

Chapter 18

Changing Assessment Practices in Science Classrooms

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Perhaps no area of education policy is as contentious—or as consistently newsworthy—as assessment... (Mansell et al. 2009, p. 4)

Throughout all sectors of education, assessment that is more interactive, that is teacher or student led and that encourages teacher differentiation and the nurturing of student skills is being endorsed (Boud and Falchikov 2004; Brooks and Tough 2006; James and Mansell 2009; Harrison and Howard 2009). In recent years, assessment in the UK and elsewhere has also seen many changes, including a shift in the focus of attention (Black and Wiliam 1998a; James and Mansell 2009), away from the technicalities of test construction towards approaches that focus on student learning. Part of this has arisen from criticism of high-stakes testing (Harlen and Deakin-Crick 2004; Brooks and Tough 2006), while the influence of several research programmes on formative assessment indicates alternative perceptions of pedagogy and learning (Bell and Cowie 2001; Black et al. 2002, 2003; Hutchinson and Hayward 2005).

There is an extensive body of evidence, which describes and explains the effectiveness of assessment for learning (AfL) as a pedagogical tool beginning with the review by Black and Wiliam in 1998 and through various projects mainly carried out in the school sector over the last decade (Black et al. 2002, 2003; Harrison and Howard 2009; James et al. 2007). Through an assessment for learning approach, short cycles of assessment, feedback and changes to teaching take place and directly affect students' learning and progress. This AfL approach is also geared to train the learner to be more self-regulating (Harrison 2011; Sadler 1989) through regular experience of self- and peer-assessment opportunities and within classrooms that foster a dialogic approach (Harrison and Howard 2009).

The last two decades have also seen many changes in the ways that schools are managed, inspected and financed in the UK, with school improvement and effectiveness measures becoming key factors in the daily life of schools. Such pressures influence the

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way that teachers decide to teach, how they manage the curriculum and the ways in which they interact with their students. The introduction of the National Curriculum in England and Wales in 1989 and its assessment procedures affected teaching strategies in science classrooms (Fairbrother et al. 1995; Hacker and Rowe 1997; Russell et al. 1995). All three studies reported a reduction in the range of teaching strategies employed by teachers, with a movement away from pupil-centred teaching towards a more didactic approach. In Hudson and Smith's survey, over 70 % of the sample admitted that they could not teach in the way they would select because of recent changes in the curricular and assessment demands of the National Curriculum. The teachers felt they were being constrained by the content overload of the curriculum and the introduction of new assessment procedures that had been externally imposed.

While there have been large- and small-scale moves to implement AfL practice in schools in England and elsewhere, the reports from school inspectors (OfSTED 2007, 2010), government agencies (DCSF 2007) and researchers (Carless 2005; Smith and Gorrard 2005) indicate that the implementation is sporadic and underdeveloped. Instead, the accountability demands of summative assessment have driven many teachers to 'teach to the test' (Mansell 2007; Popham 2001). This chapter sets out to explore teachers' formative and summative assessment practices in science classrooms and outline some of the complexities that teachers face when wanting to change their assessment practices. Historically, for most examples of curriculum change, assessment has been essentially an afterthought and the role and significance of assessment in curriculum development has been undervalued and underinvested (Black et al. 2006). At the same time, there is evidence that classroom assessment becomes less formative and more summative in response to high-stakes testing (Pollard et al. 2000), and so formative assessment is crowded out or downplayed by teachers because of the dominance of summative styles of assessment (Carless 2006). Harlen (2006) suggests that formative and summative assessments are potentially complementary, while Broadfoot and Black (2004) indicate that ways of working that link the two purposes together need to be actioned to help teachers deal with the current assessment dilemma many find themselves in. Other researchers emphasise that formative and summative assessments should be dealt with separately (Pellegrino et al. 2001; Simpson 1990), since their purposes are so different and therefore cause difficulties and misinterpretations if dealt with simultaneously. This chapter attempts to begin the important role of providing the detail of what happens when teachers begin to make changes in their assessment practices and attempts to unveil some of the tensions and synergies that prevail when they make these changes within their classrooms and within their school contexts.

