Beyond the curriculum: The positive effects of Continual Professional Development for a group of post-16 science teachers

Chris Devereux
ABSTRACT

This paper examines the perceptions of a cohort of post-16 science teachers about formal and informal continual professional development (CPD) that has been significant in changing their professional thinking and action over a two-year period. It also analyses conversations with the students of these teachers - conversations that focused on those critical incidents that students saw as a valuable contribution to their own learning.

Altogether, 36 conversations from the two cohorts were examined for key themes. This showed that successful CPD, as gauged by both teachers and their students, is more about subtle sensitivities to individual student needs that enable higher level thinking, than it is about a focus on targets and the curriculum. The data from teachers reveal their increased interest in theories of learning, and that they value informal and voluntary CPD in small collaborative groups. The data from students demonstrated how much they appreciated their teachers’ efforts to interest and involve them in taking charge of their own learning.

The data suggest that effective CPD goes beyond the syllabus and examinations to focus at a meta-level on how theory can contribute to the enabling actions of teachers inside and outside the classroom. The paper summarises the complexity of the data into a conceptual map that intertwines the holistic nature of effective teaching and learning into three overarching categories. Results are related to literature in the field of CPD.

Conclusions suggest that effective CPD is ‘always more social than technical’ (Johnston et al., 1995:370), and that collaborative and other informal working between teachers in small groups yield significant benefits to both teachers and their students.
The data for this study came from a cohort of eight science teachers and a selection of their post-16 students. The teachers were involved in the Teaching and Learning National Change Programme, run by the UK government’s Standards Unit as part of the long-term ‘Success for All’ programme. The initial focus of the programme began with the four areas of Business, Construction, Science and Entry to Employment (E2E) in 2005 followed by eight other areas in subsequent years. The Standards Unit was set up to embed excellence and develop the sector’s workforce. It established three enablers to help ‘drive’ improvement: Teaching and Learning Resources; Subject Coaching Networks; and the Professional Training for Subject Learning Coaches’ (Standards Unit, 2006:1). The national network of ten Science Learning Centres became the main centres of ongoing professional development for teachers in the post-16 sector. The professional training for Subject Learning Coaches (SLCs) was started by the Standards Unit and, at the time of writing, continued under the aegis of the Learning and Skills Improvement Service (LSIS). The object of the professional training was – and still is – to develop the practice of individuals as both a coach and subject practitioner and to lead curriculum development in their own subject through coaching others in their organisation.

For science teachers, the teaching and learning resources available for every post-16 education institution had the overarching themes of: bringing variety to science teaching, promoting discussion and improving assessment for learning. In addition, network meetings were set up throughout the country for SLCs. Others, not on the professional training programme, also attended these meetings which aimed to share good practice.

This paper concentrates on science teachers drawn from schools, FE colleges and vocational settings. The rationale for the research comes from a perceived need to capture the intricacies of what positive teaching and learning looked like, as identified by teachers and students. This is in contrast to the mandated methods used to judge the success of this programme, namely measuring ‘take up’ and ‘engagement’ by the numbers attending meetings.

In the cohort of eight teachers in this study, all based in South East England, six were SLCs, but all attended SLC network meetings and several were in touch with each other on an informal basis over the two year period. It was this group that provided positive examples of what had been significant for them in their development as teachers both inside and outside the Standards Unit programme. The prevalence of compulsory, poorly thought out courses has often resulted in reports which highlight the negative aspects CPD. As Fullan puts it, quoted in Lee and William (2005):
Nothing has promised so much and has been so frustratingly wasteful as thousands of workshops and conferences that led to no significant change in practice when teachers returned to their classrooms (Fullan, 1991:315).

In focusing on positive aspects of teaching and learning, the results of professional discussions with teachers and their students are analysed in order to identify:

a. what teachers perceive as the contribution of CPD to improving their own classroom practice;
b. what students of these teachers value as contributions to their own learning and how these values relate to teacher perceptions;
c. lessons we can learn from teachers and their students about the professional development of teachers.

