, is confident that FE will adapt reasonably easily. Thinks new quals are good for science but not for maths, although the requirement for group work is a good step forward.

Is there anything that we have not discussed so far that you think schools or policy makers can do that would help improve the learning experiences of young people in subject?
Secondary schools

School A	Maths	No senior leader and former HOD maths believes that there needs to be a GCSE paper which is just focused at A and A* level and includes the algebra skills needed for A level – too much time is wasted with higher sets in revision for work that is relatively easy for the students concerned
School D	Maths	We are behind other countries in mathematics. Lack of depth in English system. From reception through the teachers don't understand the underpinnings.
School C	Science	Sees relationships as key. Within the department, between SLT and teaching staff and with pupils. New staff need to fit in with department.
School G/School H/ASchool K	Maths and Science	<u>Budgets:</u> The business plan at Barnfield is clearly important. There is a great deal of investment going on (see PPT attached), in buildings, staff and other areas. So where does the money come from? The answer was: • By growing the successful schools. Barnfield West has increased by 30 places this year, which means £150k

		each year of income • Improving college results. Barnfield college is improving its results and so its funding each year and is aiming for 97% retention this year. • More efficiency. Again the college has average class sizes of 19 compared with College norm of 10 • Back office. With all the 'back office' functions of all federation members being met my Barnfield Education Service, they are achieving around 10%-15% efficiency savings. • A happy staff which is not off sick saves money on cover and supply teachers. • They are business oriented on use of facilities. So having improved buildings, they use them more. Luton Football club is using Barnfield facilities several days a week, they fill the buildings with events and groups over the weekends and holidays. <u>Teacher incentives:</u> As well as incentivising students and celebrating success for students, they take the same approach to staff: • Rewards for 100% attendance • Bonus for outstanding observations • Employee of month • Corporate bonus ie fulfilling federation objectives leads to reward, not just school or department. • Staff recognition events They foster both cooperation and competition between schools. So the various maths departments will be competing to see who gets top achievement and the winners will be recognised. The group offers rapid advancement for successful or ambition teachers. The switching of staff between schools for instance provides great experience and the possibility of rapid promotion as established staff take senior roles in newly academies schools. <u>The Turnaround plan</u> When they take on a failing school, what do they do? • Go through current staff and identify which teachers they need to lose • Recruit new teachers who are fully supportive of the Barnfield vision • Move existing teachers to new school • Establish flexible management – need to respond rapidly to the evolving situation • Establish new Training and cpd rapidly • Allow teachers empowerment/accountability/reward • Barnfield has a high reputation and can be used to

		• change pupils and parents attitudes • Establish rigorous data monitoring Pete: Love your staff. They are the key. Even before new staff come on board, they can usually affect large improvements just be changing expectations and aspirations. Finally, the theory is that schools have freedom within a framework. So Trust might state policy of incentives or celebration but schools can decide how to do it. Leaders should have freedom and responsibility within the framework of the federation.
School F	Maths	<u>The Turnaround Plan</u> • Create a coherent & stable team • Create an open, honest and supportive culture • Be non-judgemental leaders • Have an 'open doors' teaching culture • Ask staff to work hard but work harder yourself • Treat staff and pupils as people <u>Data tracking</u> As with most schools, data tracking is an important element (and demanded by SLT). They do assessments after each curriculum topic using the voting technology associated with IWBs and self marking software. This takes about 20 minutes, involves no marking and produces instant results. They were aware that record keeping could take over from teaching and also that focusing on C grade marginals was negative to the rest of the group. They want everyone doing better than others expect. <u>Qualifications:</u> They were very keen on an AQA Applied Maths A level which is in danger of being withdrawn. They found it very positive for maths B and C grades/ It sounded like a Functional Maths variant to me.