The KREST Project

The King's Researching Expertise in Science Teaching (KREST) project was a collaborative action research project with science teachers designed to support them in strengthening their classroom assessment practices. This work is based on a 3-year

project led by King's College London in collaboration with the Weizmann Institute, Israel, and the Institute of Education. Six domains of science education were selected, with each country designing and investigating three domains with groups of science teachers in England and Israel. The focus for this approach is evidence-based professional development (PD), where the process of collection, analysis and reflection on evidence arising from classrooms provides the basis and motivation for teachers to transform their practice (Harrison et al. 2008). This science education project provided a new approach to professional development for science teachers. It draws on an extensive research base (Bell and Gilbert 1996; Hoban 2002; Loucks-Horsley et al. 2003; Shulman 1987), which puts teacher learning at the centre of the PD agenda and has been put into practice by researchers and science teachers.

KREST started by exploring the idea of teachers and researchers, comparing their views on what good teaching might look like in a number of areas of science education—so-called accomplished or expert science teaching. This process of sharing guild knowledge began to encourage science teachers to be more reflective about their own practice and that of others, so that they came to develop a collaborative understanding of what good teaching is and how they might try and improve their current practice. The essence of this approach was providing teachers with an avenue for discussion, and so meetings were arranged at approximately 6-week intervals in which teachers provided evidence of their developing practice and in which they supported and challenged the practice of colleagues.

Through the PD sessions and documenting evidence from their own classrooms to bring to these meetings, teachers began to formulate questions and descriptions of teaching and learning that prompted professional dialogue, reflection and critique, which in turn led to teacher learning. Using this approach, the teachers were able to see and discuss concrete examples of their own classrooms and those of colleagues on a similar quest, from which they could consider alternative approaches that might develop their own practice. The following transcript is taken from PD meeting 2 where teachers were discussing what they had tried in their own classrooms from the action plans they drew up in PD meeting 1.

- Chloe So I tried to do the 'wait time' strategy. I remember hearing about it on my PGCE but it was last session when I really thought why don't I do that. It makes sense. I told them (the class) what I was going to do and how it was going to help them think more and talk more instead of waiting for me to tell them the answer.
- Derwi Did it work? I know mine would just sit there or talk about something else.
- Chloe No. (Laughter) Well it did and it didn't. More of them were willing to answer and they did say more but I still ended up putting the ideas together for them and it was still the main two or three (students) answering.
- Sally Yes. That was what happened with my Year 10s but it got better the more I tried to do it.
- Researcher Can you say some more about that Sally?

- Sally Not sure if it was me or them or both but it just got better. Felt better. More started to join in and I had to do less. Things came up such as mixups between what is happening in osmosis and I managed to get them to sort it out rather than me correct it in their books later.
- Derwi Didn't it take a lot of time though?
- Sally Not really 'cos it got sorted out rather than having to keep coming back to it.
- Derwi I did say I was going to try it but I just don't feel it can work at our place. It's not like Sally and Chloe's schools and they (the students) just wouldn't ... probably couldn't do it. I know my colleagues would think I would be barmy to even try.
- Sally I did do it with my best class.
- Researcher What do others think? Can 'wait time' be done with all classes?

The professional dialogue opens up an avenue for teachers to reflect on and justify their actions in their own classrooms. The teachers could weigh up the risks involved and so begin to balance their classroom aspirations alongside their own or perceived institutional expectations. Through this process, they were able to witness the reality of ideas in practice and then make decisions to adopt and adapt specific ideas and then trial and evaluate these in their own classrooms. By promoting reflection on lesson outcomes within group discussions, teachers made public what is usually hidden. These revelations of what certain decisions were made, and why, helped the teachers strengthen both their understanding of the nature of effective classroom assessment and their resolve to make such practices work in their own institutions. The science teachers constructed pedagogic knowledge by clarifying their own understanding and so reinforced their pedagogical identity as they interacted with others. They also identified common goals and talked through problems as they arose, which helped build their professional community. The PD sessions gave teachers both the language with which to reflect on their own work and a clear framework to assist them in their reflections.

Teachers documented their ideas in a portfolio both as part of the activities in the PD meeting and back in their schools when reflecting on previous meetings or planning for future ones. The PD session discussions and the portfolio entries provided a record of how a teacher practised, developed and self-evaluated his/her competence in a specific area of science teaching and demonstrated how a teacher practised the skills acquired from the PD programme within the classroom context (Joyce and Showers 2002), sometimes with one class but more often with several different classes.

The following transcript is taken from interview 2 with Derwi, where he is using his portfolio entry from PD meeting 1 to explain his developing practice to the interviewer.