CPD can be summarised as any sustained formal or informal method that is recognised by the teacher as a positive development that results in changes in thought and action in their teaching and learning. However, one of the more complete definitions of CPD is offered by the CPD Review Group of ‘The Evidence for Policy and Practice Information and Co-ordinating Centre’:

‘Professional development consists of all natural learning experiences and those conscious and planned activities which are intended to be of direct or indirect benefit to the individual, group or school and which contribute through these to the quality of education in the classroom. It is the process by which, alone and with others, teachers review, renew and extend their commitment as change agents to the moral purposes of teaching; and by which they acquire and develop critically the knowledge, skills and emotional intelligence essential to good professional thinking, planning and practice with children, young people and colleagues through each phase of their teaching lives. (Day, 1999:4)’
(Cordingley, et al., 2005:2)
Recorded discussions with teachers focussed on two major themes, the first being examples of teaching that teachers were really pleased with, and, in their view, tangibly enabled learning in the classroom. The second focussed on where ideas for doing something different came from, and who or what helped them to develop these ideas. Drawing out critical incidents to illustrate the sorts of CPD that each teacher felt was valuable was an important part of the process. Of the eight science teachers three taught in schools, three taught in FE colleges and two taught in a college specialising in land-based industries. Conversations ranged between 17 minutes and 37 minutes and were transcribed. The transcriptions were initially analysed using grounded theory, beginning with open coding, namely, ‘the analytic process through which concepts are identified and their properties and dimensions are discovered in data’ (Strauss and Corbin, 1998:101), to construct concepts from the discussion. To give an example of these concepts, ‘hands-on practicals’ were any practicals in which students were actively involved, and were gathering and analysing data from their own experiments. ‘Thinking beyond the curriculum’ was any idea or activity that was used to stimulate scientific thought that was not immediately linked to the curriculum. These concepts were tabulated and then ranked.

Analysis of recorded conversations with 28 students taught by the eight teachers was achieved in the same manner as was used to define concepts for teachers. It became apparent very early on that the concepts used for teachers applied equally to students. For example, ‘Learning from others’, ‘Good explaining from the teacher’ and ‘Hands on practicals’ apply to both teacher and student but in different contexts.

Mirroring the themes for teachers, conversations with students focussed on critical incidents during which they had gained something useful from a lesson or series of lessons, as well as who or what helped them to understand things they did not understand before. Thoughts on what they realised they needed to learn next, and how they would go about it, were followed by a wider discussion on how they had matured and changed their thinking about how they learnt both inside and outside their educational institution.

46 concepts were identified by open coding from the teacher/student data. Concepts that yielded 3 or less responses were not used. All diagrams represented in this paper are derived from this empirical data set. In the case of Figure 4 data has been represented by meta-categories, or axial coding defined by Strauss and Corbin as ‘the process of relating categories to their subcategories’. (Strauss & Corbin, 1998:123). This conceptual map merges the originally derived concepts into 10 axial codes and three overarching themes to summarise effective CPD as
represented by the data from this study. This summary is related to the literature on effective CPD.

**Discussions with teachers**

Conversations that produced the concepts from the data were subtle. For instance, teachers frequently referred to innovative ways of capturing student imagination in their teaching - so a card game on blood grouping that both interests and involves students, also enables them to explore concepts and think at a higher level:

TEACHER A: They were doing blood grouping …and from that [the card game] I realised that by playing games and by almost distracting them from the fact that they are learning at the time, that it’s sort of like, going in, .. they are getting the concept. They’re understanding, and at the same time they are enjoying it so they want to come back for more.

The key phrase ‘almost distracting’ is the teacher recognising that engagement and enjoyment can lead - almost unconsciously – to an emerging understanding of the concept of blood grouping; and done in a way that makes them want to come back for more.

The example touches on Schön’s (1983) more detailed descriptions of knowing and reflecting in action and on the nature of tacit knowledge (Polanyi, 1958, Eraut, 2000). Many of the conversations with teachers underlined their progressively deeper understanding of how and why they were modifying their work with their pupils.

