IOP Institute of Physics

Sir Martin Taylor,
Chair, Vision project committee,
The Royal Society
6-9 Carlton House Terrace
London SW1Y 5AG

15th March 2012

Dear Sir Martin,

Response to call for views on Vision for science and mathematics education 5–19 project

Please find attached a summary of the Institute's responses to your questions and some previous consultations that you might find helpful.

This is a very wide-ranging call for views in a large and complex area of policy. It would be possible to write at some length under each heading. However, it would be impossible to produce such a response in the time available. We have therefore provided brief responses to your questions with links to previous evidence, reports and policy responses that express our views in more detail. We suggest that we can pursue these in more depth in discussions if that would be helpful.

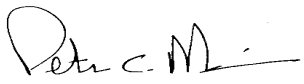
The Institute is active in all of these areas; working for over twenty years conducting research, running pilot projects, informing policy and, currently, managing two major national programmes for the Department for Education (the Stimulating Physics Network and ITT scholarships in physics). Its education department has 20 full-time staff and a network of over 70 field workers providing CPD and support for teachers.

The Institute is a partner in SCORE and has worked closely with other SCORE partners, including the Royal Society, in developing policy and responses.

For a broad overview of the Institute's position, covering many of the questions in this call for views, please see our response to the Education White Paper of 2010[1].

The Institute of Physics is a scientific charity devoted to increasing the practice, understanding and application of physics. It has a worldwide membership of over 40,000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

Yours sincerely



Prof. Peter Main
Director of Education and Science

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[1] *Institute of Physics, 2011, Response to Education White Paper: The Importance of Teaching*

General questions

1) ***Science and mathematics education in the UK***

a) What is good about UK science and mathematics education?

- There is a lot that is good. However, in most areas, there is a lot of variability and therefore room for improvement
- Strong tradition of high quality teaching in the sciences and maths
- Strong tradition of using practical work to teach the sciences and develop skills
- Some very high quality teachers, teacher trainers and educational researchers
- A tradition of successful innovation in science education
- Good, and stable, performance in international comparisons

b) What aspects of UK science and mathematics education need changing and how may they be improved to meet the challenges of the 21st century?

- The dire shortage of physics specialist teachers. Of the 30,000 science teachers (in England), we would expect about 10,000 of them to be physics specialists; it is more like 5,800[2] – a shortage of ~4,200. We reckon that there are at least 500 state secondary schools (out of 3,300) that have no specialist physics teacher.
- To correct the shortage (of ~4,200) we need to recruit specialist physics teachers at a rate of about 1000 per year; happily, there is movement towards this.
- Even then, it will take about 15 years to correct the imbalance, so we also need to work with non-specialist teachers to improve their knowledge of, interest in and enthusiasm for physics; this is something the Institute is doing effectively through the government-funded *Stimulating Physics Network*[3].
- We need clear and useful pathways for all leaners. This is particularly true up to the age of 16 but also applies beyond that. It is also particularly true for those wanting to follow a vocational pathway but, again, it also applies to academic routes[4].
- Related to that, we need clear purposes for each of the GCSE study schemes (Science; Science plus Additional Science and 'Triple Science'). The time is right to have a rethink of what options are available, what they are for and where they lead.
- Physics A-level would benefit from being more mathematical[5] (*Mind the Gap* report, attached). And it would be useful to structure the A-levels in the sciences and maths so that students can follow useful and coherent programmes in which they can use, develop and be credited for mathematics that supports their science studies, without necessarily taking A-level maths.