- Derwi I said here, "Hearing Chloe and Sarah have success with 'wait time', I did feel I may have missed an opportunity to move AfL forward. With my classes. I had ditched the 'wait time' idea for mini whiteboards and that wasn't working as the boys saw these as an excuse to write and draw silly things instead of helping them have a go at an answer. Hearing Sally say

she'd only tried it with her best class made me feel better." So I did try it with my top set Y8 and it was really good. I used 'talking partners' like Aisha did and they really took to it. So that was a real move forward for me because I had been dubious in the first meeting and getting back to school convinced me it couldn't work but now I have got it working with this class. Not sure I can do it with others but I can do it with them.

Through the portfolio and PD meeting discussions, Derwi was able to challenge his ideas and come back to consider possibilities for change in his classroom. He had gone away after the first meeting seemingly confident and eager to try things, but in the reality of his school, these intentions faded and various concerns constrained these changes. Hearing how other teachers had tried ideas, and particularly how they had been careful about which classes to try these ideas with, gave Derwi the confidence to try things out with a specific class. Without these discussions and the support of his peers, Derwi would probably have never attempted to make the changes that he did with classroom assessment practices.

Compiling a portfolio was valuable because it enabled each teacher to show his/her reflections on a particular lesson or activity, including how it might be taught differently on a future occasion. Reflection in this way enables teachers to assess their own ability to teach science, and it prompts them to reflect critically on their progress by identifying evidence of each element of that progress as their practice evolves. Such endeavours seem risky at the outset, but the collegiality, support and guidance from peers play a major part in driving this approach forward. The construction of portfolios, alongside the dialogue in the PD sessions, helped teachers improve their science teaching and to be more explicit about the progress they had made and the effects this had on their learners and classrooms.

Sadler's (1989) use of guild knowledge is pertinent here. He argues that teachers use a sense of what it means to be very good at something and translate such knowledge, 'guild knowledge', into everything they assess. The final grade awarded mirrors how closely they approximate what it means to be good at that particular skill, competency or understanding. Where formative assessment is involved, the teacher encourages the student, through peer marking and discussion, to enter that guild, empowering the learner to take a role in the assessment process. Such changes dramatically alter how classrooms function as assessment becomes an embedded practice, used by both teacher and students, to monitor progress and set learning targets. This evolution of assessment-driven learning is a far cry from the type of science classroom that relies predominantly on end-of-topic or end-of-year tests as the main form of assessment.

Pedagogic Decisions

Teaching is a highly personal activity where teachers bring together and make sense of notions of curriculum, pedagogy and assessment. While teachers do have some autonomy in the way that they choose to work in classrooms, they are increasingly

required to demonstrate accountable outcomes (Brooks and Tough 2006), and this can lead to teachers limiting their range of pedagogical practices (Harlen and Deakin-Crick 2004). Clearly, there are implications both for teacher training and for professional development of teachers if schools are to strengthen their classroom assessment practices by including more formative approaches within their pedagogy.

To understand classroom practice and some of the reasoning behind how and why teachers make decisions about what they decide to do in the classroom, we need to consider who a teacher is and how teachers interact with their social setting. In order to do this, we need a theoretically driven model of teaching in context (Enyedy et al. 2006). There already exists a substantial tome of literature that explores how the beliefs of teachers affect the decisions they make in practice for both experienced (Nespor 1987) and inexperienced teachers (Pajares 1992). Much of this focuses on how teachers use their previous experience of classrooms to make sense of new situations and dilemmas as these arise. So, for both novice and experienced teachers, beliefs about lesson planning, assessment and evaluation influence the actions and decisions made in the classroom scenario (Enyedy et al. 2006). If context and experience strongly influence practice, then this suggests that it may be difficult to bring about change in practice as the 'status quo' of teachers' existence confines the interpretation of any new pedagogic ideas within the realms of previous ideas. This suggests that radical change in practice may be difficult to achieve, which has massive implications for professional development (PD) programmes.

Throughout their teaching career, teachers take part in professional development. This generally takes the form of a course or programme that the teacher participates in but can also result from working with colleagues within their own school or from personal endeavour by individuals in their own classrooms. In recent times, many PD programmes have adopted an approach to teacher change that conceptualises professional development from a personal growth perspective (Clarke and Hollingsworth 2002), where teachers come to make sense of what they do and how they might do things differently. At the heart of this approach is professional learning and teacher autonomy. Such an approach differs markedly from that offered historically, where teacher change has been approached through offering workshop opportunities where teachers could acquire or master predetermined skills and knowledge (Clarke and Hollingsworth 2002). The latter approach results in a technocratic skills-based approach to professional development (Kennedy 2005) and has received much criticism in the literature (Fullan and Stiegelbauer 1991; Howey and Joyce 1978; Wood and Thompson 1980) and was perceived by Guskey (1986) as a deficit model of 'fixing teachers'. With a personal growth approach comes a change in agency with the focus and drive coming from the teacher, and the purpose here is not to change teachers but for teachers to be actively involved in changing themselves. This is a much more personal and proactive approach to professional development than previously envisaged and involves professional reflection and action (Schön 1983).