The 15 concepts shown in Figure 1, start with 20 responses coded into ‘learning from each other’, meaning gaining new perspectives and motivation stimulated by others in formal and informal settings. The second item, ‘student linking concepts to contexts’ links theoretical concepts to everyday contexts students recognise in order to enhance understanding. Circling round the graph the final item ends with 3 responses about ‘eureka’ moments that give a new dimension to an issue or problem for the teacher. Many of the responses are a direct result of CPD that they valued. ‘Coaching others’, for example, originates as a result of the stimulus gained from the Standards Unit Professional Coaching Programme. Others are as a result of informal self-motivated developments (‘being more reflective’; ‘learning from each other’). The concepts in Figure 1 range across ways of thinking as well of ways of acting. Concepts such as ‘confidence’, ‘struggling with difficulty’ and ‘defining what I need to learn next’ suggest an ongoing journey that goes beyond the technical and into the wider affective side of the development process. These concepts illustrate Day’s (1999:4) definition of CPD in relation to extending ‘their commitment as change
agents to the moral purposes of teaching…’

The most frequent response of teachers to key ways of developing their practice, is that of learning from each other. This collaborative process is ‘essentially about personal relationships’ (Biott and Easen, 1994:119). This statement applies equally to teachers working together and teachers working with their students.

Carnell describes non-hierarchical peer learning which relates strongly to the teacher data in Figure 1 in terms of teachers learning from students and helping them ‘to search rather than follow’ (Brookes and Brookes, 1993, quoted in Carnell, 2000:60). The idea of searching is a recurring theme within the teacher cohort and encapsulates such concepts as ‘student linking concepts to contexts’, ‘student researching answers themselves’, and ‘student discussion’.

Black et al., (2003) chose four types of action in sustained working with teachers to change their practice and enable teaching and learning to be more effective. The four actions were: questioning, feedback, sharing criteria and self-assessment. In considering the deeper implications of their highly regarded work, they felt that a sequence was recognisable in the way they approached what were mainly novel ideas, represented as follows:

Set of activities → their synergy/comprehensiveness → cognitive/affective insights

However, they also suggest that reversing the sequence may be appropriate for development programmes where there was a need ‘to improve the quality of familiar practices’

Cognitive/affective insights → need for synergy/comprehensiveness → set of activities (Black et al., 2003:115)

 Conversations with the cohort of teachers fall into this second category. Most of the teachers were on the lookout to raise their game. The CPD gave them the chance to share and talk with others in their own search for different ways and activities to engage students in their own learning. The science resources produced by The Standards Unit were not enough. These teachers have since become more reflective, they get the students to do the work, they are sensitive and creative in contextualising difficult concepts for their students, and even with high stakes tests breathing down their necks, they think beyond the curriculum to give their students a passion for science rather than just push them through the exam.
What CPD was perceived as helpful?

The concepts and perspectives of teachers gained from their conversations set out in Figure 1 are a snapshot of where teachers are in their own professional journey. The cohort of eight was open, in different degrees, to developing their own professional ability either inside or outside the classroom and Table 1 below lists the frequency of responses about CPD they found useful and stimulating. Day sums up these varied responses in his own detailed definition of CPD by referring to it as ‘all natural learning experiences and those conscious and planned activities which are intended to be of benefit…’ Thus, valued CPD ranges from conversations and working with more experienced colleagues to using technology, considering research findings, and using science resources to improve teaching and learning. The ‘natural’ and the ‘planned’ combine.

At the lower end of the scale, teachers cited particular courses that fulfilled a perceived need for them, such as the personal need to embark on an MA in the midst of a full time teaching programme, or a specific INSET on behavioural problems. At this lower end, most responses are about formal specific courses found to be helpful. Higher up the response scale the effects of CPD tend to be more informal, with the exception of the SLC professional coaching programme and the science resources, both of which were found to be useful, but only in parts. For instance Teacher B described one activity on the coaching programme thus:

TEACHER B: We had to audit all these teaching things in one activity. It was very disappointing because we went through and ‘No, we don’t do any of these drab things, any of these things’...what a waste of time!

The context in which this operated, obviously neither inspired nor enabled. Yet in a different context, involving his peers, the same teacher found mini-whiteboards ‘invaluable’, demonstrating that in CPD, context is crucial. In short, if teachers are neither interested nor involved in their own CPD, very little learning on their part will take place.