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[2] SCORE response to DfE, 2011, *Training our next generation of outstanding teachers. An improvement strategy for discussion*

[3] Institute of Physics, *Stimulating Physics Network. www.stimulatingphysics.org/about-us.htm*

[4] A SCORE response to the Department for Education consultation 4 January 2012, *Study Programmes for 16-19 year olds*

[5] Institute of Physics report, July 2011, *Mind the Gap. Mathematics and the transition from A-levels to physics and engineering degrees*

- The system will only respond if HE asks for more mathematical sophistication in the A levels.

c) *What, if any, broader educational issues concern you? (These may or may not relate directly to science and mathematics education)*

- The combination of competition between awarding organisations, arbitrary performance measures and high stakes examinations, which has led to a reduction in the quality of assessment items, in teaching and learning and in standards[6].
- The difference in grading severity between subjects at A-level[7]. Physics is more than a grade harder than some other subjects. When this is combined with school performance tables (based on A-level grades) and the fact that schools can provide predicted grades (based on GCSE results) to students when they make their choices, there is an incentive on both schools and students to avoid physics. The only students who are predicted the same grade for physics as, say, Media Studies A-level are those with 10 A*s at GCSE.
- The lack of diversity (relating to gender[8], ethnic origin[9] and socio-economic background) in the population of students who take physics beyond GCSE.
- The National Curriculum Review; we are concerned about the pace of the review, the structure of the review bodies and the review process[10].
- The reporting requirements (league tables) are so blunt that they are leading to many unintended consequences, distorting what schools are trying to do.
- We need better statistics on the workforce and their deployment; i.e. the qualifications and experience of teachers in schools and what they are teaching.
- We need the ability to track students throughout the educational system (particularly at the interface into HE) and even into employment.
- There is a lack of stretch and systemically low expectations.

Other comments:

2) Science and mathematics education internationally

- We should be very careful about selectively picking (and then mixing) individual attributes from a collection of high performing jurisdictions. As an example, the high-performing Finnish education system is very different in its structure and philosophies to our own; its success in international comparisons is as likely to be related to those differences than to its science curriculum[11].

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[6] SCORE (response to Select Committee Inquiry) 7 November 2011, *How Should Examinations for 15-19 Year olds in England be Run?*

[7] Coe, Searle et al, 2008, *Relative difficulty of examination in different subjects, summary report.*

[8] Institute of Physics, 2006, *Girls in the Physics Classroom.*

[9] Institute of Physics and The Royal Society of Chemistry, 2008, *Why choose physics and chemistry? The influences on physics and chemistry subject choices of BME students*

[10] SCORE, April 2011, *National Curriculum Review, response to call for evidence*

[11] Oates, Cambridge Assessment 2010, *Could do better*

Teachers (and the wider workforce)

The biggest single external influence on learners' progress in, engagement with, understanding of and enjoyment of the subject is their teacher. It is essential, therefore, that there is a complete, professionalised, engaged and satisfied workforce that includes enough accomplished teachers with expertise in teaching physics.

Please note that a number of the answers in this section relate to physics, rather than science, teaching.

1) Teaching as a career

a) What needs to be done to make teaching a top career choice for trained scientists and mathematicians?

- Improved status; better professional recognition, less regulation.
- Closer links to their subject communities and career progression that stresses links to the subject without taking them out of the classroom into management.

2) Initial Teacher Training

a) What should the minimum entry requirements be for entry to primary and secondary science and mathematics teacher training courses?

- Primary: this is a big question. The first step is to get the curriculum right (it currently contains too much inappropriately high level content). Once that is set, then we can determine what the needs of the workforce are. However, there is a real problem with a shortage of science graduates.
- Secondary[12]: There are two main routes to teacher training in physics:
  - Physics/ Engineering Degree
  - Other degree + Subject Knowledge Enhancement course

b) Should diagnostic tests be applied to test the suitability of candidates? If so, what types?

- It has been difficult to develop tests which predict aptitude for teaching[13]
- A typical is a study in the Chicago area (Aaronson et al, 2007) which found that "gender, race, teaching experience, undergraduate university attended, advanced degrees, teacher certification and tenure explain less than 8% of teacher quality".
- We remain convinced that the aim should be to recruit subject specialists. As well as being more likely to have (or be able to quickly acquire) the necessary subject knowledge, they are more likely to be inspirational. This is supported by UPMAP[14].
- Subject knowledge is amenable to testing and we have on-line tests that could be used diagnostically within training and as a measure of knowledge on completion.

b) Should inducements be offered to attract entrants into science and mathematics teacher training? If not, why not? If they should be offered, then why and what might they be?