Clarke and Hollingsworth (2002) draw attention to the 'idiosyncratic and individual nature of teacher growth' (p. 965) and the importance for both researchers and professional development trainers to understand more about teacher change. Teachers are regularly bombarded with ideas intended to improve their classroom

practice but find that many of these ideas fail to come to fruition or get displaced by competing priorities (Harrison 2005). Effective PD needs to be designed to provide opportunities for professional development that are centred on classroom practice (Joyce and Showers 1988) and allow time and support for teacher reflection and learning. Through these processes new practices can be evolved (Priestly and Syme 2005), moulded and honed from existing classroom practice (Hoban 2002). Teachers need to familiarise themselves with new ideas and also understand the implications for themselves as teachers and for their learners gradually in the classroom before they accept or reject them. This involves them reshaping their own beliefs about what science teaching and science learning is, especially if the new practices suggest they 'go against the grain' (Cochran-Smith and Lytle, 1999).

Bell and Gilbert's work (1996) on the Learning in Science Project (LISP) suggests that there are three facets to teacher development that need to be considered to promote teacher learning and changes in practice. These are personal, social and professional development. Teachers use their beliefs about curriculum, pedagogy and assessment combined with their current knowledge of their students to decide both whether new ideas are worthwhile and how they might mould their current practice to take in these changes. This is neither an easy nor a simple move to make and is likely to result in different outcomes for different teachers. This is because teachers have complex beliefs about learning as well as a range of expectations and aspirations for their learners and for themselves and sometimes teaching dilemmas arise from the intersection of these beliefs and their identity. An example of this arose in one of our early formative assessment projects (Black et al. 2003), when one of the teachers was eager to improve classroom talk but was reticent to allow his students to work in groups, as he believed they would not focus on the task in hand without him leading the discussion. So while the teacher wanted to bring change in the classroom, his perception of his role in the teaching-learning process initially inhibited him from making that move. For several months, the teacher tried to improve classroom talk by working on his questions and working on 'wait time' (Rowe 1974), and it was only when he recognised that these actions in themselves were insufficient to build the type of classroom talk he wanted, that he was able to reconsider and try to integrate more group work in his lessons.

So, if teacher development needs to be construed from a professional growth perspective, then it needs to be planned and designed with teacher autonomy in mind, and its effectiveness needs to be considered from a teacher-learning viewpoint. My belief is that effective PD needs to provide an opportunity for teacher dialogue and reflection so that learning about how new practices can evolve or be moulded from existing classroom practice. In other words, professional development needs a formative approach that allows each teacher to self-regulate their own development. At the same time, such changes require collaborative endeavour to both provide support and offer possibilities of what can be achievable in the reality of the classroom.

Research evidence on teacher professional transformational change concurs that deep-rooted changes are difficult and generally take considerable time and effort to achieve (Fullan 2003). Senge and Scharmer (2001) argue that creating a system that facilitates such change requires action on three levels:

1. Establishing a shared statement of purpose and a shared set of guiding principles
2. Developing infrastructures that support community building
3. Undertaking collaborative projects that focus on key change issues that create concrete projects for further deepening common purpose and improving infrastructures (p. 242)

These ideas helped form the framework and design for the PD programme that we undertook within the KREST project.

This project provided the impetus for teachers to investigate a number of inter-related issues, namely, how AfL might be strengthened in their classroom, the role that formative assessment takes alongside how they make judgements of students' attainment, why and how these decisions foster or limit learning experiences in their classrooms and how they deal with the pressures they encounter when sharing assessment information with parents, students, teacher colleagues, senior leadership teams and inspectors. It has enabled the project teachers to consider what the 'ideal' assessment situation might be for them and to see how far they might reconcile the achievement of this ideal with the policy constraints and practical realities that they face on a day-to-day basis in their schools. The problem lies in unravelling the complexities of this reconciliation to produce a workable system of teacher assessment.