TEACHER B: There was something that the maths department did. That’s the first time I had seen it. It has cropped up in various of the subject learning coach training days, [and] in the networks it’s been mentioned, is the mini whiteboards. I did that with this group just earlier on. That can be very good – can be extremely effective. I find that’s a good revision activity and it’s a good way for me to know who knows what and do I need to go through something again... get an immediate feedback on their understanding or their knowledge. It’s invaluable.
Valued concepts and perspectives of teachers

Figure 1
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<thead>
<tr>
<th>Educational research findings and theories</th>
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<tr>
<td>Subject Learning Coach programme</td>
<td>9</td>
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<tr>
<td>Conversations with colleagues inside and outside the institution (networks)</td>
<td>9</td>
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<tr>
<td>Using technology/internet</td>
<td>5</td>
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<td>Standards Unit science resources</td>
<td>3</td>
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<td>More experienced colleagues</td>
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<td>Desire to extend own CPD to others</td>
<td>3</td>
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<td>Talking with more knowledgeable people</td>
<td>2</td>
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<td>Talking to clever people</td>
<td>2</td>
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<td>Leading staff induction</td>
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<td>International experience</td>
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<td>Doing an MA in Education</td>
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<td>LSC sponsored 6th form meetings with other schools</td>
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<tr>
<td>Vocational GCSE Conference</td>
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Table 1. What teachers found most useful and stimulating about CPD

Table 1 also has some features that tell us more about the cohort. Teachers highly value the informal networks inside and outside their institutions as well as aspects of the Subject Learning Coach programme which itself gave opportunities for informal gatherings outside the main programme.

However, what emerges as the most useful aspect of CPD for these teachers is the value of educational research in developing their work in the classroom. Translating educational research findings to the classroom has not usually come to the top of the CPD agenda for teachers. Ratcliffe et al., (2004) found that to use a research finding effectively in the classroom, practitioners needed to recognise how to apply general or specific contexts to their teaching. Teaching materials informed by research were also used by teachers, but many teachers may not have been able to articulate the nature of the original research. Helmsley-Brown and Sharp, (2003) undertook a systematic search of the literature relating to teachers’ view of
research. They found more barriers than they did cases of using research to inform practice and policy. They highlighted ways in which research could be made more accessible by means of networks and change agents who could disseminate findings to schools. Williams and Coles, (2007) recognised the concerns about the lack of engagement by teachers, and examined the issue from an information literacy perspective, i.e. teachers’ strategies to find, evaluate and use research information. A survey of 312 teachers and 78 head teachers from nursery, primary and secondary schools revealed that whilst, on balance, people were positively disposed towards the use of research evidence, their actual use of it was limited. The most prominent barriers were associated with lack of time and lack of ready access to resources.

These findings pose the question of why did this particular group find research evidence so useful. Further work may uncover the reasons, but initial signals suggest that:

- some established teachers already consulted research findings (e.g. see Teacher F’s verbatim below)
- teachers had read research findings for their qualifications (e.g. the MA course or the Professional Training Programme for Subject Learning Coaches)
- drip-feed of relevant research findings, offered and interpreted for teachers at appropriate points in their small network meetings, were seen as essential by the network coordinator and found to be useful by the network members.

Sometimes for the first time, a teacher is drawn back to theory through new development situations at work. One teacher has to run a CPD session on questioning, but is not too sure how good she is:

TEACHER E: This was giving a session to staff on questioning, and as a result of that I went away and did some reading and found out how poor my questioning techniques were and so I then actively started using it much more…

Later on in the conversation, the researcher asks about her perceived improvement.

RESEARCHER: You said something about a Subject Learning Coach. Is that where you picked it up from?

TEACHER E: No, I think, well, yes, to some extent because obviously some of the resources [i.e. Standards Unit Resources] are to do with questioning, but I think much more because as a result of that, I’ve done much more
reading, having done virtually no reading at all, on educational theories or research or anything.

Comments from two other teachers about research and educational theory show that they are aware that if the development that has already taken place is to continue, they need to keep up to date with recent theory as well as practice.

TEACHER C: I mean that’s one of my big things is that I’m interested in is how we, in teaching, manage feedback. I don’t think it’s done very well at all. I think largely speaking it’s done in a very traditional, heavy handed, laborious way.

I am particularly interested in assessment for learning and how children learn and enabling, and to unpick what students find difficult.

I try to keep up to date with recent developments...looking for ways of introducing things that are slightly different.

Dylan Wiliam – he is good to listen to.

TEACHER F: Barbara McGilchrist, The Intelligent School. That’s probably one of the most phenomenal pieces I’ve read.

