

29-30 Tavistock Square
London WC1H 9QU
Tel: 020 7679 4995 Fax: 020 7916 8528
info@sciencecampaign.org.uk
www.sciencecampaign.org.uk

Campaign for
Science and
Engineering
in the UK



CaSE 06/13b

Science education in Northern Ireland's Schools

Report of a series of *Opinion Forum* meetings with teachers, education, officials
educationalists, academics and other groups

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Preface

CaSE exists to improve the scientific health of the UK by promoting effective policies in areas relevant to science and engineering. The education system is a crucial part of this, and is currently one of the areas presenting some of the greatest barriers for UK science. CaSE's standpoint on school level science was set out in detail in Chapter 6 of *Science and Engineering Policies for the Next Parliament: Agenda 2005-2010*, which is available at <http://www.sciencecampaign.org.uk/documents/2005/CaSE0503.htm> We believe that every young person has the right to a high quality and engaging experience of science at school and to the career opportunities presented by science qualifications.

This document presents a an assessment of the current situation in Northern Ireland, and covers issues that CaSE believes could most effectively be addressed by Government policies. A companion document in CaSE's series of *Opinion Forums* sets out a summary of CaSE's findings and policy recommendations. It can be downloaded from <http://www.sciencecampaign.org.uk/documents/2006/CaSE0613a.pdf>

Our starting point was a series of meetings that took place in Belfast in December 2005. We have brought the results of these meetings together with further data and evidence, and would like to thank all those who have helped to inform this report. Appendix 1 gives more detail about the meetings.

Introduction

Northern Ireland's education system is a unique within the UK. The province has its own curriculum regulations and school funding mechanisms, as well as its own arrangements for Further and Higher Education. The 11-plus exam (referred to as the 'transfer test') is still used to measure pupils' attainment. However, the challenges facing science education here are similar to those in the rest of the UK and indeed across most of the industrialised world. Low student uptake of science, engineering and mathematics subjects remains the key concern.

The education system and distribution of responsibilities in the region are currently in flux. Since the Northern Ireland Assembly was suspended in 2002, ministerial responsibility for education has been removed to the Northern Ireland Office. The Assembly is has reconvened on a temporary basis, and this attempt to restart devolution may lead to further changes to the administrative structure the education system.

The Curriculum Authority for Northern Ireland has undertaken a major review and reform of the school curriculum through all key stages, with the official changeover due to occur in September 2007. The teaching profession is also under review. The Departments for Education and for Employment & Learning have been undertaking this review jointly since 2003, focusing on professional development, and the role of the General Teaching Council for Northern Ireland. Meanwhile independent bodies have been moving toward developing a regional strategy for science education, with a publication from the Northern Ireland Science Education Forum (Northern IrelandSEF) expected soon.

There is now a climate of motivation to improve science education as part of the broader aim of tackling social inclusion issues in a post-conflict society and to provide the skills base needed to strengthen Northern Ireland's economy.

The usefulness of science qualifications is already well documented on a national level. Post-compulsory science qualifications have been linked to favourable career prospects and earnings potential. A survey carried out specifically within the Northern Ireland region found that graduates in science and engineering subjects were less likely to be over-qualified in their jobs than graduates of other disciplines¹. Another survey showed that return in earnings on science and engineering degrees have been rising since the 1980s, with men earning on average 21% more relative to arts graduates².

Larger companies are currently providing support for anything from PhD placements to primary school experimental kits, indicating the importance of science skills in the region. Further information will soon be available on the skills needs of Northern Ireland's scientific companies, as the Learning & Skills Development Agency for the region are currently carrying out a survey on this issue.

Due to its small size and partial autonomy, Northern Ireland presents opportunities for cohesion and coordination throughout the science and educational communities which may be more difficult to achieve in other parts of the UK.

¹ Overeducation and the graduate labour market, Economic Research Institute of Northern Ireland, 2004.

² Education and Earnings in Northern Ireland, Harmon and Walker for DELNI, March 2000

Uptake of science & engineering subjects and Standards

The UK Government has begun to respond to the need to improve standards and uptake in science subjects in post-compulsory education. For example, in 2002, the Roberts Review looked at various school level issues, the science strategy *Investing in Innovation* set out plans for improving schools science, and the Budget for 2006 sets out targets for increasing the numbers of A-level students and teachers in physics and chemistry over the next eight years. However, both in terms of the research and evidence for understanding the problem and in terms of subsequent actions schemes, much of this work has excluded Northern Ireland. The region's own Departments and educational bodies do not consistently prioritise science subjects to the same extent as their English counterparts.

Northern Ireland published its regional innovation strategy *Think Create Innovate* in 2003, a year after the UK wide *Investing in Innovation*. It sets out an intention to move toward a 'knowledge based economy'. Unlike the UK strategy, it does not mention science, maths and engineering education specifically, only noting that overall achievement at school is high. It aims to "promote innovation at every level of the Northern Ireland education system", and sets out that "education and vocational training deliverers should target resources on developing the knowledge and skills necessary to enhance the selected areas of high promise for R&D and innovation". However, the emphasis throughout the strategy is on further and vocational education, with the only specific proposal for schools being a reference to CCEA's curriculum review. It is not yet clear how this will manifest itself.

