Professional Development Portfolio 2

Module Leader: Karen Turner

Tutor: Caroline Daly
Tutor Group: Portland

Katherine Richardson

'I' route

June 2009

Word count: 5108 (excluding professional context, evidence and bibliography)
Philosophical statement: 1099
Participation in RPP: 1374
Evidence Study: 1544
Critical Appraisal: 1091

Professional Teaching Context

Teaching students

A-Level Chemistry study support at an Inner London comprehensive school
- 4 students, 1 hr/week contact
- most students have EAL and are the first people in their family to enter higher education

HND/BSc Biomedical Sciences chemistry teaching
- 3 students, 2 hr/week contact
- through a central London charity working with disadvantaged women
- all students have EAL and are from BME groups, first generation to enter higher education
- they are studying biomedical sciences without A-Level chemistry background

Working with teachers

Maximum Impact teacher coach (7 teachers, 6 1-to-1 meetings per year)
Working with second year teachers to set, achieve and evaluate transformational learning goals with their pupils.

Science Professional Learning Days
Designing and delivering a professional development programme for second year science teachers in urban complex schools in London and Manchester.

Science Associate Tutor
Supporting university tutors in Initial Teacher Training for the Teach First programme through workshops, microteaching feedback, and support for written assignments.

Talking to Learn
Supporting a professional development programme in argumentation for the science departments of four London schools.

Inquisitive Minds
Working with teachers to develop activities and structures to support pupil inquisitiveness.

Philosophical statement

In PDP1 I considered my professional positioning, which I defined as an *"identity or image which states **important** and **differentiating** features and values"*[1]. This positioning has evolved during the MTeach course: the themes below have been chosen to illustrate this development, exemplified by recent professional writing.

The role of educational theory in teaching

"Helping teachers to engage with theory doesn't mean putting Bloom's taxonomy on a Powerpoint slide and asking them to reference it in their written assignments. Theory is everything we think about education – how students learn, what understanding and skills we value, and what we choose to think about in education. Some ideas are codified and generalised by others, some we have noticed almost tacitly in our classrooms. The choice is not whether we use educational theory – we all do – it's about whether we are aware, critical and open to change with respect to our theories."[2]

My starting point in the MTeach was strongly scientific and favoured explicit reasoning. Theories should be abstract generalisations, and as elegant as possible. Theories should be empirically-based, falsifiable and tested as often as possible. I distrusted 'intuitive learning' (Torff and Sternberg, 2001) and 'narrative ways of knowing' (Bruner, 1985), dismissing them as encouraging prejudices through confirmation bias. However, after working with highly skilled teachers who have encountered minimal formal theory, I now value tacit and narrative understandings, appreciating their more reflective approach to practice and development. Similarly, working with strongly academic trainee teachers who claim to 'hate theory' yet 'critically reflect' on (Hatton and Smith, 1995) and theorise from their experience made me question the division between academic and experiential theories. I remember feedback on an assignment asking me to cite literature on research methodology. However, I felt I hardly needed the authority of *Ground Rules for Good Research* (Denscombe, 2002) to understand the difference between an interview and a questionnaire. I am still questioning when referencing 'theory' is merely a mark-scoring academic convention, and when it is a useful guide to intellectual influences and heritage.

I strongly challenge teachers who believe theory is irrelevant to practice. My experience as a teacher coach, and research into naïve psychology (eg Patrick and Pintrich,

[1] PDP 1 Philosophical Statement, January 2006
[2] Note in support of theory, Teach First Summer Institute planning weekend, May 2009

2001, Tsai, 2007) suggest that we all hold theory-like beliefs about learning which influence our teaching. Constructing and critiquing theories helps teachers to avoid confirmation bias and to justify purposeful decisions in their classes.

Furthermore, changes in teaching theories are entangled with sustainable changes in teaching practice (Clarke and Hollingsworth, 2002). Changes in teaching theory are likely to follow the pattern of conceptual change articulated by Posner, Strike, Hewson & Gertzog (1982), occurring only when there is dissatisfaction with existing ideas, and new ideas seem plausible, intelligible and fruitful to the teacher. Change therefore relies on teachers who can critically engage with theories derived from both academia and experience.