Without going into verbatims in ever-finer detail, the story that emerges from teacher perceptions of useful CPD indicate:

- informal events and networks are seen as more valuable than formal events with a rigid framework, though these latter ones occasionally prompted ‘renegade’ parallel informal networks, determined not to be patronised.
- formal CPD with a qualification (such as an M.Ed. programme) may possibly give increased career opportunities to teachers
- the more reflective and experimental the teacher is, the more likely they are to develop an interest in the results of educational research.

What do students value from their teachers?

What is presented here is an overall assessment of what students valued from their teachers using the coding system already described. Figure 2 depicts the results of the analysis of the 28 conversations omitting any codes that had less than 3
Figure 2: Valued concepts and perspective of students
responses. As an example, ‘hands-on practicals’ and ‘interested and involved’ are illustrated in the following extract:

STUDENT A1: Recently she’s [the teacher’s] done a lot more hands-on learning. We’ve done lots of modelling with plasticine and stuff and we’ve done lots of experiments – we did one where we had to check the eye peripheral vision and moving pencils either side of ourselves to see if we could tell what colour they were and stuff like that – just experiments and practicals and things like that seem to help me learn.

The overriding key concept in the student data is how teachers successfully enable students to link concepts to contexts in their daily world, thereby situating their learning contexts within their own social interaction and perceived values. (Lave and Wenger, 1991). Although the students may not recognise the theory of this, they are clear from the examples in their conversations about how much they value how their teachers enable them to make meaning of science in everyday life.

STUDENT G3: I do lots of work at the sea life centre in Brighton. I started there and I didn’t know hardly anything about fish and stuff and now from college I’ve learnt… like….what parts of a fish are, and stuff… like they’ve got a lateral line to protect temperature. I just think that little things like that help me to explain it to the public. Seeing their faces light up when you tell them a bit of information they didn’t know …incredible. It’s one of the nicest things you can have, like especially explaining it to a little kid. I really enjoy it. I love it.

In summarising what students most appreciate in terms of how their teachers have helped them to learn, we can list their top 10 values as follows:

- Thinking skills, recognised in:
  - Linking concepts to contexts
  - Working on ideas outside the syllabus and curriculum
  - Researching answers themselves

- Collaborative dialogue
  - Learning from each other (pairs)
  - Discussion in small groups

- Positive relationships with the teacher
  - Good explaining by teacher
  - Teacher as a collaborator in learning
• Work is made interesting and involving

- Practical applications
  • Hands on practicals
  • Developing ways of visualising science concepts (often through games and practicals)

The maturity of these responses is a tribute to both the students and their teachers.

Can we judge congruence between teacher and student data?

The most obvious example of congruence in the narratives is where teacher and students agree directly about the value of a particular activity. ‘Interesting facts’ is an example.

Extract A
TEACHER A: ‘Interesting facts’ was an activity I started with my Key Stage 5 students right at the beginning of the year in September – first lesson, first homework was ‘go away and come back with something that for you is an interesting fact, either from the media or from something you’ve read or from something that you’ve seen or been talking about with somebody else. Could be absolutely anything but it must be related somehow to biology’. When they came back we sat down in the next lesson and the students came up with all sorts of diverse, interesting facts which we took and explored each one of their interesting facts individually. And people made within the room, made comments about what they thought of the interesting facts. And this led to discussing a lot of the curriculum issues by initially going outside the curriculum, getting them to instigate the interest.

Extract B
RESEARCHER: Tell me about interesting facts.
STUDENT A5: I love it! We all love it!
R: Why?
A5: It’s interesting but at the same time it’s not even related to the topic we’re doing, but it somehow manages to spark conversation and makes things interesting, and somehow makes us all feel more like we actually all do know something, because we can all contribute something – somehow: these random facts someone’s brought in.
R: And what was your latest one?
A5: Oh, I don’t remember. I had one, my boyfriend took me to the zoo for my eighteenth birthday, and took a picture of the fact cards at the zoo and I brought that in and there’s one about an animal called a Coati that turns its ankles 180% degrees so that it can walk down a tree instead of climbing.
R: Very interesting.
A5: So that turned into a conversation about joints and the body and things like that so it just makes the whole conversation interesting.