For example, The Department for Education (DENI) Business Plan for 2005-6 includes attainment targets for English and mathematics, but science is not mentioned anywhere in the document. A recent review of the Curriculum Advisory Service suggested "Regional Strategies, similar to Literacy and Numeracy, to provide coherent and consistent levels of support across key areas of service such as Special Educational Needs, Irish Medium, English as an Additional Language and Behaviour Support"³, but again, science is not mentioned.

In *Science Policies for the Next Parliament*, CaSE proposed the inclusion of science in national educational strategies⁴. This proposal applies equally to Northern Ireland as well as other parts of the UK. Teachers involved in our *Opinion Forum* meetings told us that schools have reduced funding for science support since efforts have been focused on literacy and numeracy hours. Teachers in primary schools were particularly frustrated that extra teaching support is now provided for these hours, but is not available for practical sessions where it would be of more use. CaSE believes that science should be represented in regional targets and school development plans.

The Department for Employment and Learning (DELNI) Skills Strategy published in February this year includes a key target to develop a *Skills for Innovation Action Plan* by September 2006. In order to be effective in developing the skills needed for an innovative and successful economy in the long term, CaSE believes that this action plan must include the school science that lies within DENI's remit.

The region remains in a slightly better situation than the UK as a whole in terms of post- 16 uptake in science subjects, and has a strong participation and achievement in education overall.

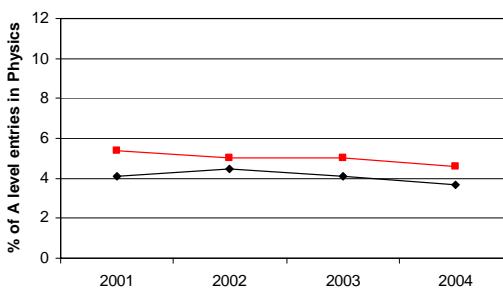
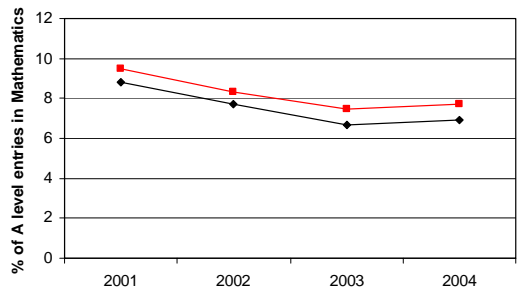
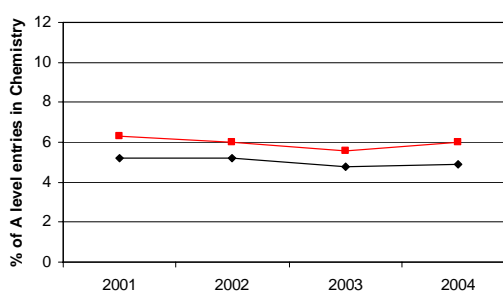
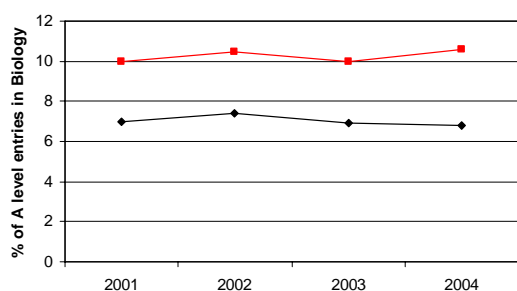
³ CASS Best Value Fundamental Service Review, Central Management Support Unit for ELBs, December 2005

⁴ chapter 6, page 49

This position gives the responsible bodies and Departments an opportunity to act before greater challenges arise.

Participation of 16-17 year olds in full time education and training is high at around 78% as compared to only 67% in England⁵, and these rates have shown a steady increase in recent years. GCSE and A-level results are traditionally higher in Northern Ireland than the national average. For example, in 2002, 58.7% achieved 5 or more A*-C grades in their GCSEs, compared to only 52.5% across the UK as a whole⁶.

However, in the uptake of science and engineering Northern Ireland follows similar trends to the UK. At A-level, Northern Ireland consistently enters a slightly higher proportion of its students for science subjects than in the UK as a whole, but patterns of low and declining entries in the physical sciences are the same. The graphs below show percentages of total A-level entries in each subject for 2001-2004⁷. Northern Ireland entries are shown in red and UK entries in black.



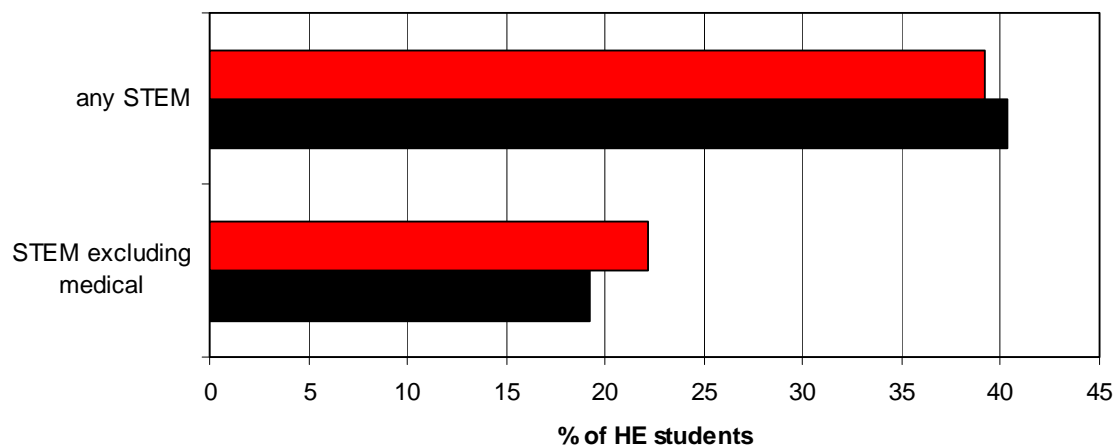
For students leaving school and entering Higher Education, the picture changes. At this stage Northern Ireland's students are less likely than those in the rest of the country to take up sciences. The table and graphs below show this. Again, Northern Ireland students are shown in red and UK students in black. While the overall proportion studying the selected subject areas is slightly higher among Northern Irish students, this is mainly due to the enormous popularity of healthcare subjects. In any other area apart from computer science, students are less likely to study sciences than their UK counterparts.