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[12] SCORE, 2011, *Subject Specialist teaching in the Sciences: definitions, targets and data*

[13] SCORE, response to the Education Select Committee inquiry, October 2011, *Attracting, training and retaining the best teachers*

[14] Institute of Education. *Understanding Participation rates in post-16 Mathematics And Physics.*

- There is some evidence that incentives have aided recruitment. Smithers[15] shows the effects of recruitment incentives (typically £6000) on PGCE recruitment in England on applications and acceptances. This has to be set against the background of general new graduate unemployment.
- It would be more productive (especially on retention) to offer better career progression – possibly through links to professional bodies; and to offer teachers of sciences opportunities to explore other interests (either educational or scientific) whilst remaining a teacher.
- More people with higher degrees will raise the status of teaching; the IOP ITT scholarships (funded by the DfE) are contributing to this.

c) *What is good about initial teacher training programmes in science and mathematics in the UK?*

- Tutoring is based on the needs of the individual and not distorted (or narrowed) by the needs of a particular school

d) *What changes to these programmes (e.g. philosophy, content, or emphases) are needed?*

- Not all physics and engineering graduates want to teach the other two sciences. 25% of physics graduates who go into teaching choose to teach maths. We hope that some of them will be kept in physics by the new Physics with Maths PGCE.
- PGCE providers are unique, within HE, in the way that they are subjected to two inspections: Ofsted and the REF.
- The current, sequential system for admission to ITT is inefficient and off-putting (many applicants drop out after their first rejection). A parallel, or central, application system would be more efficient, consistent and effective at keeping potential teachers in the system.

e) *How can the standard of science and mathematics initial teacher training programmes be of a consistently high quality across the UK?*

- Currently, there is no requirement to test subject knowledge for QTS[16].
- The Institute has found (from the IOP ITT scholarships applications) that degree class is not a good predictor of subject knowledge at school level.

g) *In what sort(s) of institution(s) should science and mathematics teacher training take place? Why?*

- It is important that trainees have contact with someone outside school; and that that person is connected to research in educational good practice.
- The current model where university-based teacher trainers are expected to do original research themselves is poor and should be rethought. Their primary role should be training and good trainers will not necessarily have the experience or skills to do the research; in most other subjects, typical academics appointees have at least 6 or 7 years of research training and experience after their first degree. .

h) *How much of this training should be spent gaining experience in the classroom?*

- The current amount of time is about right. However, the missing piece is the subject knowledge (see below).

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[15] *University of Buckingham, Report for the National Union of Teachers, Smithers & Robinson, 2001,* Teachers Leaving*,*

[16] Institute of Physics response to DCSF, 2009, *Teacher Training Inquiry*

i) *How long should courses be for training (i) primary; and (ii) secondary science or mathematics teachers to become fully qualified?*

- PGCE programmes are too short to enable trainees to acquire the subject knowledge they need to go into teaching. We advocate a longer (by at least 6 months) PGCE which includes a subject knowledge primer
- There should also be adequate time to develop pedagogical content knowledge (PCK).

3) Continuing Professional Development (CPD) for teachers

- From the remit of the National CPD committee:
  The biggest single external influence on learners' understanding of, achievements in and enjoyment of the sciences is their teachers. Good teachers need to be nurtured, supported and developed to provide the best possible experiences for their learners. Effective, **subject-based Continuing Professional Development** plays a crucial part in having accomplished teachers with strong expertise in teaching the sciences.
- CPD can have a number of purposes for a teacher of physics:
  - Improve subject knowledge (particularly acute for the thousands of non-specialist teachers)
  - Improve pedagogical content knowledge (PCK)
  - Provide a shot in the arm about cutting edge developments in physics
- There is more to CPD than one day, off-site courses. Observing lessons, team teaching, in-school work with whole departments are all likely to be more effective. The key to engagement and success is participation rather than delivery.
- The delivery and cascade model is flawed and, in some cases (notably for non-specialist teachers) cannot work; we find that bespoke, continued, in-school, group (often whole department) CPD is most effective[17].

