



Registration and accreditation of expert teachers in the science

Summary of a seminar organised by SCORE
at the Institute of Physics, 5 February 2010

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This is a report of a SCORE seminar held on 5 February 2010 at the Institute of Physics. The report summarises the main issues raised and describes views presented at the meeting. This report captures the views of participants and does not represent SCORE policy.

1 Background

The SCORE partnership has concerns about the terms specialist and expert teachers in the sciences. The term 'specialist' has many definitions amongst different stakeholders and this has resulted in inconsistent data on the number of subject specialist teachers teaching in England and a lack of focus on subject based CPD. Findings from the seminar will help the SCORE partnership to develop its policy in this area.

This seminar aimed to discuss:

- Definitions of the terms *specialist* and *expert*
- How to recognise and assess expertise
- Accrediting teachers
- Recognition for accreditation

2 The seminar

The seminar was chaired by Professor Peter Main, Director of Education and Science at the Institute of Physics.

Presentations were given about currently held data: Luke Graham of the Teacher Development Agency (TDA) on employment tracking of teachers trained to teach mathematics and science; and Mark Fieldsend of the General Teaching Council of England (GTCE) on science teachers registered with the GTCE.

Professor Robin Millar from the Department of Educational Studies at the University of York gave a presentation on measuring teacher expertise in the sciences.

There were also 3 presentations about current models for accrediting science teachers: the Masters in Teaching and Learning (MTL) by Luke Graham from the TDA; the Science Learning Centre (SLC) Professional Development Award for Science Teachers by Miranda

Stephenson, National Centre Programme Manager from the National Science Learning Centre (NSLC); and the Chartered Science Teacher (CSciTeach) by Kathryn Thomson, Director of Professional Development, Association for Science Education (ASE) and Alisdair Orr, Deputy Registrar of the Science Council.

The seminar split into small groups to discuss the issues raised by and related to the presentations.

Around 50 teachers, representatives of learned societies, academics, representatives of Science Learning Centres, education consultants and SCORE partners participated in the seminar.

3 The purpose of defining the terms *expert* and *specialist* science teacher

The introductory talk by Professor Peter Main highlighted that at present there is no common understanding of the meaning of the terms *specialist* or *expert* science teacher. The term *specialist* has become somewhat devalued as each teacher training institution and school can define it in their own way; it can also be by self-designation. It can simply mean someone who teaches a particular subject.

The government uses the term *specialist* to collect data on the teaching workforce and so it is arguably important that it should have a consistent definition. The difficulties lie in the large number of degrees available in the UK which are classified as science related. With trainee teachers coming in from such a huge variety of backgrounds it can be very difficult to work out who is a specialist in what.

Qualified Teacher Status (QTS) is non-age range and non-subject specific. So there is no mechanism for schools to require (or be required to hire) staff to have a designated qualification to teach a given age range or a given science subject.

4 Recognising and assessing expertise

4.1 Expert teachers

In groups, delegates discussed the likely attributes of an expert teacher in the sciences. Discussion groups suggested that an expert science teacher should

perhaps: be able to enthuse, engage and inspire students; enable learning; not be merely communicating a received set of facts, but encouraging a scientific way of thinking; reflect on their practice; be able to state the learning objectives of each lesson and justify the methods chosen to reach those objectives; be able to change their lesson as they go to meet the needs and interests of students; be able to answer a wide range of questions on their subject.

4.2 The definition of an expert teacher

Professor Robin Millar discussed understanding and measuring subject expertise. He suggested that, in order to understand what teacher expertise is in the sciences, it is necessary to be able to measure it. While it could be claimed that it is possible to spot an expert teacher in action if you see one, really to understand what an expert teacher is requires that the expertise can be quantified. To do this it is necessary to identify what it is that teachers need to know to be able to teach effectively. The knowledge that teachers need in order to teach effectively has been sub-divided into the following categories¹:

- Content knowledge
- General pedagogical knowledge – broad principles and strategies of classroom management which transcends subject
- Curriculum knowledge
- Pedagogical content knowledge (PCK) – the blending of content and pedagogy: how to teach or organise a topic or problem
- Knowledge of learners and their characteristics
- Knowledge of educational contexts
- Knowledge of educational ends, purposes and values.