⁵ DENI statistics for 2004/5

⁶ <http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=7733>

⁷ JCQ data

	% of all HE students (at any UK institution) gaining a qualification in this subject area	
	Northern Ireland domiciled ⁸	UK domiciled ⁹
medicine and dentistry	2.3	2.5
subjects allied to medicine	19.0	14.0
veterinary science	0.1	0.2
biological sciences	5.4	6.9
physical sciences	2.9	3.5
mathematical sciences	0.9	1.3
computer science	5.8	5.5
engineering and technology	4.2	5.0
STEM (science, technology, engineering & medicine) excluding medical and veterinary	19.2	22.2
any STEM	40.3	39.2



Admissions tutors from Northern Ireland's universities in physical sciences and engineering told us that they have seen a continuing decline in applicants since the 1990s. The situation is taken as a signal of broader problems with the education that students receive at school. In order to maintain student intake relative to other subjects, departments have adapted either by lowering entry requirements or by offering new courses combining traditional scientific content with other areas of study. This can either lead to lower output standards, or to courses becoming highly pressured with less time for personal development and creative or innovative thinking. The current situation is of great concern and is unsustainable if trends continue.

In subjects allied to medicine courses are very popular, and the main barrier to increasing uptake is the MaSN cap on student numbers, which was abolished in England in 2002/3.

⁸ DELI Northern Ireland 2004-5

⁹ HESA 2004-5

Allocating the cap separately between subject boundaries would be one way of optimising return on government investment in HE.

The Further Education sector faces a different range of problems recruiting students into science subjects, as it has struggled to offer qualifications and courses which are seen as appropriate. For example, the science GNVQ was perceived as harder than and not equivalent to the standard of other GNVQs. Due to funding pressures many colleges decided to offer this in place of existing courses, even though there was a lower demand for it. This situation is now developing and there are hopes that foundation degree and HND programmes in science will tackle these particular issues. In Engineering, vocational and FE routes are better established. Deans of Engineering reported to us that undergraduates entering via these routes have a clearer idea of what the subject entails than those who have entered through academic routes such as maths and physics A levels. At Ulster University, the drop out rate is lower among these students.

The teachers we spoke to told us they generally observe a drop in enthusiasm for science toward the end of Key Stage 2. This contrasts to impressions of teachers in England, where pupils more commonly turn away from the subject at the end of Key Stage 3. This has been accounted for by the pressures of the Transfer Test which Northern Ireland students were taking at the end of Key Stage 2, in English, Maths and Science. The decision has now been taken to abandon these tests, and the last round will be held in November 2008. Teachers at both primary and post-primary levels told CaSE that they are optimistic that the end of these tests will at least delay the decline in pupils' enthusiasm for science. It is also interesting to note here that DENI decided to drop school league tables in 2001¹⁰.

Of course, exam pressures are not the only barrier to students' enthusiasm for science. The curriculum and the way it is delivered present a much more complex picture. We will consider these factors in more detail in the next sections. Further research is needed regionally, nationally and internationally to understand student uptake in science subjects. Some of the schools represented in CaSE's focus groups in Northern Ireland had seen increases in physical science uptake in recent years, against the national trend, but were not able to account for this on the basis of their own experience. An investigation of uptake trends on a school-by-school comparative basis could be informative.

Science teachers in Northern Ireland's post-primary schools told CaSE that they feel blamed for the decline in student interest, but at the same time powerless to make a real difference to the situation. Faced with various combinations of unsupportive school management, lack of resourcing, inappropriate careers advice, an unsatisfactory curriculum or the need to meet other pressures, many are not in a position to take the main responsibility for their students' choices.

For example in careers education, some science teachers told us they feel unable to advise in case they are accused of 'canvassing'. This leaves advice solely in the hands of careers teachers, who may not have all the relevant expertise in particular subject areas. Many teachers told us that there is a tendency for students only to choose science subjects if they are requirements for a particular career. Teachers are disappointed that this seems to be the only way they can promote their subject to students.

Stronger Government support is needed to tackle these issues. The next sections look at ways of approaching this.

¹⁰ <http://www.bbc.co.uk/dna/actionnetwork/A1181819#3>

Science teaching Workforce

A good science teacher can be the most important part of a student's science education.