Other issues
Junior

School P	Maths	We also talked about text books. They have improved and different teachers use them as they need to. They do not have to The school uses calculators but only when opportunities arise – eg when using real data involving large numbers, decimals etc. (I got the feeling that they are not used widely) CH thought the practising maths was necessary but that application is key. She wants maths to be relevant and challenging – sees the teachers' role as often facilitating and guiding learning. The staff use lots of questioning techniques; particularly open questions. They differentiate questions – in order to do this, teachers need to know the child

		CH wants children to be challenged and to be made to think CH does some teaching herself Thinks the concept of subject specific pedagogy is vital – teachers need to know HOW to teach maths (as well as what to teach) The RC ethos seemed to be an important factor in the school's success 99% of the pupils are RC Pupils get 6.5 hours maths a week There are 'periods' but also flexibility (30 periods a week of 50 mins each) The tracking system has been further developed Each teacher assesses pupils' learning in a particular area (eg addition) and give a coloured grading of developing (red), consolidating (amber) or secure (green). This school has gone further and has 1, 2, 3 bands within each of the three colours. Eg a pupil can be red 3, which means they are nearly an amber They do not have gifted and talented pupils but have identified particular pupils as being 'able' and they are monitored There are pupil committees – there are overseen by different teachers on a rolling programme which is part of the teacher's own professional development The HT considers the school to be well resourced LL (the maths champion) thinks that maths has made steady progress in the two years since she has been at the school
School O	Science	Very little homework in science; teachers have visits to secondary school to see that we have high enough expectations and make sure we use a common science language. Important for secondary schools to see what we do in the primary school (they visit us) and they have removed certain areas to make sure lessons/areas are not replicated and pupils get bored. The school is well resourced – but what we don't have we can borrow. There are two periods of science a week (2 x 50 = 100 mins) It's a tougher school to work in that St Josephs – some pupils/parents live in very deprived housing but the pupils that I met all seemed very polite and engaged.
School J	Maths	National Numeracy Strategy morphed into the Primary Review and they use a mixture of the two in a flexible way. They have about 10 secondary schools they send children to so transition is difficult. Try and be a little flexible how the maths curriculum is followed but we like the lower sets to always include at least one number session each week. Balance between over-emphasising the basics only. We particularly concentrate on mental calculations. On average each lesson spends about 25% on this. Homework: a nightmare issue – some parents complain there is too much. About 45 mins a week (30 mins for Y3 and Y4) – practising mental calculation or a worksheet (also have other homework). Makes the point how brilliant NCTM is.
School J	Science	The schemes of work are based on the QCA schemes of work. The monitoring team found that some teachers were not teaching the prescribed areas in the year they were supposed to

		have been but this has now been rectified. They need to do more to develop cross-curricular links – do quite a bit with ICT but the school as a whole have a very subject led curriculum. There are not very many peer observations but Richard sometimes can let other teachers see good practice in SC1 but I don't think there is much of it In Y4 they have 1.5 hours of science a week; by Y5 it is 2.25 hours –one afternoon. No homework in science but school has a science club in Year 4 – 8 children max over a 6-week period. Means that at least half the children (48) in Y4 attend the science club, which is after school and on a voluntary basis. Children really enjoy it -emphasis is on skills rather than knowledge. Thinks more science on TV also helps enthuse children.

Other Issues
Colleges

College 2	Maths	Hopes for more consistency in approach eg Additional maths courses more universally taken.
College 6	Maths & Science	Further notes on Scottish system: • Students can spend up to 4 years in FE, providing university access to those with quite low starting points. • Find it hard to find people who want to do higher maths – though no problem with sciences • I think the GCSE retake cohort does not exist, because there is no demand for Maths/English at a set grade. The thresholds are more complex and nuanced. Low achieves are doing SL4 Foundation programmes, which are more geared to work skills than English/maths quals.
College 3	Maths & Science	This was a very interesting conversation. The contrast between Gill's ideas about good teaching and the system as it now exists was stark. She sees good, enthusiastic staff as the most important aspect of teaching. She feels that Teacher Training is central to this and it has to improve. She feels that primary schools need to create more excitement and enthusiasm for maths and science at an early age. Yet, as noted above she accepts that the onerous burden of data monitoring, compiling of evidence of progress, filling in boxes and endless forms is something which takes up too much teacher time, and saps their enthusiasm. Also not included elsewhere was her observation that getting many on apprenticeships to Level 2 Functional Maths 'legitimately' is impossible, and that it is too high a hurdle for many on programmes such as hairdressing. She notes that employers have been taught the mantra of the need for 5 GCSE's A*-C even when the work they are offering

		does nto demand that level.
College 7	Science & Maths	We had a brief discussion on funding. Scottish FE is not on a payment b result tariff as English colleges are. If she gets 20 students on a Intermediate Maths course and at the 25% point she still has 16 students, she gets paid for the 16 students. Feels that under the English system she would not be able to run the courses she does.