The most subject specific of these are content knowledge and pedagogical content knowledge. Content knowledge is generally accepted to be necessary, although not enough in itself, for effective teaching. As it is explicit knowledge it is relatively easy to measure but what is hard to determine is how much subject knowledge a teacher needs in order to be effective. Pedagogical

content knowledge is somewhat harder to assess as certain aspects are considered tacit.

Some delegates in the seminar considered teaching expertise to be highly context-related; that pedagogical content knowledge could be viewed as transitory, appropriate just for one lesson, as the pupil context keeps changing. Others disagreed and felt that pedagogical content knowledge was the central core of a teacher's knowledge and equipped teachers with the necessary skills to teach their subject; that while the relevant PCK changed, all lessons would require a teacher to draw upon his/her PCK.

4.3 Linking to other standards

The seminar discussions suggested that definitions could perhaps be linked to the TDA professional standards:

- Qualified teacher status
- Core standards for main scale teachers who have successfully completed their induction
- Post-threshold teachers on the upper pay scale
- Excellent teachers
- Advanced skills teachers (ASTs).

These definitions are neither age-range nor subject specific. It was felt that any definition of an expert science teacher had to have an element of subject knowledge included along with a specification of subject and age range. The particular difficulty in science, which is perhaps not true in other subjects, is that it is possible to have, for example, someone who is an excellent teacher of chemistry to A-level (and therefore designated an excellent science teacher) but who may not have the required expertise to teach physics to GCSE.

4.4 Assessing teachers' content knowledge

While teachers are required to have a degree, the knowledge gained from their academic qualifications is usually very different to that required for them to be effective teachers – even if their degree is in the subject which they teach. In order to define and accredit an expert teacher it may be necessary to get a measure of a teacher's content knowledge. The seminar stressed that it is important this is done in a way which is formative and encourages and supports further learning. There are also some practical issues:

- The reliability of data obtained from any assessment depends on the amount of testing

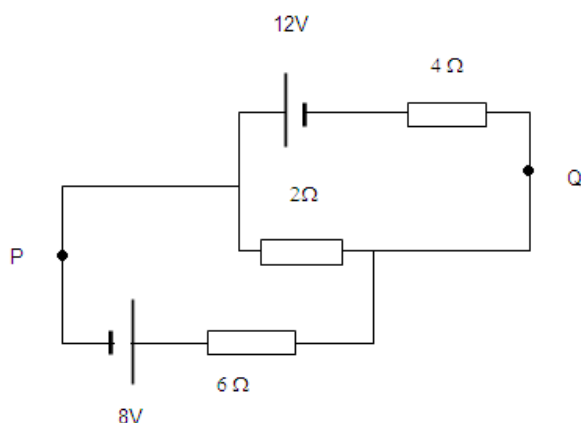
¹ Shulman, L.S. (1987). *Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57* (1), 1-22.
Shulman, L.S. (1986). *Those who understand: Knowledge growth in teaching. Educational Researcher, 15*, (2), 4-14.

time; the longer you take, the better the evidence you gather;

- The assessment needs to be both feasible and reasonable;
- A science subject is a large domain – should any assessment be broad but not in great depth or deep but only covering some sub-domains?
- What kinds of questions should be asked?

In his talk Professor Robin Millar suggested diagnostic tests as one possible method of assessing teachers' content knowledge. Diagnostic questions require the respondent to understand rather than just apply routine algorithms and have been used at the start of the Physics Science Additional Specialist Programme (SASP) to determine how much a teacher knows before taking the course. An example of a diagnostic question from the Physics SASP is demonstrated below:

For the circuit shown, calculate (a) the current in the 2Ω resistor and (b) the potential difference between points P and Q.²



Professor Millar noted that while a test like this could possibly be used to indicate broad areas of strength and weakness, it would not give a full and reliable picture of an individual's understanding. It is not clear at present how many questions of this there are or if similar sorts of questions can be written for chemistry and biology. If a test of this type was chosen to assess teachers' expertise it would need to be validated and tested with key groups such as recent graduates, Newly Qualified Teachers (NQTs) and experienced teachers.

² Mazur, E. (1977). *Peer instruction* (pp. 5-7). Prentice Hall.