What are the benefits of subject-specific CPD for science and mathematics teachers?

- Improve subject knowledge (and therefore satisfaction of learners)
- Improves the quality of lessons – more confidence etc.
- Developing confidence in using apparatus and practical work in teachingl
- Enables teachers and learners to gain an overview and a deep understanding of the subject at school level
- Improve retention
- Develop capability within the system
- Develops PCK
- Overcome the temptation for teachers simply to do what was done to them (especially important for non-specialist teachers)
- It can build a team spirit in a department and engender a culture of physics (in which physics is valued, discussed and part of teachers' pedagogical thinking) within science departments.

How should science and mathematics teachers best keep up with their subject and with new approaches to teaching, assessment and the curriculum?

[17] Institute of Physics, 2011, *Stimulating Physics Network, an impact report*

- The Institute runs a series of *Physics Updates* for established physics teachers. These are based in a university department and include lectures in cutting edge physics and engineering (from the academic staff) and pedagogical issues (from CPD providers). The Updates give teachers a welcome shot in the arm and a reconnection with the subject at university level.
- The Institute is embarking on a project called *Translating Research into Practice*. The aim of this project is to link CPD providers and teacher trainers with education researchers. We have run a conference along these lines in each of the last two years.

c) *At what times throughout their teaching careers and with what regularity should teachers undertake subject-specific CPD?*

- Throughout; but more intensively at the start. We advocate mentoring of early career teachers and will be supporting 400 physics NQTs in 2012.

d) *Should CPD be voluntary or mandatory? Why?*

- It should be an entitlement – i.e. it should be mandatory for schools (and their leaders) to provide CPD opportunities for teachers when they need it.
- It is worth exploring the possibility of, say chartering (see below), which would require continued engagement with the chartering organisation. This might take the form of CPD but in its broadest definition. The aim is to ensure reflective practice and the continued development of teachers' competencies; CPD will be one way of achieving this.
- Chartering – or other accreditation - will be most effective if it is at the subject level, not at a general teacher level (such as MTL) or even at the level of science – CSciTeach. Most physics teachers will identify themselves with physics rather than science or a general teaching accreditation.

e) *Are there key obstacles preventing science and mathematics teachers from accessing subject-specific CPD? If so, how can these be overcome them?*

- Senior leaders tend to fund CPD that supports whole school issues rather than professional development as a subject teacher. Whole school issues are often highlighted in Ofsted reports and senior leaders are, quite rightly, expected to address them.
- However, there are no external drivers to prioritise subject-based CPD. It might be highlighted through internal performance management, but it will be given a lower priority (within the limited budget) than the Ofsted-highlighted issues – because they are public.
- The cost of providing time for teachers to take part in CPD; i.e. the cost of providing cover.
- Some schools put limits on how much time teachers are allowed to access cover – this includes for school trips, meetings and CPD.

f) *Should subject-specific CPD be linked to broader CPD development strategies within schools and colleges, for example in areas such as leadership and assessment?*

- The development of subject knowledge and PCK within a school science department should be part of every school's strategy. It makes sense for senior leaders – through heads of department – to be responsible and accountable for developing these competencies as part of their leadership strategy.

g) *Should CPD be accredited (eg through the awarding of Masters-level credits)?*

- This is an area that the Institute is investigating. However, we are looking at a chartering route rather than Masters level credits.
- One difficulty with using Masters-level credits is that it requires an element of research. Whilst some teachers are suited to, enjoy and benefit from research, it is important to

engage (and develop professionally) those who are not. Scholarship is as valid as (and in some cases more valid than) direct research in developing professional competencies. The fundamental need is the on-going development of professional competencies. Research represents only one route to developing some of those competencies for some people. So an accreditation that relies on research is not going to cover all types of development and engagement, whereas chartering could do so.

4) The wider workforce

a) How and where should we be training laboratory technicians?

- School lab technicians are a vital part of the workforce. We would like to see a registration system to provide and recognise basic and continued training and development.

c) Will there be a role for teaching assistants in science and mathematics classes? If so, what should this be? How and where should they be trained?