Further notes from Primary Schools

School P	Maths	We also talked about text books. They have improved and different teachers use them as they need to. They do not have to The school uses calculators but only when opportunities arise – eg when using real data involving large numbers, decimals etc. (I got the feeling that they are not used widely) CH thought the practising maths was necessary but that application is key. She wants maths to be relevant and challenging – sees the teachers' role as often facilitating and guiding learning. The staff use lots of questioning techniques; particularly open questions. They differentiate questions – in order to do this, teachers need to know the child CH wants children to be challenged and to be made to think CH does some teaching herself Thinks the concept of subject specific pedagogy is vital – teachers need to know HOW to teach maths (as well as what to teach) The RC ethos seemed to be an important factor in the school's success 99% of the pupils are RC Pupils get 6.5 hours maths a week There are 'periods' but also flexibility (30 periods a week of 50 mins each) The tracking system has been further developed Each teacher assesses pupils' learning in a particular area (eg addition) and give a coloured grading of developing (red), consolidating (amber) or secure (green). This school has gone further and has 1, 2, 3 bands within each of the three colours. Eg a pupil can be red 3, which means they are nearly an amber They do not have gifted and talented pupils but have identified particular pupils as being 'able' and they are monitored There are pupil committees – there are overseen by different teachers on a rolling programme which is part of the teacher's own professional development The HT considers the school to be well resourced LL (the maths champion) thinks that maths has made steady progress in the two years since she has been at the school
School O	Science	Very little homework in science; teachers have visits to secondary school to see that we have high enough expectations and make sure we use a common science language. Important for secondary schools to see what we do in the primary school (they

		visit us) and they have removed certain areas to make sure lessons/areas are not replicated and pupils get bored. The school is well resourced – but what we don't have we can borrow. There are two periods of science a week (2 x 50 = 100 mins) It's a tougher school to work in that St Josephs – some pupils/parents live in very deprived housing but the pupils that I met all seemed very polite and engaged.
School J	Maths	National Numeracy Strategy morphed into the Primary Review and they use a mixture of the two in a flexible way. They have about 10 secondary schools they send children to so transition is difficult. Try and be a little flexible how the maths curriculum is followed but we like the lower sets to always include at least one number session each week. Balance between over-emphasising the basics only. We are particularly concentrate on mental calculations. On average each lesson spends about 25% on this. Homework: a nightmare issue – some parents complain there is too much. About 45 mins a week (30 mins for Y3 and Y4) – practising mental calculation or a worksheet (also have other homework). Makes the point how brilliant NCTM is. DW tells me about the demise of the LA. She is not that unhappy: ie there were 5 advisory teachers who were not very good; some of the money from the LA cuts have come directly to the school. She has £40,000 to spend this year on supporting her maths network. This consists of 30 schools: they meet once a term. Leader cascade information back to their schools. School J has become a teaching school; other teachers visit and observe good practice; DW and other staff visit local school and teach and proffer advice on developing CPD.
School J	Science	The schemes of work are based on the QCA schemes of work. The monitoring team found that some teachers were not teaching the prescribed areas in the year they were supposed to have been but this has now been rectified. They need to do more to develop cross-curricular links – do quite a bit with ICT but the school as a whole have a very subject led curriculum. There are not very many peer observations but Richard sometimes can let other teachers see good practice in SC1 but I don't think there is much of it In Y4 they have 1.5 hours of science a week; by Y5 it is 2.25 hours –one afternoon. No homework in science but school has a science club in Year 4 – 8 children max over a 6-week period. Means that at least half the children (48) in Y4 attend the science club, which is after school and on a voluntary basis. Children really enjoy it -emphasis is on skills rather than knowledge. Thinks more science on TV also helps enthuse children.