A test of this nature would not assess teachers' pedagogical content knowledge. Finding ways of doing so will be much harder as certain aspects of such knowledge are largely tacit.

5 Accrediting teachers

5.1 Accreditation schemes

The seminar highlighted the plethora of accreditation schemes available to science teachers. Current schemes, noted by delegates, included CSciTeach, Chartered London Teacher status, Chartered Chemist, Physicist, Biologist, Scientist, Partnership MEd schemes in local authorities and OU Masters modules post PGCE to raise a PGCE to M-level. There are also schemes for teachers in Further Education (FE).

Schemes in pilot or development stages include the Masters in Teaching and Learning (MTL) and the Science Learning Centre Professional Development Award. In addition there is potentially the introduction of the Licence to Practice (LtP) which would need to be renewed every 5 or so years.

One of the key issues identified in getting teachers and employers to recognise and value accreditation was the plethora of schemes available and confusion as to what each was rewarding.

5.2 How to ensure all teachers can become expert

There was some support for beginning with PGCE courses and making the courses longer and more rigorous, particularly to ensure that they contained more subject knowledge.

There was also some discussion around the idea of there being a ladder of progression of some sort – such as qualified, accomplished and expert. This could provide aspiration and encourage entitlement to Continuing Professional Development (CPD) to facilitate progression. It was noted however that this could have negative consequences as for some teachers it could be demotivating. The consequences for a teacher not progressing would also need to be considered.

There was strong support for putting structures in place to allow teachers access to more subject specific CPD. It was acknowledged that this would need a change in thinking across many schools as such CPD is not always highly valued.

6 Recognition for accreditation

Even with a plethora of additional qualifications and accreditations available, only a small proportion of teachers have taken the opportunity to gain one. It is apparent that the majority of teachers will not be interested in something which appears to be a lot of extra effort and paperwork but which does not have any obvious positive impact on either their career progression or classroom teaching. It would seem that for teachers to value any accreditation it is also necessary for it to be valued by school management and linked, perhaps, either to entitlement to CPD or to pay, perhaps via the current teacher threshold.

There was also agreement amongst delegates that courses are not the sole means of CPD for teachers – there can be much value in observing and being observed by expert and experienced teachers, especially early in a teacher's career.

7 Issues raised

7.1 Masters level content

Groups discussed the potential for the MTL qualification to act as a measurement of teacher expertise in the sciences. It was felt by some delegates that the MTL did not contain enough subject specific knowledge for this purpose and that the ability to perform well on M level tasks may not be a reliable indicator of whether a person is a good teacher; there may be excellent teachers who do not produce high quality research. In addition, it was suggested that in order for school management to value any accreditation it will need to recognise excellence in classroom practice

7.2 11-16 schools

There was general agreement that any definition of *expert* should take into account the teaching age range at which the teacher was accredited. However, there was also a recognition that such a scheme could make it harder for 11-16 schools to recruit if teachers could not become *expert* at 16-18 teaching while working at that school.

7.3 Desirability of accrediting *expert* teachers

There was some discussion about whether it would be

desirable to have a mechanism in place to accredit *expert* science teachers. It is possible that it would ensure some level of quality in the teaching of science subjects, but it may mean that schools might not offer some subjects because they were not able to recruit accredited teachers.

7.4 Degree classification

While there was agreement that there should be a minimum entry requirement to the teaching profession, there was very little support for the idea that all training teachers should have a 2.1 or 1st class degree. While it shows that knowledge has been tested to a certain level, it does not take into account outside interests, other experiences and learning.

7.5 Mathematics teachers

It was generally agreed that mathematics teachers should be accredited in a similar way to science teachers to ensure parity among the STEM subjects.

7.6 Teaching context

Teachers who are able to teach well in a high performing selective school may struggle in a comprehensive school with less able pupils and the converse is also true. Thus the context within which a teacher is working may affect whether they are considered expert.

8 Summary

Seminar participants identified at least 4 aspects to making an accreditation process work:

- Providing entitlement for teachers to take it;
- Having a reliable and valid way of assessing teacher expertise;
- Commitment from schools to support it;
- It being valued by schools and the professions.

They also noted that it should require and provide opportunities for teachers to keep up to date with:

- Subject knowledge (school level);
- Developments in their subject and cutting edge research;
- Subject specific pedagogical ideas.