In a recent survey, A quarter of the interviewees remarked that advice from their subject teachers had influenced their decision to study AS/A2-levels post-16. These young people reported that subject teachers had given them the impression that it was best to stay on at school and had encouraged them to do so. One commented:

*'I think it's encouragement from teachers, because they would talk about the A-level courses and they give you loads of information about what you are going to do, so they kind of persuade you into staying on.'*¹¹

Nationally, science teachers are among the hardest subject groups to recruit. However, many of the surveys and reports looking at this challenge have either excluded data from Northern Ireland, or grouped it together with the whole of the UK. While data on applications to undergraduate courses are published nationally (by UCAS), postgraduate (PGCE) data are published separately. The Graduate Teacher Training Registry (GTTR) aims to represent the whole of the UK, but obtains its statistics only from England's Teacher Training Agency (now the Teaching Development Agency) the National Assembly for Wales and the Scottish Higher Education Funding Council. The equivalent figures for Northern Ireland are not included, but are published separately by DELNI.

Northern Ireland represents around 3% of the UK's population¹², but has 3.5% of its school pupils and 3.7% of its teachers¹³.

	pupil: teacher ratios (2002/3)
Wales	18.0
England	17.9
UK total	17.6
Northern Ireland	16.3
Scotland	14.9

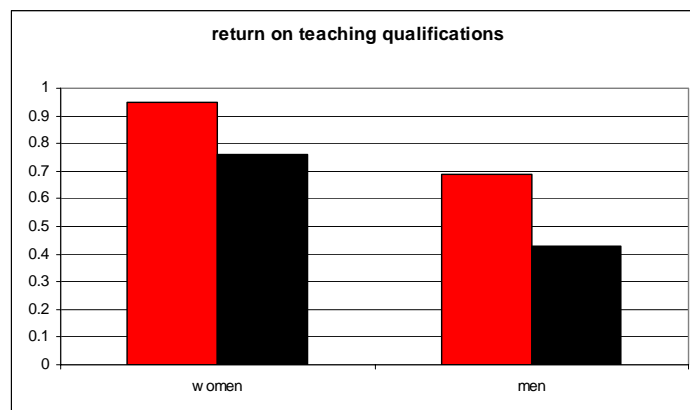
The ratios shown above are indicative both of the number of posts available in the school system, and of the popularity of teaching as a career. There are indications that teaching is a more attractive career to Northern Ireland students than in it in the rest of the UK. Research on individuals' financial return on qualifications (illustrated in the graph below) shows how teaching represents a higher proportional earnings potential in Northern Ireland (shown in red) than it does in the rest of the UK (shown in black)¹⁴.

¹¹ CCEA 'moving forward, thinking back'

¹² <http://www.statistics.gov.uk/CCI/nugget.asp?ID=6>

¹³ <http://www.statistics.gov.uk/STATBASE/Expodata/Spreadsheets/D7727.xls>

¹⁴ Education and Earnings in Northern Ireland, Harmon and Walker for DELNI, March 2000



Looking at applications to undergraduate teacher training degrees, these represent a lower proportion of both applicants and acceptances among Northern Ireland students than among UK students. They consistently represent around 1% of applications from Northern Ireland students, compared to 2% of applications from UK students. However, most of the region's science teachers are science graduates holding a PGCE. This may in part be encouraged by the fact that most of Northern Ireland's schools do not require teachers to teach outside of their specialism of biology, chemistry or physics.

The vast majority of Northern Ireland's teachers are home-grown. Qualified Teacher Status (QTS) does not apply in Scotland or Northern Ireland, but in most cases it is possible for candidates to transfer their qualifications and register with the GTCNI if DENI grants them eligibility¹⁵. Initial Teacher Education for Northern Ireland is offered by three institutions and their member colleges: Queen's, Ulster and the Open Universities. The relevant courses include elements specialising in the Northern Irish curriculum and educational system. In 2004-5, 72% of all Northern Ireland domiciled students took their first degree within the region and over 90% of students studying for a PGCE in Northern Ireland were native to the region¹⁶.

In the current climate this does not present a problem for teacher recruitment, but it does make the supply of science teachers more vulnerable to changes in the region. Post-primary teachers to whom we spoke were concerned that if science departments in Northern Ireland's universities were to close, the supply of teachers for those disciplines would dry up. There is an increasing awareness in the teaching community that there are shortages 'on the horizon'.

While the situation for the teaching workforce is better in Northern Ireland than it is in the rest of the UK, the situation for school lab technicians situation is if anything worse, and the supply is almost non-existent. In one of the schools we contacted, the post had been filled by a dinner lady. At present science teachers are heavily relied upon to train candidates for these posts. Teachers felt strongly that standards and qualifications should be made mandatory, and that every school should be entitled to an adequate number of posts.

One of DENI's Strategic Aims is 'to have highly skilled and motivated teachers and support staff', and it has set out its intention to develop workforce plans by March 2006¹⁷. The approach to achieving this aim has so far largely been via professional development of teachers. It is not yet apparent what steps will be taken as part of the review to address the careers of laboratory technicians. Professional Development is the responsibility of the General Teaching Council,

¹⁵ I have requested data on how many actually do this each year, it is not publicly available. The idea is that they aren't a significant number.

¹⁶ DELNI statistics

¹⁷ DENI Business Plan 2005-6, Strategic Aim 4.3

GTCNI, and we will look at this in more detail in the next section. While the GTCNI reports to DENI, ITE comes under DELNI's rather than DENI's remit. CaSE believes that the Departments will need to collaborate to consider the supply of the workforce in the longer term, and to approach the issue with consideration to the different situations in specific subject areas. As is the case for post-16 science uptake, when it comes to science teaching uptake, Northern Ireland is in a position to learn from other areas of the UK and act now before problems arise.

