How do weekly mentor sessions and written lesson feedback support science beginning teachers in explaining complex science concepts?

Research into subject specific mentoring on the PGCE science course at the Institute of Education, University of London, in the academic year 2004/5.

By

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1. Project Overview

How do weekly mentor sessions and written lesson feedback support science beginning teachers in explaining complex science concepts?

How do beginning science teachers[1] learn the art of explanation? This question arose for us a few years ago when we noticed that written feedback from experienced teachers to our beginning teachers (BTs) about their teaching contained relatively few comments, let alone advice, about how to explain the science. Feedback more often focused on generic teaching skills and classroom management. There was no doubt, however, that by the end of the training year our beginning teachers were reasonably skilled at explaining science to a range of pupils of different ages and aptitudes. Where and how were they learning these skills; and what was the contributing role of the experienced teachers with whom they worked? We had long argued that subject specific mentoring was an essential part of teacher training – but had no clear model of the way in which the *process* of mentoring was contributing to the development of beginning teachers' ability to explain science.

The purpose of this research, therefore, was to study the process of mentoring more closely, with respect to the development of beginning teachers' subject specific knowledge which was relevant to teaching. We hoped to develop a model of effective practice, by characterising those interactions between secondary school science mentors and beginning teachers which stimulate productive dialogue about explaining scientific concepts and which support the improvement of beginning teachers' range and depth of explanations which they use in the classroom.

1 Often known in other institutions as 'trainee teachers'

2. Names and institutions of those undertaking the study

Researchers

Project Director: Ralph Levinson
Researchers: Ruth Amos and Jenny Frost

Higher Education Institution

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The three researchers work at the Institute of Education as researchers, lecturers and as tutors on the PGCE science course. Ralph Levinson had worked at the Institute of Education since 1998, Ruth Amos since 2003, and Jenny Frost since 1970. They were therefore researching what was happening within the training programme for which they carried considerable responsibility. The teachers, who agreed to work on the project, and the schools were well known to them.

For information about the project contact the Project Director, Ralph Levinson at: r.levinson@ioe.ac.uk or at the address above.

A link to the full report will be found at Ralph Levinson's web-page by going to www.ioe.ac.uk
then typing in 'Ralph Levinson'.

Schools

The three main schools which took part in the project have not been identified in the report. One was a mixed state comprehensive school in the London Borough of Barking and Dagenham, another a mixed state comprehensive school in the London Borough of Camden and the third a boys comprehensive school in the London Borough of Lewisham.

Mentors and trainees (beginning teachers)

The mentors and beginning teachers in the project have been given pseudonyms, listed below.

The three mentors: Fiona, Ann, Peter

The BTs in the three schools:

School 1 with Fiona as mentor:	Placement 1: Judy and Suzie; Placement 2: Leo and Delipa.
School 2 with Ann as mentor:	Placement 1: Shamira Placement 2: Kate
School 3 with Peter as mentor:	Placement 1: Laura Placement 2: Marie

Other BTs interviewed: Emma, Françoise, Justin, Jonathan, Katerina, Matthew, Michael, Paul, Rachel, Seema.

3. Key Findings and Recommendations

3.1 Findings

1. The role of the mentor in developing BTs' ability to explain science is exercised through a combination of: written and associated oral feedback on lessons; formal scheduled meetings; informal discussions; availability of resources; team teaching; observation of teachers.

2. Written feedback varies not only in what is addressed but how it is addressed. Four types of comment were identified: descriptive, evaluative, advisory and/or justificatory.

3. Descriptive and evaluative statements, on their own, do not help. Focused suggestions with justifications are the most helpful.

4. Written feedback on its own has limited use. BTs learn much more when teachers discuss the written feedback with them, helping them to identify the significance for their own development. It is in these discussions that descriptive and evaluative accounts are likely to develop into specific advice with justifications.

5. A lot of written feedback is about classroom management and organization. This is helpful to beginning teachers especially in the early stages of their development. There is greater variation, between teachers, in the extent to which written feedback addresses subject pedagogy.

6. Provision of feedback is a good opportunity to focus on pedagogical content knowledge (PCK), subject knowledge (SK), curriculum content knowledge (CCK) and the Nature of Science (NoS). There is a wide variety of PCK in written feedback from subject mentors and classroom teachers. There is little feedback on SK and CCK and there are no explicit comments on NoS.

7. Of the comments on PCK in the written feedback, those referring to pupil learning are in a minority. A higher proportion of comments focus on teaching.

8. BTs want and gain from support during the planning process, particularly with PCK.

9. BTs find that one of the most valuable inputs for developing an ability to explain science is to go through subject knowledge of the lesson with specialist teachers (or others) beforehand. Rehearsal of explanations coupled with feedback are essential.