- Teaching Assistants are often seen as a way of providing additional staff whilst saving on the cost of teachers. Research recently reported by the Sutton Trust has shown that their effect on learning is questionable and may be detrimental. Replacing part of the role of the teacher in a science laboratory with someone who is neither a teacher nor a scientist is a particular concern.

d) Who should be responsible for providing advice on careers in or related to science, technology, engineering and mathematics (STEM)?

- We have found ourselves in a position where STEM subjects are the only ones that promote specific careers to students. This can be counterproductive (teenagers do not necessarily have a self-image that involves, for example, working in a factory for the rest of their life). Careers advice in schools should cover all subjects.
- The emphasis for the advice should not be on specific jobs (which are unlikely to appeal to many, if any, students in a class); instead it should promote the idea that STEM subjects open doors for the next step. Taking STEM subjects keeps open the most possibilities.

Leadership and ethos

- There need to be routes for excellent classroom teachers to be promoted but to remain in the classroom. It is likely that this would have to be through a national scheme and would relate to the chartering described above. One possibility would be to allow promoted or chartered teachers time to take on national roles (CPD, curriculum development, research, working on assessments). All of these are currently possible but they do not form part of a leadership structure. So, for example, there might be ‘leaders in physics education’.
- The AST scheme became too fragmented; there is no central register, for example. As a result, it is often used as a retention device without producing any local or national impact.
- The Institute’s experience with the Stimulating Physics Network has shown that it is vital that schools (and therefore their leaders) recognise the importance of STEM subjects and that this culture is shared across the school. A culture in which the sciences are undervalued by the senior leaders and/or by other subject teachers is off-putting and undermines the efforts of the science teachers. There needs to be a whole school attitude that is positive about the sciences and maths (and, of course, history, geography, English and languages etc.)
- This is particularly true if we are to encourage girls to take physics (we have come across examples of teachers of other subjects saying to girls that it is a boys’ subject). Getting girls to take physics is a whole school issue rather than an issue for physics.

Skills, Curriculum and Assessment

The biggest single external influence on learners' progress in, engagement with, understanding of and enjoyment of the subject is their teacher.

The physics curriculum is the structure that allows teachers to engage learners and help them get better at physics. The curriculum can only ever be built around content, contexts and ideas. It cannot in itself stimulate interest or understanding; this comes from excellent teaching. However, it must provide the framework that allows teachers to make the subject engaging, stimulating and comprehensible.

a) *What skills are particularly important to young people's progress in (i) science and (ii) mathematics, and when should they begin to acquire them?*

- This is a huge question. It is best addressed through our response to the National Curriculum Review.
- However, one particular area of concern is the primary phase. There has been a trend for more and higher level science content to be introduced at primary school; on the basis that the sooner they grasp it the better. This is flawed and counterproductive. Much of the physics content in the primary National Curriculum is at too high a conceptual level for learners to grasp it in a way that is satisfactory to them and gives them lasting understanding. Instead, they are drilled in learning and labelling tasks which give a poor reflection of science, leaving them frustrated and demotivated. They often (have to) repeat them later – which further dulls their experience of science.
- If there is any physics at primary school, it ought to be chosen so that it develops useful attitudes (including inquisitiveness, enjoyment and an appreciation of the explanatory power of science) and some skills (including literacy, numeracy, manipulative skills, using scales). In other words, science at primary school needs some content through which to develop these attributes. But the content should not be the driver – there is plenty of time to study such conceptual content properly at the appropriate age.
- We would like to see more coherence between mathematics and the sciences in schools; both in the way that they are taught and when mathematical ideas are taught and used.
- A common complaint about students entering physics and engineering courses in HE is that they lack fluency in the use the mathematics: they have usually met most of the relevant mathematics but are not well-practiced in its application. The comment applies particularly to the use of mathematics in modelling a physical problem.

e) *What characteristics of assessment best serve learning in its various forms in school science and in mathematics?*

- Assessment of pupils should be disentangled from school accountability and performance measures. Only then will students' study programmes and learning be driven primarily by their needs.
- Assessment also plays a major role in influencing what is taught and learnt and assessment schemes are important for setting the ethos of a subject. So, for example, it is important to retain some form of practical assessment.

f) *To what extent can/should science and mathematics be effectively assessed through other subjects?*

- For physics, not at all.
- However, there should be coherence with maths and the way that, for example, mechanics, is taught.

g) *At what age(s)/stage(s) should public examinations and testing be conducted during students' school careers?*

- Not at 11 or 14; 16 and 18 seems fine.