Continuing Professional Development in Science

One way of ensuring that teaching remains an attractive option for science graduates is through the right professional development and progression opportunities (CPD). Following the recent work of GTCNI and DENI, CPD will play a more important role for Northern Ireland's teaching workforce and raise the profile of the profession.

I know that in Northern Ireland we are very fortunate with the calibre and qualifications of young people who want to go into teaching and of course that is a real plus for the system in Northern Ireland. But high quality beginning teachers must stay high quality, and that means high quality training and support throughout their careers

Angela Smith, Minister for Employment and Learning and Education¹⁸

The General Teaching Council for Northern Ireland¹⁹ has said that the nature of CPD "has been somewhat restricted, characterised by reactivity and driven by systemic priorities."

These are very positive steps, but are not in line with the needs that teachers we spoke to told us about. The emphasis is on professional and pedagogical knowledge, with less subject content. CaSE has consistently argued for improved subject knowledge CPD in science²⁰. The primary and post-primary teachers we spoke to in Northern Ireland raised science support and training as one of their main unmet needs. Not only does this greatly strengthen the case that there is a need for such provision, but it also suggests that it is likely to be welcomed by the workforce, and therefore more effective. Teachers also clear on their preferred ways of receiving CPD.

Primary teachers told us that they would strongly welcome peripatetic specialists to their lessons. A scheme currently in place at Queens University achieves this by placing science graduates into primary schools as part of their PGCE training²¹. Trainees have an opportunity to learn how to teach, but teachers also have an opportunity to learn more science. Obviously the number of schools this scheme reaches is highly limited. There is a need to make similar projects available to all schools on a regular basis.

Teachers at both levels are excited about the prospect of improving their science knowledge with training from scientists in industry and academia. Many feel uninspired by the CPD they are already familiar with, and would in any case welcome contact with practicing scientists. At the Teacher Education Conference last November, Angela Smith, Minister for Employment and Learning and Education, said "it is vital that all teacher educators should have recent and relevant experience of teaching in the classroom so that they are best placed to support beginning teachers by knowing of what they will actually face". In context here, referring to professional ITE providers, this is highly appropriate. However, it should be noted that teacher education does and should not only come from professional educators, other professionals also have a highly valuable contribution to make. In the same way that teacher educators must stay in touch with teaching, science educators must also stay in touch with science. An example of a highly successful regional scheme achieving this is the Teacher Scientist Network based at the John Innes Centre in Norfolk. Similar projects should be supported in Northern Ireland.

Teachers at both levels generally agreed that one day training courses may be helpful but are insufficient to make a real impact. This is the basis on which three day residential courses are

¹⁸ at the Teacher Education Conference, November 2005

¹⁹ in its review of CPD.

²⁰ *Science Policies for the Next Parliament*, page 49

²¹ <http://www.qub.ac.uk/edu/>

now offered at the National Science Learning Centre. However teachers in Northern Ireland are concerned that cost will mean this training is inaccessible for most teachers.

Post primary teachers raised one further point about their preferred forms of CPD, which is peer-based. One of the main concerns of science teachers was that they can become isolated from science teachers outside of their own school. The enthusiasm of teachers at both levels to share ideas and learn from each other was quite apparent. Northern Ireland needs more fora and networking opportunities, and to ensure that they are accessible to all.

Support is currently available from a range of bodies and institutions:

Education & Library Boards and their Curriculum Advice and Support Services:

Northern Ireland is split into 5 Education and Library Boards (ELBs), which were established in 1972. Their statutory role includes the provision of a Curriculum Advisory and Support Service (CASS). Since the curriculum changes of 1989, each has provided a science advisor as part of this service. CASS was reviewed at the end of last year by the Central Management Support Unit for ELBs²², and DENI has set out its intention to take forward their recommendations²³.

Teachers at CaSE's focus group told us that their ELB advisors had originally been very active in providing advice for science when the service was first introduced, but that support had gradually waned over the following decades. It was understood that Advisors' activities are currently driven largely by changing government priorities such as literacy or social inclusion targets, rather than ongoing subject support. The review of CASS described the role as having 'evolved' from supporting programmes of study to playing 'a wider school improvement role', and recommends that the service be renamed "'The School Improvement Service" to describe its activities more fully'. However, there was a unanimous impression among teachers we spoke to from all ELB areas that the changing role had left a gap in science- specific provision.

Teachers also told CaSE that for a number of reasons ELB science courses were only reaching a small proportion of teachers. In many cases only subject coordinators or heads of department have been involved. Teachers believe that science support should boost the subject confidence of all teachers, but in most cases ELBs had not been able to provide this. The financial management difficulties of the Belfast and South Eastern Boards²⁴ have meant that these areas have become less proactive in publicising and promoting their courses to teachers. It was also noted that meetings for the whole region were always held in Belfast, placing an uneven burden on schools from different areas.

Teachers told us that travel expenses and funding for cover teachers were also a significant problem. The Review of CASS report noted the "concern of teachers regarding the effects of their absence from class and the extent of preparatory work to enable them to attend courses" and proposes "to assess the support among teachers and to review the potential for providing courses for teachers outside of term-time, which would reduce the impact of their absence on the classroom". CaSE awaits developments on this issue, but we note that funding for cover teachers may also be a necessary part of the solution, and that this particular barrier applies to CPD from all sources.