The role of a teacher and teacher development

"The same root gives us 'educe' - the ability to establish meaning and direction in complex situations. Faced with highly complex environments and expectations, educational leaders can establish a vision of excellence and direct the actions of others to make it a reality. We are called to understand learning, to understand classrooms, and most importantly to understand the young people we work with. I believe that defining excellence is one of the greatest challenges for everyone in education. "[3]

I identify with teachers who self-define as leaders of learning, and teachers who think they, rather than policymakers, are best placed to identify and meet their pupils' needs by engaging in action research (Stenhouse, 1975), reading and reflection. In PDP1, I spoke of my short-sighted agenda while learning to teach, which prevented me from "*maximising learning or reflecting my values*".[4] I believe this severely limited my teaching role, and now see my primary purpose with classes to be establishing a shared vision of success, identifying potential barriers to reaching it, and being innovative and purposeful in reaching the goal. In my first half-term with new classes I use diagnostic conversations and activities to determine a useful goal for students, and to set ambitious progress targets. For example, my A-Level chemistry class set individualized goals around our main goal 'We can use chemical concepts and our creativity to suggest explanations for everyday phenomena.' This goal drew on my experience of Oxford interviews and tutorials, which depend on connection-making and creativity, and was therefore a suitable preparation for my students' university aspirations. As a teacher coach with Maximum Impact, I help other teachers in urban complex schools to set transformational pupil goals which go beyond attainment scores, based again on evidence that there is a huge disparity in educational experience of students which correlates primarily with parental income (Blanden & Gregg, 2004). I recently observed a participant teaching an A-Level class,

[3] Teach First conference booklet, November 2008
[4] PDP1 Philosophical Statement, January 2006

whose students worked collaboratively to reason through an economic scenario, and I am glad that high-stakes assessment has not reduced his classroom to a series of revision exercises. Teacher quality is the biggest school-based influence on a child's success (King Rice, 2003), and in my experience the best teachers directly address educational barriers – whether attendance, poor literacy, or complacency. In contrast, my first year of professional development was driven by personal interest in AfL strategies, rather than consideration of my pupils' needs – in retrospect, literacy for fluent EAL learners would have benefited my classes more. Thus, a direct focus on defining and maximising pupil learning in our contexts prevents professional development from lapsing into introversion and indulgence, from focusing on teacher, school or government interests rather than pupil needs.

The purposes and pedagogies of science education: towards evaluatism

"What will your students be like in seven years' time? What learning goals will you set: Is understanding particle theory important to you? Being able to carry out an independent investigation? Knowing whether to trust an internet site? Enjoying science lessons? Being able to weigh up evidence and make decisions? Wanting to know more?" [5]

My insistence that teachers should define success for their classes means that I acknowledge a variety of valid purposes and pedagogies in science education. The purpose of education is and should be continually re-evaluated in the light of classroom contexts, and so an enthusiasm for science can be more or less important than the ability to critique energy policies: I believe it is teachers and pupils who can best make that judgement.

[5] Science Professional Learning Days, Departmental Case Study, April 2009

Participation in MTeach module: Research and Professional Practice

VALIDITY FOR WHAT?

'Professional diktats' based on what 'research shows' spark a professional dilemma which is summed up by BBBB's question: "**Who knows best practice for my students in my classroom today?" A similar concern comes through in CCCC's view on improving practice: "Although this research is small-scaled and not overtly seeking a planned outcome I still feel it is just as valid as any academic research." Perhaps the path to answering BBBB's question, and dissolving CCCC's implied 'competition' with academic research, starts by recognising that we cannot divorce validity from our context and purpose.** BBBB and CCCC want to know how to improve learning in their classes. Academic research will be helpful to the extent that their answer to a specific context-based question is transferable to their classes. . . . In this I disagree slightly with CCCC: it is precisely because "the issues we face in the classroom" are ***not*** universal that academic research may not be 'valid'. . . . The subsequent misuse of research by divorcing it from its purpose and context (often spottable by the awful phrase "research shows . . .") does not make the original research less 'valid', nor are our teacher-researched improvements 'validated' or 'invalidated' if they are useless to our colleague in the art department. **The validity of research is perhaps reducible to its 'fitness-for-purpose': it is the ill-advised extrapolation of this research which we need to resist.**

This extract draws heavily on Messick's (1993) idea of consequential validity in an assessment: validity is not inherent in an assessment instrument but rather depends on the inferences drawn from the assessment. However, after reading Tooley and Darby (1998), I realised that there are also inherent standards of argument, research design and inference which are necessary (though not sufficient) for consequential validity in research. For example, the article I critiqued for my RPP assignment (Bunyan, 1998) made grand inferences on the basis of minimal data and his 'conclusions' did not follow directly from the study, but were merely reiterations of common practice in science departments.