Appendix D: Summary of data on providers interviewed

	Type	FSM	5+ GCSE (inc M&E)	Change since 2008	Expected progress English	Expected progress maths
England						
School A	Mixed, Catholic Voluntary Aided, 11-18	FSM: 20.5%	81%	+14%	80%	85%
School B	Mixed academy, 11-18	FSM: 27.6			Data not available	
School C	Mixed, Foundation school, 11-18	FSM: 18.6	53%	0%	92%	59%
School D	Mixed CTC, 11-18	FSM: 10.0	98%	-1%	97%	94%
School E	Mixed academy, 11-18	FSM: 37.3	53%	+22%	84%	52%
School F	Mixed academy, 3-19	FSM: 45.4	37%	+28%	54%	44%
School G	Mixed academy, 11-18	FSM: 26.0	59%	+12%	72%	70%
School H	Mixed academy, 11-18	FSM: 30.9	48%	+10%	73%	50%
School I	Boys Independent, 11-18	-	100%	0%	100%	100%
School J	Mixed Community, 5-11	FSM: 11.1	N/A	N/A	93%	93%
School K	Free school, 5-11	Data not available				
College 1	FE College	N/A				
College 2	FE College	N/A				
College 3	FE College	N/A				
Scotland			SQCF L5			
School L	Mixed secondary	FSM: 6.9%	72%			
School M	Mixed secondary	FSM: 3.8%	73%			
School N	Mixed secondary	FSM: 23.7%	21%			
School O	Primary, 5-12	FSM: 20.3%	N/A			
School P	Primary 5-12	FSM:7.5%	N/A			
College 4	FE College	N/A				
College 5	FE College	N/A				

College 6	FE College	N/A				
College 7	FE College	N/A				
College 8	FE College	N/A				
Wales						
School Q	Mixed Community, 11-16	FSM: 31.3	40%	+9%		
College 9	FE College	N/A				
Northern Ireland						
School R	Catholic (non-selective) 11-18	FSM: 35.5	40%			

Appendix E: Survey for teachers of mathematics and science

General questions

1) What is your job title?

____

2) Which of the following do you teach?

(tick all which apply)

[ ] Mathematics
[ ] General science
[ ] Physics
[ ] Chemistry
[ ] Biology
[ ] Other (please state): __________________

3) In what subject was your degree qualification?

(if combined degree, please tick both elements)

[ ] Mathematics
[ ] Physics
[ ] Chemistry
[ ] Biology
[ ] ICT
[ ] Engineering
[ ] Education
[ ] Other (please state): __________________

4) What form of initial teacher education did you experience?

[ ] Bachelor of education or equivalent
[ ] Post graduate certificate or equivalent
[ ] Graduate teacher programme
[ ] (please state): __________________

5) Were any of the following influential in your decision to become a teacher of mathematics and/or science?

(Tick all that apply)

[ ] Family member
[ ] A teacher
[ ] Availability of a bursary
[ ] Advertising
[ ] Passion for your subject
[ ] Work/voluntary experience in a school
[ ] The *TeachFirst* programme
[ ] (please state): __________________

6) How would you describe yourself?

( ) A teacher
( ) A maths teacher
( ) A science teacher
( ) A physics teacher
( ) A chemistry teacher
( ) A biology teacher

( ) Other (please state): _________________

7) For about how many years have you been teaching?
( ) 0-5
( ) 6-10
( ) 11+

8) What phase of education do you teach in?
[ ] Primary education
[ ] Secondary education
[ ] Further education

9)What type of school or college do you teach in?
(tick all which apply)
[ ] Local authority administered
[ ] Academy
[ ] Independent/private school
[ ] General FE college
[ ] Sixth form college
[ ] A selective school

10) And in which nation is the school/college?
( ) England
( ) Scotland
( ) Wales
( ) Northern Ireland

11) Approximately what percentage of pupils/students in your school/college claim free school meals (FSM)?
( ) 0-5%
( ) 6%-10%
( ) 10%-20%
( ) 20%-30%
( ) More than 30%
( ) Not sure

About maths and science in your school
12) How would you personally rate the teaching of maths in your school/college?
( ) Excellent
( ) Good
( ) Moderate
( ) Poor

13) Would you say that the teaching of maths in your school/college is:
( ) Improving rapidly
( ) Improving slowly
( ) Staying the same
( ) In decline

14) How would you personally rate the teaching of science in your school/college?
( ) Excellent
( ) Good
( ) Moderate
( ) Poor

15) Would you say that the teaching of science in your school/college is:
( ) Improving rapidly
( ) Improving slowly
( ) Staying the same
( ) In decline

16) How would you rate your subject leader/coordinator in maths?
( ) Excellent
( ) Good
( ) Moderate
( ) Poor