As well as difficulties in accessing science provision from CASS, teachers told CaSE that there were limits to the quality and expertise available. Support mentioned included managing laboratory equipment budgets, health and safety advice and physics boosters for those teaching outside of their specialism. When it came to science teaching in general, however, teachers felt that ELBs offered a repetitive, worksheet based programme. They were not the interesting

²² Best Value Fundamental Service Review, December 2005

²³ DENI Business Plan 2005-6

²⁴ See the Jack Report, DENI website

opportunities that teachers were looking for. Post primary teachers made it clear that since most Science Advisors do not hold a science degree, they do not present a suitable source of expertise for subject training.

SLCs:

Science Learning Centres were introduced in 2004 to provide CPD to science educators. There is one in each of the 9 English Regions, with a national centre based in York. At present there are no centres in Scotland, Wales or Northern Ireland, although professionals in these regions can access training at the National centre. The teachers we spoke to were not particularly concerned that this scheme is not extended more fully to Northern Ireland, but if the project is successful DENI should consider setting up its own.

Inspectors:

The Education and Training Inspectorate (ETI) is run by DENI. It plays a similar role to OFSTED and ALI in England, and is responsible for inspecting ITT, the CCEA and ELB curriculum services²⁵. The ETI's statutory role is "to monitor, inspect and report on standards of learning and teaching". Beyond this, the teachers we spoke to saw scope for a stronger supportive and advisory role, both for subject teaching and for school management. They commented that inspectors used to be able to provide subject specific advice, but this is no longer available. It was very much dependent on expertise of individuals, and the culture and climate of the Inspectorate. Some science teachers felt that their inspectors placed too much emphasis on exam results as opposed to the overall quality of the learning experience and actual learning outcomes. This opinion was not consistent across all areas, giving the impression that the approach of inspectorate teams is variable.

CLEAPSS:

CLEAPSS is the Consortium of Local Education Authorities for the Provision of Science Services, providing advice on practical science. It is an independent organisation based at Brunel University and run through subscriptions from LEAs, ELBs and others throughout the UK.

The Primary School Science Coordinators who we spoke to had found this service to provide the most useful advice on purchasing laboratory equipment. They said they would normally turn to CLEAPSS rather than their ELB for this kind of advice. However, teachers across Northern Ireland are not making as much use of this service as they could.

ASE:

The Association for Science Education operates in regional groups, one of which covers Northern Ireland. It provides advice, guidance and professional development opportunities to its members, who are individual teachers rather than ELBs. The regional secretary told us that the greatest barrier to training events and courses is time. Courses and events recently arranged on Saturday mornings have been poorly attended, while it is difficult to arrange time off for courses during school hours. Some teachers we spoke to mentioned that they can be put off joining the organisation or attending its events because of its reputation. It can be seen as boring, cliquy, for a certain 'type'. Despite this other teachers had found the courses very useful, and membership numbers have increased in Northern Ireland in recent years.

NIESU:

The Northern Ireland Educational Support Unit was set up at Queens University in 1991 to focus on teachers' professional development. It has a strong science emphasis with subject panels in biology, chemistry, physics and maths, which 'provide short courses, consultancies and support activities associated with curriculum development, innovation, evaluation and assessment'. The

²⁵ ETI, A Charter for Inspection

panels include teachers, ETI, ELB and university representatives. Each of the panels has its own emphasis and approach to CPD.

The SETPOINT for Northern Ireland is called SETINUS, and also represents the BA in the region. Main focus is in providing science events for students. Teachers we spoke to were very positive about these activities. According to SETNET, for the most recently published results, only 40% of schools are 'active in STEM', which is a lower proportion the UK total at 47%²⁶. At that time only 18,000 students were involved in SETINUS's activities, but in 2005 the number rose to over 58,000. This increase is a great achievement for the region²⁷.

²⁶ SETPOINT Effectiveness Survey 2003-4

²⁷ Ann Morrison, Belfast Institute

Curriculum and assessment

Northern Ireland has a single exam board unlike England, which has several independent awarding bodies. In Ulster, this function is combined with that of curriculum authority in a single body, the CCEA. The two functions are now dealt with by two separate branches, which in 2005, moved into separate office buildings.

The secondary teachers to whom we spoke were generally satisfied with the Examinations Team, which they perceive as responsive to feedback and offering good courses. While all the UK exam boards meet the requirements of Northern Ireland's GCSE and A-level provision, in practice, CCEA is chosen by many schools. The Curriculum and Assessment Division of CCEA plays a more challenging role in improving science education. As mentioned in the Introduction, a curriculum reform is currently underway across all key stages. CCEA has submitted reform proposals for approval to DENI for all key stages. Implementation of the revised Key Stage 3 began in September 2005, with statutory changes at all levels due in 2007-8²⁸. Many sectors of the science education community view this division as too powerful in the current political vacuum and are concerned that the organisation has been left with responsibilities beyond its resources.

While many teachers we spoke to highlighted constant change as their main concern, there are hopes that the new curriculum will prove to be an opportunity for improvements to science education. The GTCNI review of CPD highlighted concern among teachers about implementing the new curriculum, and steps are being taken to address this. However, implementation is not the only concern that teachers have about the new curriculum.