By plotting together the key concepts as perceived by teachers and by students, a series of relationships emerge, illustrated in Figure 3. There are 14 concepts in all, given that each group did not choose the same concepts.

Five concepts show overlap between teacher and student data, namely:

- Enabling learning by helping students to link concepts to contexts that they understand
- Learning from each other (all combinations of student and teacher)
- Thinking beyond the curriculum to involve students in a love for science
- Students researching answers themselves
- Student discussion in small groups.

Outside this area of congruence, students find that:

- Being interested and involved is crucial to learning
- Good explaining from the teacher is valued
- Teacher is seen as a helper/guider rather than a deliverer of knowledge
- Visualising concepts through practical work and multimedia helps science learning.

Teachers find that:

- Being more reflective as a result of effective CPD has helped their teaching
- Seeking information and feedback from students helps them to modify their teaching to improve student learning
- Hands-on practicals help students to take charge of their own thinking and learning
- Effective CPD builds teacher confidence.
Figure 3: Relationship between top 10 responses of teachers and students
Summarising the data on effective CPD

The data obtained in this study signal that there are many instances in which students can articulate the positive effect teachers have had on them. Similarly there are instances in which teachers can describe how they have benefited from CPD – and how they think their students have benefited as result.

The minutiae of the data can highlight particular instances, but to get an overview of teacher and student narratives, open coding has been developed further into axial coding, using the original empirical data.

This was achieved by further grouping the concepts of student and teacher data, to produce three meta-categories. These axial codes have 10 sub-categories and the results are represented in the concept map of Figure 4. The three overarching categories are:

1. Metacognition
2. Motivation
3. Responsive relationships

Figure 4: Summarising effective Continual Professional Development
The 10 sub-categories not only enlarge the meta-categories but also try to paint a picture of what is central to effective CPD from the data gained in this study.

1. **Metacognition**

‘The term metacognition literally “thinking about thinking” is commonly used to refer to the selection and monitoring processes, as well as to the more general activities of reflecting on and directing one’s own thinking.’ (Pellegrino et al., 2001:78). It embodies the challenge of enabling reflection on thinking that helps make unconscious processes overt and explicit, thereby making them more available for future use.

‘Metacognition depends on two things: knowing one’s mental capabilities and being able to step back from problem-solving activities to evaluate one’s progress. (Pellegrino et al., 2001:78)

Flutter and Rudduck (2004) in their work on consulting pupils find that giving learners time to:

‘think and talk about aspects of teaching and learning can have a direct impact on pupils’ metacognitive development and on their understanding of how they learn’. (Flutter and Rudduck, 2004:8).

The same authors quote others in expanding this thought.

‘Good learners monitor their learning using strategies which hinge on self questioning, in order to get the purpose of learning clear, searching for connections and conflicts with what is already known’ (McCallum et al. 2000:276).

Within the narratives here, metacognition is expressed through the intellectual process of translating science concepts into a variety of contexts that enable students to pause, reflect, recognise and understand. It is also expressed through learning from others (teachers and students) and thinking outside the curriculum in the search for new and innovative ideas. To do this, teachers must not only have extensive subject knowledge, but must also be able to apply this knowledge to many contexts inside and outside the curriculum. The narratives also identify how different learners thought and learnt through kinaesthetic, visual and audio processes and the challenge for teachers was to respond effectively to these strategies in order to promote and extend student thinking. ‘Interesting facts’ is one example.
2. **Motivation**

Teacher experimentation in the classroom comes from a variety of motivations to do something different as a result of informal or formal CPD. Motivation is also infectious. The data analysis indicates that motivated teachers were able to transmit their own enthusiasms to others and to foster those of their students in such a way that these students gained a confidence to take responsibility for their own learning. Such students were able to persist in the face of difficulty and uncertainty, motivated by a teacher who always displayed an ‘I believe you can’ attitude towards them. The ‘interested and involved’ responses of students are testimony to the enthusiasm of their teachers.

3. **Responsive Relationships**

As well as cognitive and motivational processes, effective teachers have a style that responds continually to the needs of students. This means understanding what it is that make interventions effective with different students and different groups in differing circumstances. Formative assessment is linked to self-assessment in such a way that students ‘can understand the main purposes of their learning and thereby grasp what they need to do to achieve.’ (Black and Wiliam, 1998a:10). Responsive relationships also involve clarity of purpose and honesty with students and feedback from them helps their teachers to reflect on and modify their own teaching. Their own learning is thus used to improve the learning of their students.