17) Would you describe your mathematics subject leader/coordinator as being:
(tick all which apply)
[ ] Highly enthusiastic about teaching
[ ] Highly enthusiastic about maths
[ ] Approachable
[ ] Highly organised
[ ] Good at paperwork
[ ] Source of advice and support
[ ] Good at using pupil performance data
[ ] Good at maintaining pupil/student discipline
[ ] Always ready to listen to staff
[ ] Good team leader
[ ] Innovator and source of fresh ideas
[ ] Maintains high profile for the department/or for maths in the school or college
[ ] A very hard worker
[ ] Ensures resources are available for you to do your job

18) How would you rate your subject leader/coordinator in science?
( ) Excellent
( ) Good
( ) Moderate
( ) Poor

19) Would you describe your science subject leader/coordinator as being:
(tick all which apply)
[ ] Highly enthusiastic about teaching
[ ] Highly enthusiastic about maths
[ ] Approachable
[ ] Highly organised
[ ] Good at paperwork
[ ] Source of advice and support
[ ] Good at using pupil performance data
[ ] Good at maintaining pupil/student discipline

[ ] Always ready to listen to staff
[ ] Good team leader
[ ] Innovator and source of fresh ideas
[ ] Maintains high profile for the department/or for maths in the school or college
[ ] A very hard worker
[ ] Ensures resources are available for you to do your job

20) As a teacher of maths or science, who has the most influence on you:
( ) Your head teacher
( ) Your subject leader/coordinator
( ) Your peers
( ) A teacher in a previous school/college
( ) A tutor/trainer in a previous school/college
( ) Parents
( ) Students
( ) Others (please state)

21) What factors do you think are most important in effective maths or science teaching?
(tick all which apply)
[ ] Well qualified teachers
[ ] Enthusiastic teachers
[ ] Having pupils in appropriate sets
[ ] Support for pupils outside of lessons
[ ] Wide range of extra-curricular activities
[ ] Good relationships with pupils
[ ] Well equipped teaching rooms
[ ] Good materials and resources
[ ] Data tracking of pupils and target setting
[ ] Supportive Governing body
[ ] Whole school ethos
[ ] Effective subject leader/coordinator
[ ] Effective head teacher

22) How important do you think subject-based teacher CPD is to actual teaching performance?
( ) Very important
( ) Quite important
( ) Not very important

[Note: extra 'pop-up' question for those that answer 22 – **Why?**
23) About how many hours of subject based CPD did you do last academic year (2011-12)?
( ) 0-10 hours
( ) 11-20 hours
( ) 21-30 hours
( ) 31+ hours

24) How do you mainly get information about CPD in your subject area?
( ) From subject leader/coordinator
( ) From school CPD leader
( ) Own research
( ) From local authority or other local network
( ) Other (please specify): __________________

25) Which types of subject based CPD do you think have an impact on teaching?
(tick all which apply)
[ ] Theoretical/pedagogic (eg theories of learning)
[ ] Technical information (eg use of Interactive Whiteboards)
[ ] Examination information (eg marking schemes, briefing form exam boards)
[ ] Meeting teachers in same subject from different schools/colleges to share ideas and good practice
[ ] Sharing ideas and practice with colleagues in own school
[ ] Seeing others teach
[ ] Being formally observed teaching and getting feedback
[ ] Being peer observed teaching and getting feedback
[ ] Learning about different teaching approaches to topics in the subject
[ ] Engagement in research
[ ] Delivery from subject experts at external events e.g. conferences, courses
[ ] Finding out about new resources for learning
[ ] Other (please specify)

26) What percentage of pupils/students in your school/college choose to study maths at a higher level after GCSE, Standard Grade or equivalent level?
( ) 0-10%
( ) 11%-25%
( ) 26%-50%
( ) 51%-70%
( ) More than 70%
( ) Don't know/not applicable

27) What percentage of pupils at your school choose to study one or more science subjects at a higher level after GCSE, Standard Grade or equivalent level?
( ) 0-10%
( ) 11%-25%
( ) 26%-50%
( ) 51%-70%
( ) More than 70%
( ) Don't know/not applicable

28) What factors encourage pupils to study maths/science at a higher level after GSCE, Standard Grde or equivalent level?
(Tick all that apply)
( ) Success at GCSE, Standard Grade or equivalent level
( ) Good teaching at earlier stages
( ) Teachers with enthusiasm for their subject
( ) Science or maths in the media
( ) Extra-curricular activities in maths/science (eg external speakers, visits to museums)
( ) A focus on career opportunities in maths/science
( ) Other (please specify): __________________

29) Finally, what single change do you think would improve maths and/or science teaching in your school/college?

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