The teachers found it challenging to put the ideas developed during the PD sessions into practice when they returned to their classrooms. It required a full understanding about why they were bringing in new practices. This involved examining and perhaps changing their views about what constituted effective science teaching. Teachers' identity is an important factor in terms of how they negotiate their role within their school community, and this has a direct impact on their practice (Enyedy et al. 2006). They also needed to justify to their students and other colleagues their reasons for changing practice.

Teachers initially found the evidence-based approach to PD difficult due to time constraints, problems of acceptability of new approaches with colleagues in school and reticence to work new ideas into their existing practice, so that different overall practice emerged. However, when they looked back on their experiences, many of the teachers recognised that the concerns they had had were not as critical as first envisaged:

The idea of having to bring evidence was scary but, in reality, it's been the thing that has helped me see what I am doing and not doing to help my students learn. (Chloe, Interview 3)

I wanted to change how I did assessment in my classroom but the pressures from our senior leadership's approach to assessment seemed unsurmountable at first. Little by little, I found ways of squeezing in more AfL, while satisfying the examination gods. (Tracey, Interview 3)

Creating a portfolio and justifying to yourself and others that how you were teaching was helping (students learn) seemed impossible but now I see it as an inevitable and necessary step in helping me understand what really counts in terms of classroom assessment. (Aisha, Interview 3)

Conclusion

The KREST project demonstrated that asking teachers to recognise and collect evidence from their own classrooms reduced dependency on an external expert coach and established a more autonomous approach to professional development. It also helped to foster a teacher-learning community that provided support for the teachers in their learning both within the timescale of the project and beyond. Being able to share difficulties and achievements with their peers provided the impetus for teachers to take risks when they returned to their own classrooms. This was crucial to their professional growth. The researchers noted that, on the whole, the teachers felt positive and satisfied with the programmes and as such:

- Enhanced their acquaintance with particular domains of science teaching and learning that fitted with an AfL approach
- Improved their pedagogical content knowledge
- Improved their practical teaching knowledge
- Heightened their sensitivity to students' understanding and progress
- Empowered teachers as professional learners

The main findings within this domain of KREST were that teachers could strengthen their formative assessment practices at the same time as they carried out periodic summative assessments. The reason why this was possible, despite strong pressures from within their schools to focus on summative assessment, was the essential part in aiding professional learning played by the sociocultural practices that were engaged in through the PD programmes, which strengthened their resolve to include a more formative approach in their classrooms. In order to do this, the teachers needed to recognise good practice within a domain, make sense of its complexities and understand the effects and synergies of various aspects of practice as they came to find their own ways of establishing such practice within their own institutions.

This way of working took considerably more time than had been envisaged at the start of the project as teachers needed to be involved in planning, actioning and evidencing practice as well as analysing and reflecting on their teaching and that of others. Many researchers have commented on the slow pace of teacher change (Fullan 2005; Hargreaves 2005), and the KREST project documents some of the reasons why this is inevitable, as teacher identity is challenged by new ideas from professional development programmes invading the classroom domain. What was clear was that even within the contentious area of changes in classroom assessment practices, the resolve and professional bonds that formed within the teacher community steadied the situation sufficiently to prevent teachers rejecting new ideas as untenable and provided breathing space for them to suspend disbelief of new ideas so that there was sufficient time and opportunity for new practice to develop at a reasonable pace. This approach to PD meant that the teachers did not become risk averse and instead were energised to take action as they took control of the change within their own classrooms.

Much of the literature on teacher development focuses on the training methods used and the design of programmes with effectiveness outcomes sometimes measured by student achievement or, more often, by teacher confidence. Making changes in classroom practice is a highly complex series of events, and when teachers take part in professional development, much of the change process that they go through and the variability in implementation of the professional development goals of the programme remain undocumented. By looking in some detail at the professional development of science teachers on an Assessment for Learning Project, we explored why and how a focus on change in assessment practices requires professional development programmes that support professional dialogue and encourage teacher autonomy in order for teachers to develop as reflective practitioners.

Much of the early literature on professional development artificially narrows and simplifies the path towards professional growth, often resulting in a stepwise ‘catch-all’ approach to professional development, which engages only some aspects of teacher beliefs and identity. The KREST project highlighted why there is a need to focus on teacher change from a professional growth perspective because changes in assessment practice may impinge on teacher beliefs about pedagogy and curriculum as well as assessment. This has implications for both training new teachers and the professional development of teachers.

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