Infrastructure

Infrastructure refers to the nature of the learning environment in which formal teaching and learning take place. For the purposes of this exercise, picture an 'ideal' learning environment of the future (in one or two generations' time, for example) which has all the resources and support systems in place to enable the best possible teaching and learning in science and mathematics.

c) *What kinds of specialised facilities, linked to key areas of learning in science and mathematics, should be available in the future?*

- Clearly, the sciences need laboratories and technicians to enable practical work – which is an essential part of the sciences[18]. These can be costly to run. Therefore, we have grave concerns about the changes to the funding formula for post-16 education and the loss of the 12% weighting given to the teaching of the sciences – through the funding of complete study programmes rather than individual qualifications[19].

f) *What other more general changes to school infrastructure would support excellent science and mathematics teaching and learning? How can we measure this?*

- Bringing physics and maths closer together, perhaps in a "faculty" structure" allowing for cross over for individual teachers. But also cross-fertilisation and improved coherence between the subjects.
- Move away from the notion of a subject called science beyond Year 7. Similarly, move away from the notion of a 'science' teacher – unless they are a specialist in teaching science in Year 7. Above that level, they should be a recognised specialist (or additional specialist) teacher in the discipline (physics, chemistry or biology) that they are teaching.
- We have found through our work on the *Stimulating Physics Network* that there needs to be a positive culture of physics in school science departments. This can come about through the department having a full complement of committed specialist teachers of physics[20]. But it can also be developed through effective CPD with a whole department of non-specialist teachers. Many adults (who have now become biology or chemistry teachers) had a poor experience of physics at schools but, once they revisit the subject through effective CPD, they find it immensely rewarding and interesting. Consequently, they discuss it amongst themselves and bring the evangelism of the convert to their students, thereby improving student motivation and success[21].

g) *What evidence is there of the effect on their learning of science and mathematics of separating cohorts by (i) age and (ii) gender (e.g. should there be single sex classes or schools)?*

- No evidence that single sex classes improves the uptake of physics by girls.
- Although single sex schools get better uptake, this is probably more to do with the can-do attitude within the school rather than the fact that all the classes will be single sex.

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[18] *A SCORE response to the Science and Technology Committee, 2011, Laboratory and field work*

[19] *A SCORE response to the Department for Education consultation document, 2011, 16 -19 Funding Formula Review*

[20] *Smithers & Robinson, University of Buckingham, for Gatsby Charitable Trust, 2005, Physics in Schools and Colleges, Teacher Deployment and Student Outcomes*

[21] Babcock Research for IOP, 2012, *Interim Top-line Data: AS and A2 Physics 'Starts' in Stimulating Physics Network Partner Schools*

Accountability

Those who are responsible for science and mathematics education within schools and colleges should be accountable for their performance.

a) *How should science and mathematics in a 5□19 education system best be made accountable to (i) students; (ii) parents/guardians/carers; (iii) higher education; (iv) employers; (v) taxpayers; and (vi) ministers?*

- Schools should be judged on what they are trying to achieve. Blunt measures associated with simple examination passes in GCSEs and A levels will simply reinforce differences between schools and lead to students taking inappropriate qualifications. We have worked in schools where even a hint of a change in the reporting criteria led to a wholesale change in the qualifications offered by the school.
- What is really required is not accountability but involvement and commitment. If parents, students, employers and HE took more interest, the world would be a better place.