The teachers we spoke to were very dissatisfied with CCEA's consultation process. They were concerned about manipulation of results, misunderstanding of responses, ignoring teachers' input, asking leading questions, misrepresenting proposals, not consulting at the right time, and writing such long-winded documents that teachers simply could not realistically take the opportunity to respond. This has resulted in a strong feeling of mistrust among the teaching community, and a risk of unwillingness to implement changes. In many cases teachers, are bemused at CCEA's decisions. Some thought that the curriculum reform process had pandered to intra-subject rivalries.

There is a general opinion that current teachers should be more closely involved in curriculum development. They have clear ideas about curriculum content, and are well placed and motivated to develop these. Some commented to us that CCEA staff 'must have forgotten what it's like in the classroom'. While this concern has already been acknowledged by the education Minister, it is vital that it be addressed in an appropriate way.

Widespread use of a single exam board makes the transition from school to university slightly easier in Northern Ireland than in the rest of the UK. For example, there is generally consistency in the mathematics that has been covered at A2 level. However, there may be a lack of awareness among those designing and delivering undergraduate courses as to the changes that are occurring at school level. Likewise there is a lack of awareness among secondary school teachers as to what changes are occurring at primary level. While it is to a large extent the responsibility of educators to remain up-to-date with changes, CCEA could do more to publicise its work. Consultation documents are typically only sent to those teaching at the particular Key Stage in question. However, teachers at earlier or subsequent stages may also have valuable contributions to make, and should be made aware of the details of the reform process. A stronger effort is needed in the fields of communications and publicity.

²⁸ See CCEA's Pathways website

In *Science and Engineering Policies for the Next Parliament*, CaSE recommended for England that “the Qualifications and Curriculum Authority needs to liaise more effectively with higher education institutions in order to address the issue of the interface between school and university science courses”. If anything, this applies to an even greater extent in Northern Ireland.

CCEA does not appear to make sufficient use of university expertise when it comes to determining syllabus content. Only a few members of Northern Ireland’s universities have contact with the authority. One barrier to communications is that there is little incentive for individual university staff in terms of career structure, ratings in the Research Assessment Exercise or financial reward. A further barrier to involvement has been the attitude of the CCEA itself. Academics told CaSE that their attempts to join CCEA curriculum boards had repeatedly been rejected over a period of over ten years. They also pointed out that some relevant areas can be excluded unintentionally. For example since engineering is not a school subject, these faculties can easily be neglected, even though maths and science qualifications are essential for engineering.

In our *Science Policies*, CaSE set out that “science must remain part of the curriculum throughout compulsory education. Giving up science at any earlier age would mean that students would be limiting their options of subject choice far too early on, and would mean that not all students reached a basic level of science knowledge to which they are entitled. Following the recent decision to remove modern languages from the core subjects for the 14-16 age group, the Government was surprised to find that at least a quarter of students have now opted to study no foreign language at Key Stage 4. The same should not happen to science lessons”. This was written bearing in mind the age at which students *give* up science, rather than the age at which they *take* it up.

CaSE emphasises the need for a curriculum that maintains pupils’ and teachers’ enthusiasm. Allowing primary teachers the flexibility to cover only the topics which they feel are appropriate and are comfortable teaching will help to achieve this. It is also important to appreciate that at primary school level, much of the work is project-based and includes aspects of several disciplines. For this reason the primary teachers to whom we spoke thought that a more integrated approach to subject boundaries in the curriculum would be appropriate.

The main concern about delaying the start of compulsory science was about how this would affect standards further down the line. University staff were undoubtedly the most concerned group, and felt that pupils’ progress was being sacrificed for the sake of ‘selling’ science to them. However, according to the views of some of the post-primary teachers we spoke to, the changes could actually quicken a pupil’s progress during Key Stage 3.

The current national curriculum has not served to provide sufficient consistency between primary schools, with the result that post-primary teachers sometimes have to re-cover most topics in order to ensure that pupils are all up to speed. This interface was identified as a problem, and teachers were unanimous about the importance of a joined-up approach to designing each stage in the curriculum. ‘Horizontal continuity’ between mathematics and science was also raised as an important issue. CCEA must ensure consistency between different curriculum areas. The current repetition of content at Key Stages 2 to 4, and between different curriculum areas, mean that pupils get bored in lessons.

There was a strong consensus among the primary school teachers whom we consulted that the new, more flexible curriculum will be a good thing. There would be more opportunities for hands on science, and teachers will be able to spend more time on topics in which they are confident, competent and interested.

There is also an issue that in some cases, primary teachers' lack of scientific knowledge and understanding has misled pupils on some scientific issues. This could be avoided under the new Key Stage 1 and 2 regulations. Throughout the UK, most primary school teachers have no post-compulsory science education, and are less confident in teaching science than other subjects²⁹. The primary school teachers we spoke to openly acknowledged the lack of science background among themselves and their peers, recalling the reaction of the workforce to the introduction of compulsory science as 'fear and panic'. One educationalist commented to us that 'the old physics curriculum was written so as to be unintelligible to most primary teachers, this resulted in teaching to test'.

Unpicking misunderstanding of scientific concepts and then 'starting from scratch' takes up additional time during the first few years of post-primary. The post-primary teachers we asked about this were confident that they would be able to bring students up to at least current standards at Key Stages 3 and 4. They also thought that pupils would enjoy physics more if it was taught thoroughly and accurately later in their educational careers.