10. While the weekly meeting may not focus specifically on PCK it can be a means of generating reflectivity and establishing a good working relationship between the mentor and the BT. Where the meetings focus on PCK they have

been used as a means of: reassurance, supporting planning, promoting metacognition, suggesting alternative approaches and modeling pedagogies, shifting focus from BT-as-teacher to pupil-as-learner, and challenging BTs' assumptions.

11. Informal discussion between the BT and other members of staff (teachers and technicians) plays an enormous role in the development of BTs' subject pedagogy. Where discourse about teaching and learning pervades informal exchanges within the science department, and where the department as a whole is committed to supporting the BT, the learning gains for the BT in terms of their pedagogy are very considerable.

12. The research has provided a lot of examples of subject specific feedback and discussion. These examples are likely to prove useful in provoking discussion and review of mentoring processes within a science department or within initial teacher education partnerships (e.g. at mentor meetings).

13. Subject specific aspects of written feedback which were instrumental in supporting BTs' developing capacity to explain were drawing attention to: the specialised language of science; sensitivity to what pupils do and do not understand; significant points; contexts which are familiar to pupils; breaking arguments into its constituent parts; linking principles, theories and laws to a wide range of phenomena; use of demonstrations and other resources; BTs' own content knowledge; helping pupils construct their own ideas.

3.2 Recommendations

Our recommendations are based on the significance we place on the department being a place where discourse about teaching and learning pervades discussions (finding 11). We believe that similarly discourse within a department about the process of mentoring and about the learning of the beginning teachers will have great benefits.

We have focused only on subject pedagogy – and in particular the process of generating science explanations in the classroom – as this was the subject of the research project. As a result:

1. We would encourage all members of the science department - teachers and technicians - to learn from each other how they support the development of beginning teachers' subject pedagogy, with a view to enhancing that support. BTs spoke very highly of the craft knowledge in explanation they gained from experienced teachers and technicians. Often the latter had seen a range of classes from the point of view of practical work and could distil helpful support for the BTs.

2. Given the importance of support for the planning of lessons and the rehearsal of science explanations, we would encourage departments to review the ways in which support for planning focuses on explanations and on ways of engaging pupils in constructing their own meanings in science.

3. Explanation in science classrooms is a complex activity. The analysis of it derived from the work of Ogborn *et al.* (1996) would be useful for understanding the demands science explanation makes on teachers and learners. Our examples of the ways in which teachers have supported and given feedback on different aspects of explanation could be used to examine a department's own practices.

4. As the research has identified a lack of explicit dialogue about teaching the nature of science, this remains an area for further study. Mentors and whole departments could contribute to such a study, particularly in light of the demands of the changes in the science curriculum (2006).

5. The importance which beginning teachers place on written feedback being supported by oral feedback, and on feedback which opens up other possibilities (advice) and justifications, can be used to examine the nature of the feedback which is given and the opportunities teachers have for such discussions.

6. The extent to which feedback reflects the development of the BT can form another aspect of review. While the main focus of BTs' concerns early on will be classroom management and organization it is valuable to examine the extent to which feedback also directs the BT's attention to subject pedagogy and in particular student learning.

7. The models of mentoring (Maynard and Furlong, 1995) and of communicative approaches (Mortimer and Scott, 2003) would be useful tools for analyzing how subject mentors use the weekly meetings to support planning, promote metacognition, suggest alternative approaches and model pedagogies, and help shift focus from discussion about the performance aspects of teaching to consideration of pupil learning.

8. We would encourage departments to view such a reflection on their own mentoring practices to be one stage of the Kolb learning cycle and to use the reflection to move to experimenting with new ideas, re-reviewing and learning.

4. Background and context

The context of the research was the ten month teacher training programme for science graduates[2] in one training partnership[3], namely the Institute of Education, University of London and its associated schools. As in all other training partnerships in the UK, such courses are subject to government legislation, which requires beginning teachers to spend two thirds of their ten-month course in two different schools, where they are supported by a designated subject mentor[4], with whom they have a weekly meeting. Other subject teachers whose classes they teach, give further support and guidance. With over six months of the course spent in schools, school mentors and the other teachers have considerable influence on the development of beginning teachers.

To be successful in their training beginning teachers have to reach national standards which have to be achieved for successful entry into the teaching profession (TTA 2005). These apply to all subjects and hence are described in generic terms. These are given under the following headings:

S1: Professional Values and Practice
S2: Knowledge and Understanding
S3: Teaching
3.1: Teaching: Planning expectations and targets
3.2: Teaching: monitoring and assessment
3.3: Teaching: teaching and class management.

Generic statements of standards[5] inevitably pervade the documentation which accompanies any course. While such statements have their function, for instance they frame much of the reporting on progress of BTs, they cannot provide the rich detail related to individual subjects which occurs when particular lessons are being discussed. There is therefore a level of dialogue and interaction underneath this generic wording which is at the heart of what this project is exploring.