b) *How should qualifications in science and mathematics be regulated?*

- The professional bodies have a role in setting the criteria for A-levels and accrediting specifications. The professional bodies are well placed to act as a guardian for their disciplines by bringing together a single committee for their subject that includes academics from higher education, professionals and teachers
- We think that proposals from Awarding Organisation through which each AO would have its own committee are unworkable and likely to lead to widespread duplication and dilution of quality[22].
- The objection that some subjects, such as Media Studies, do not have a professional body can be countered with the fact that there is a good mapping between the subjects that do professional bodies and that require a core of required knowledge and skills to allow progress to the next stage.
- Exams should be regulated by Ofqual[23]; but it needs to be given greater powers.
- In particular, Ofqual should be able to look at exam papers before they have been taken – to act as an air traffic controller rather than their current, limited, role of crash scene investigator[24].

c) *How can we ensure that all students can access the science and mathematics courses they wish to?*

- By having a complete, well trained and updated workforce

d) *What are (ii) the disadvantages of performance targets and do any apply particularly to science or mathematics education?*

- They have completely wiped out the notion of a useful grade below C (at GCSE); in most schools, D is seen as failure, which, among other consequences, means that much of the

[22] Institute of Physics response to Cambridge Assessment, 2011, *Consultation on higher education/awarding body engagement*

[23] SCORE response to Ofqual consultation, 2011, *From Transition to Transformation – Strategic Regulation of Awarding Organisations and Qualifications*

[24] SCORE response to the Education Select Committee inquiry 7 November 2011, *How Should Examinations for 15-19 Year olds in England be Run?*

teaching is focused on the C-D border, often at the expense of stretching the more able pupils.

- There is a danger of the E-Bacc morphing from a school performance measure to a certification that all students will be expected to get[25]; that change would not be appropriate for a great many students.

e) *How should measures of performance best be reported to different audiences? What other measures of performance may be required?*

- Progression rates (by gender)
- Some measure of appropriateness of study programmes for students

Permissions

a) Are you content for us to publish extracts of or the whole of your submission? Yes

b) Would you like to be kept in touch with the project? If 'yes' please provide a contact email address. Yes

email address: peter.main@iop.org

[25] *SCORE response to Department for Education, 2011, The English Baccalaureate*

Enclosures

1. Institute of Physics, 2011, Response to Education White Paper: The Importance of Teaching http://www.iop.org/policy/consultations/education/file_50527.pdf

2. *SCORE response to DfE, 2011,* Training our next generation of outstanding teachers. An improvement strategy for discussion http://www.score-education.org/media/8171/itt%20strategy.pdf

3. *Institute of Physics,* Stimulating Physics Network. www.stimulatingphysics.org/about-us.htm

4. A SCORE response to the Department for Education consultation 4 January 2012, *Study Programmes for 16-19 year olds* http://www.score-education.org/media/9694/dfestudy.pdf

5. Institute of Physics report, July 2011, *Mind the Gap. Mathematics and the transition from A-levels to physics and engineering degrees.* http://www.iop.org/publications/iop/2011/file_51933.pdf

6. A SCORE response to the Education Select Committee inquiry 7 November 2011, *How Should Examinations for 15-19 Year olds in England be Run?* http://www.score-education.org/media/9364/ed%20select%20exams.pdf

7. Coe, Searle et al, 2008, Relative difficulty of examination in different subjects, summary report. http://www.score-education.org/media/3194/relativedifficulty.pdf

8. Institute of Physics, 2006, Girls in the Physics Classroom. http://www.iop.org/publications/iop/archive/page_41614.html

9. *Institute of Physics and The Royal Society of Chemistry, 2008,* Why choose physics and chemistry? The influences on physics and chemistry subject choices of BME students http://www.iop.org/publications/iop/2008/file_38221.pdf

10. SCORE, April 2011, National Curriculum Review, response to call for evidence http://www.score-education.org/media/7650/scorencevidence.pdf

11. Oates, Cambridge Assessment 2010, *Could do better* http://www.cambridgeassessment.org.uk/ca/digitalAssets/188853_Could_do_better_FINAL_inc_foreword.pdf

12. SCORE, 2011, Subject Specialist teaching in the Sciences: definitions, targets and data http://www.score-education.org/media/7987/spec-teach.pdf

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