Elsewhere, Carnell (2000), emphasises that when teachers engender sound relationships with their students through dialogue, discussion and feedback, those students come to see themselves as ‘active participants’ in their own learning, becoming more committed and effective as learners in the process.

**How do the data relate to literature on effective CPD?**

Figure 4 cites three key areas as being central to effective CPD from a cohort of eight post–16 teachers. The CPD literature field is large, but much work in this area has been summarised by Cordingley et al., (2005, 2007) through systematic reviews of the CPD literature concerning both collaborative CPD and the intervention of specialists in CPD programmes.

In summary, Cordingley’s reviews of the literature on the impact of collaborative CPD suggested:
All studies report observable and self-reported changes in at least one of the affective aspects of learning:

- Motivation
- Confidence
- Attitudes and belief

Positive benefits came from:

- the use of peer support
- explicit use of specialist expertise
- applying and refining new knowledge and skills and experimenting with ways of integrating them in their day-to-day practice
- teachers observing one another
- consultation with teachers either about their own starting points, focus of CPD, or the pace and scope of CPD
- involving specialists in observation and reflection

(Cordingley, 2005: 65-66)

Additionally, it seems that shorter, smaller and more frequent collaborative work is more effective than larger, infrequent meetings (Cordingley, personal communication). Cordingley’s findings resonate with the data presented here with the exception of the last two mentioned for which there is only little evidence in the narrative data. All other aspects, however, are included in the narratives.

Two of the 26 papers cited in Cordingley’s review - Ertmer and Hruskocy (1999) and Lin (2002) - relate to effects on secondary science teachers and their students. In the Ertmer and Hruskocy study on technology in the classroom, the CPD programme had a positive impact on teacher confidence. Attitudes to technology by ‘at risk’ students excelled, showing increased confidence and self-esteem. The Lin study found that ‘insights offered by research provided teachers with a rationale for thinking about teaching and learning... and interviewed students were able to take a more active role’ Cordingley et al., (2005:141).

Much of the data gathered for the present study, from teachers and their students, focuses on collaborative working between them both. The straight presentation of knowledge, though crucial in teaching, is largely missing in teacher and student narratives. Instead, much of the activity is about thinking, experimenting, coming up with different ideas, being sensitive to individual needs, and recognising the subtle and holistic nature of enabling learning. In short, tacit knowledge and intuition are key aspects in effective teaching from this cohort’s point of view.

In the context of professional development, Eraut (2000) makes a detailed analysis of non-formal learning and tacit knowledge, the latter being that personal knowledge we have gained from life experience which can be adapted ‘in flexible
and developmental ways as (we) move between roles and settings’ (Evans et al., 2006: 71). Furlong (2000) argues that the intuitive dimensions of professional practice have a large role in rebuilding teacher professionalism, and Richardson (2002) celebrates the imaginative gifts and inspirational quality of teachers, as well as their courage, commitment and energy. Elsewhere, Hodkinson & Hodkinson (2005) examine teacher learning and argue for the construction of more expansive learning environments in secondary education, emphasising the social, participative and personal aspects of learning. Harrison et al. (2008) specifically examined CPD for science teachers in the UK and Israel, highlighting the need to set professional challenges while tailoring CPD to teachers’ needs to create an environment in which teachers can advance and transform their practice.

This ‘softer’, more personal approach to CPD, which focuses more on the promotion of dialogue and collaboration, and more on learning than on performance at a school or policy level (Watkins, 2000:78), is reflected by Hustler et al. (2003) in a Government commissioned report on CPD. He notes from the results of 2500 questionnaires and the in-depth study of teachers’ experiences in 22 schools that they were critical of standardised ‘one size fits all’ CPD, and that they wanted CPD that enabled them to develop their own personal interests.