The purpose of this report was to probe that interaction so that we could gain an insight into the processes of mentoring and feedback. To that end we were able to attend mentor briefing sessions and interview mentors, as well as analysing written feedback and talking to a range of BTs. We attended eight mentor sessions in all in three very diverse state schools in London.

2 The course leads to the award of the Post Graduate Certificate of Education (PGCE), which qualifies people to teach in a secondary school. Entrants have previously gained their Batchelor degrees in a relevant subject.
3 Teacher training is conducted through partnerships of an institution of higher education and a range of associated schools.
4 At the Institute of Education, University of London, subject mentors are referred to as Subject Co-Tutors. The more general term ‘subject mentor’ is, however, used throughout this paper
5 An example of the generic language is ‘Those awarded Qualified Teacher Status must demonstrate that they can teach the required or expected knowledge, understanding and skills relevant to the curriculum for the pupils in the age range for which they are trained.’ (standard 3.3.2)

5. Methodology

There are seven routes through which subject mentors, subject teachers and beginning teachers communicate. These are:

- Lesson observation: notes;
- Lesson observation: summary form;
- weekly meetings between the mentor and the BT;
- records of weekly meetings.
- oral feedback on individual lessons;
- informal exchanges on an *ad hoc* basis;
- terminal reports (graded reports at the end of each school placement)

Given the limited scale of the research there was no possibility of spending long periods in school either as an observer or as a participant observer. All the data was gathered over the 2004-05 PGCE year. The *Lesson Observation: notes* and the *Lesson Observation: Summary Forms* from 18 BTs were therefore selected for analysis as these were easily available. The weekly meetings were also selected as these were timetabled events and it was possible to arrange to attend a eight of these at different stages of the BTs' practice. We relied on interviews of beginning teachers and subject mentors to gain greater insight into the weekly meetings and written feedback. Their comments soon ranged over other aspects of mentoring, particularly the oral feedback on individual lessons and the informal exchanges. A questionnaire to an additional 66 beginning teachers at the end of the 2004/5 course, based on information from interviews with BTs, gave further information about all means of communication.

Our theoretical perspectives drew on five theoretical models. The progressive models of mentoring (Maynard and Furlong 1995) allowed us to map phases of BT development from apprentice to co-enquirer; models of mentoring related to Kolb's learning cycle (Kolb 1984) was used to understand how mentors and BTs review what has been learned to both apply the learning to appropriate future tasks and to contribute significantly to long-term learning; Shulman's models of teachers' content knowledge (Shulman 1986) was developed into codes to analyse written feedback; Mortimer and Scott's communicative approaches (Mortimer and Scott 2003) helped to identify those moves in mentor-BT dialogue which support progression through Kolb's cycle; and analysis of explanation in the classroom (Ogborn, Kress et al. 1996) helped us identify aspects of written feedback which are most instrumental in gaining insight into how explanations help children to learn.

6. Areas for further investigation

We have identified the processes of helping beginning teachers explain difficult science concepts based on theoretical insights and empirical evidence. If these findings were implemented we do not know what effect that would have on the practice of beginning teachers. We know that we cannot disembed quality of explanations from the web of discourse about learning which goes on in the science department. Case studies which can capture the qualities of this discourse which we have identified both on an informal and formal level while mapping the ways in which BTs in these departments develop their explanations will further help to ground our generalisations.

Our findings find a gap in explanations about the nature of science. The evidence we have gathered suggests that very little discussion about the nature of science takes place through feedback or planning. This has particular ramifications given the emphasis on the nature of science in the national curriculum starting in 2006 and the large take up of courses such as 21st Century Science. There is scope for a study in supporting beginning teachers to reflect on the nature of science and its impact on their teaching.

7. Dissemination and other outputs

The research has been the subject of three conference presentations:

European Science Education Research Association, Barcelona (September 2005)

British Educational Research Association, University of Galmorgan (Sept 2005)

Association for Science Education, University of Reading (January 2006)

These conferences have already generated a small number of people who are interested in reading the report. Some of these are teachers, but some are in other institutes of higher education. It is likely to influence the work they do with their mentors. In particular people welcome the examples of feedback and discussion which can be used as a basis of discussion with mentors.

Findings of the report have been disseminated to science subject mentors in the Institute of Education partnership as work in progress. A summary of the report will be published for science mentors in the partnership with findings, recommendations and examples of feedback to enhance the ways in which science mentors and science departments help BTs explain science.

We will be notifying Science Learning Centres of our report to run sessions on mentoring. A range of articles will be written for professional and academic journals.

8. Additional useful information:

The full report can be accessed on:
ioewebserver.ioe.ac.uk/ioe/cms/get.asp?cid=12330&12330_0=4847

and through the ceruk database:
www.ceruk.ac.uk

A related project on the development of physics pre-service teachers can be found on:
http://www.education.bham.ac.uk/research/proj/physep/default.htm

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