Chief examiners have been told that science must still be taught, even if it is not to be assessed. Teachers pointed out that students and parents find it easier to recognise the value of courses that lead to a qualification. Although little is likely to change in the next few years, teachers are concerned that room has been made for science to be dropped in the longer term, perhaps as a response to future teacher shortages. Post primary teachers were outraged at the principle that post-14 science should be non-compulsory. They felt this provided an opportunity to 'dump' lower ability sets and give up on their science education.

At primary and post primary levels teachers were unanimous in wanting more time and flexibility to include practical classes in the curriculum.

If the new compulsory requirements mean students end up taking two rather than three sciences, teachers would not be concerned - this would merely be reverting to the situation that pertained several years ago. Chemistry and physics uptake would 'inevitably' suffer. Teachers think pupils have more to gain by developing their skills in a particular area, rather than be pressured to somehow cover 'the whole of' science. The history curriculum was cited as an example: students develop their skills looking in-depth at a few different historical periods or events, but are not expected to memorise a few facts from each period from across the whole of history. In science, the problem is exemplified in that students are required to know what momentum is, but not to know anything about it.

²⁹ for example Ofsted has surveyed this in England

Appendix 1

Participants in CaSE's Opinion Forum meetings in Northern Ireland in December 2005

Bob Bankhead, Science Teacher
Jim Beggs, Graduate School of Education, Queen's University
Martin Brown, NISEF
Kevin Burness, Primary Teacher, Science and ICT Coordinator
Paul Canavan, Science Teacher
Maureen Eccles, Primary Teacher, Science Coordinator
J Emmerson, Science Teacher
Jeremy Farrell, Primary Teacher [Principal]
Cathy Ferrin, Primary Teacher
Mr W. Gordon, Science Teacher
Caroline Greer, Science Teacher and representative of the Association of Science Education
Chris Hardacre, School of Chemistry and Chemical Engineering, Queen's University
David Hatton, Engineering Training Council
Alan Hibbert, Department of Applied Mathematics and Theoretical Physics, Queen's University
Clare Hill, Primary Teacher
Lesley Hunter, Primary Teacher
Mr R Irvine, Primary Teacher
Harry Johnston, School of Civil Engineering, Queen's University
Steven Kelly, Primary Teacher [Assistant Principal]
Marian McAllister, Primary Teacher
Mrs Linda McKee, Primary Teacher
Hugh McKenna, Dean of Life Sciences and colleagues, University of Ulster
M. McLaughlin, Primary Teacher
Richard Millar, University of Ulster
Edwin Mitchell, Science Teacher
Lorna Monroe, Science Teacher, and representative of the Association of Science Education
Rosemary Moore, Science Teacher
Robin Morrow, Science Teacher
Collette Murphy, Graduate School of Education, Queen's University
Lisa Murphy, Primary Teacher
Brian O'Donnell, Science Teacher
Catherine O'Jeill, Science Teacher
Peter O'Prey, Primary Teacher
Colin Press, NISEF
Irvine Richardson, the Principal Science Inspector for Northern Ireland
Maggie Robinson, Learning and Skills Development Agency
Therese Searle, Primary Teacher, Science Coordinator
Dr. John K. Watterson, School of Mechanical and Aerospace Engineering, Queen's University
Brian Wheeler, Science Teacher
Maureen Young, Science Teacher

Appendix 2

Abbreviations and website addresses:

CASS	Curriculum Advisory and Support Service	
CCEA	Council for the Curriculum, Examinations and Assessment	http://www.ccea.org.uk
DELNI	Department of Employment and Learning	http://www.delni.gov.uk
DENI	Department of Education	http://www.deni.gov.uk
DETI	Department of Enterprise, Trade and Investment	http://www.detni.gov.uk
ETI	Education and Training Inspectorate	# see DENI site
ELBs	Education and Library Boards:	
	Belfast	http://www.belb.org.uk
	North Eastern	http://www.neelb.org.uk
	South Eastern	http://www.seelb.org.uk
	Southern	http://www.selb.org
	Western	http://www.welbni.org
GTCNI	General Teaching Council	http://www.gtcni.org.uk
HESA	Higher Education Statistics Agency	http://www.hesa.ac.uk
JCQ	Joint Council for Qualifications	http://www.jcqq.org.uk
LSDA	Learning and Skills Development Agency	http://www.lsdn.org.uk/ni/
	Northern Ireland Assembly	http://www.niassembly.gov.uk
NICS	Northern Ireland Executive	http://www.nics.gov.uk
NIESU	Northern Ireland Educational Support Unit	http://www.qub.ac.uk/edu/niesu/
NISRA	Statistics and Research Agency	http://www.nisra.gov.uk
NITEC	Teacher Education Committee	# existed 1994-2002 #
NISEF	Northern Ireland Science Education Forum (also Northern Ireland Student Endowment Fund)	
PMB	Partnership Management Board	http://www.pmbni.org.uk
SENTINUS	SETPOINT Northern Ireland	http://www.sentinus.co.uk
UCAS	(universities and colleges admission service)	http://www.ucas.co.uk
UCET	Universities Council for the Education of Teachers	http://www.ucet.ac.uk

Think-Create-Innovate DETI's Innovation Strategy.

<http://www.detini.gov.uk/cgi-bin/moreutil?utilid=19>

included Further and Higher Education, but not school-level issues.