The Professional Training Programme for Subject Learning Coaches, was working with professionals who operated collaboratively inside and outside this framework. In the science subject area, the teaching and learning resources themes (learning from discussion, the use of variety in the classroom, and assessment for learning) spring largely from the work of Black and William who were able to influence policy makers about the importance of formative assessment (Black and William, 2003). They also interpreted their research findings for classroom practitioners in the form of practical summaries of their work on formative assessment, particularly in science. (Black and William, 1998; Black et al. 2004; Black & Harrison, 2004). The teacher cohort for this paper was exposed to these publications and others, and Figure 4 emphasises much of their own development work on formative assessment.

Cordingley (2007) found that when specialists helped on CPD programmes (as happened with the Standards Unit programme) changes resulted in teachers achieving one or more of the following:

- learning more about their subject
- learning more about learning
- learning new ways of teaching.

(Cordingley, 2007:11)

Pickering challenges a technicist, standardised approach to CPD, ‘in which knowledge, skills and understanding are ‘delivered’ to teachers, and thereby transferred, by a combination of top-down experts and examples of best practice’
(Pickering, 2007:193). Rather than this ‘done to’ approach, his research with teachers finds that what most enhances their professional learning are:

- an engagement with learning – the pupils’ and theirs;
- real collaboration with people they trust;
- a sense of their responsibility for their CPD; and
- active engagement in their CPD, not being passive recipients of expert advice. (Pickering, 2007:210).

But in Pickering’s last point one could also be an active participant rather than a passive one in the field of expert advice. In their work on networks, McCormick and Fox (2007) assert that a focus on collaboration and close connections (i.e. ‘strong links’) is not all-encompassing. ‘It is also necessary to have weak links to feed the strong ones’. An example they give of a ‘weak link with high value’ is ‘an expert speaker at an event who discussed something that excited the listener’ McCormick and Fox (2007:9). Teacher F in our earlier verbatim is an example of an excited listener.
Figure 4 indicates the breadth of understanding that is apparent within the cohort of eight teachers. Figure 3 confirms that students value both the thinking and doing that their teachers challenge them with. Students’ own thoughts about the high level of interest and engagement they have in their work, and the way they value the explaining and guidance of their teacher, also emphasises the skills of their teachers. Although a cohort of science teachers are considered here, the Subject Learning Coach programme has now operated across post-16 curriculum areas for some time (http://www.subjectlearningcoach.net). The cohort described here was one of the first to undertake this programme before many other curriculum areas were included. The development of additional curriculum areas suggests the results reported here have applicability across the post-16 curriculum.

What still remain are two questions thrown up by the data, namely: a) Why did the cohort appear to value research results so highly and b) Why is there so much congruence between the values of teachers and those of their students? Neither question is fully answered here, each needing further research. As regards the former, both network meetings and the coaching programme offered summaries of research findings from time to time, and network meetings linked them directly to day to day practice. This may have had some effect. The Black et al. (2003) model, mentioned earlier, for ways of approaching novel ideas to improve the quality of current practice, is applicable in this case, namely:

*Cognitive/affective insights → need for synergy/comprehensiveness → set of activities.*

It seems that teacher activities were indeed enriched by relating research to their own ideas, which ultimately developed their own insights into teaching, resulting in learning activities their students appreciated.

The themes of Metacognition, Motivation and Responsive Relationships also offer a starting point for the reasons why students valued their teachers. The positive CPD results teachers have found for themselves seem to be transmitted back to their students, thereby forming an ever enlarging virtuous circle of collaborative working between teachers and their students, which both recognise.

However, what ultimately comes across from the nature of the data – and the literature about effective CPD – is that compulsory, non-consultative and non-sustained programmes or events are unlikely to have much lasting effect. Rather, CPD that interests and involves teachers, stretches their cognitive abilities slightly beyond their comfort zones, builds learning dialogues between individuals and
small groups, and develops teaching and learning strategies that each individual recognises are increasingly effective, are far more likely to endure.

This means, as the cohort indicated, a much more holistic, inclusive and sustained approach to CPD is needed in the post-16 area. It requires an approach that operates through multiple small collaborative networks, and works with a specialist to experiment with, share and develop approaches that extend beyond the curriculum, to engage teachers and their students in learning about learning. This suggests that knowledge-based CPD at fixed times in fixed places is not the best way to proceed. Instead, informal small groupings of professionals, ready to push themselves further in the search for new ways of learning - for themselves and their students - is the way ahead. And it might be an idea to invite the cohort of eight teachers to be the expert catalysts in such a process.
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