The text also reveals my logico-deductive approach to reasoning at the beginning of this module. I adopted a highly academic stance and worked primarily on the conceptual entanglements surrounding validity. I did not address implicit concerns about the power relationships which influence the recognition of teacher research, or the ongoing debates about teachers' roles as professionals or technicians (Scott, 2000). This may be because I have not experienced powerlessness at the hands of national policy initiatives. My belief was (and still is) that bad policy is an inconvenience which can usually be subverted, and that my teaching is more likely to be curtailed by the beliefs of colleagues and students than by government initiatives. Therefore, I immediately adopted the position of a teacher with the power to determine the relative value of practitioner and academic research for her own classroom, and ignored the implications of 'prestige' and 'validity' as loaded

concepts. This probably contributed to the disagreement in the third extract I will present.

I still blithely take a 'magpie' approach to adapting and justifying my practice, drawing on other teachers, policy and research alike. All of these ideas are filtered through my own criteria for 'believability' (Bruner, 1985) which reflects my confidence in my educational literacy. Even when developing new schemes of work or lesson activities, I tend to develop my own ideas before I look for existing resources. This is partly based on my belief that something reasoned through for myself is better than something handed to me, which mirrors my 'individual sense-making' approach to learning (Watkins, 2003).

A challenge I found throughout the discussions (and still find in constructing this portfolio) was adopting dialogic reflection (Hatton & Smith, 1995) by considering multiple viewpoints in my own posts. While I am skilled in anticipating counterarguments, trying to consider two stances at the same time causes cognitive overload (Kuhn & Udell, 2007), and I find it tedious to unpack warrants and assumptions unless I am directly challenged.

THE EPISTEMIC BASIS OF CLAIMS ABOUT TEACHING

AAAA said: "I am struck with the overwhelming impression that teacher research is hard . . . it is very hard to give opinions weight or meaning without backing them up with hard evidence. Research is not the same as narrative, and surveys or sustained studies are needed, in order for trends or conclusions to be observations rather than speculation."

It was interesting to look at Sullivan's article immediately after the Leading Learning module, in which most of us assumed that narrative reflection and personal experience led to some professional learning. Perhaps it's easier to be aware of of narrative enquiry's (narrative research's?) limitations when we look at dissemination of that research, or the extent to which we are confident of 'conclusions' about our practice.

Do we apply the same standards of justification to other 'professional learning' that we will to our own research and that of others? Every day I make decisions about 'how to teach' from anecdotal experiences and preconceptions. Should these decisions be justified to the same extent as educational research that aims to inform learning? Could I cope with that level of professional challenge, even ignoring the pragmatic limitations?

A recurring theme in my professional development is the epistemic basis of claims about teaching: how do we know what we know? This module complemented Leading Learning, allowing me to compare narrative approaches and research as starting points for professional learning. Engaging in these modules helped me to develop an evaluatist stance on teaching practice, and the view that all answers are tentative and should remain falsifiable (Popper, 1959), irrespective of whether they emerge from the experience of researchers or of teachers. This is even more true in education than in science, as we cannot assume that even well-established phenomena, such as children's misconceptions

about light, will remain constant through social and educational change. However, I reject the idea that good teaching is entirely a matter of opinion: while 'good' teaching is value-laden and influenced by context, it is also amenable to empirical study and some consensus, and for any given purpose and context some teaching methods will be demonstrably better than others. I believe the 'opinion' approach is a misguided attack on the rational-technical model of teaching (Scott, 2000) and an attempt to sidestep the diktats of policy. it would be far better to emphasise the empirical and knowledge-based nature of teacher judgements and reflections, as well as ways of preventing confirmation bias (for example, by sharing judgements with colleagues). For example, narrative enquiry could be considered a self-reporting form of qualitative research. In fact, in dismissing narrative techniques as a sufficient basis for building a professional knowledge base, Furlong et al (2000) have overlooked its importance as a renewing force in any professional knowledge base. Narratives problematise practice and theory which has become an unchallenged paradigm (Kuhn, 1962), encouraging us to revisit the question 'How do we know this?'

What implications has this had for my practice? As a teacher educator and coach, I ask teachers to explore the epistemic basis of their teaching practice, and encourage them to consider alternative explanations and arguments through questioning. I constantly ask 'What would change your mind about this?' As a researcher, I finally understand why papers often spend several pages expounding their theoretical frameworks, and have become more able to articulate the frameworks I am using, rather than taking them for granted. As a teacher, I use the predict-observe-explain model (White and Gunstone, 1992) to make theorized predictions about my students, observe the outcomes, and try to understand the differences. I use both expected and unexpected behaviour to reflect on my decision making. I use narrative enquiry through a professional log as a way of 'thinking at the edge' (Claxton, 2006) and questioning my assumptions about education.

NEGOTIATING THE INTERPERSONAL AND METAPRAGMATIC ELEMENTS OF DISCUSSION

XXXX "**Katherine's comments suggest that we are merely discussing 'validity' and I don't think this is the case**. Yes, it is fair to say that sometimes it appears that teacher's want to feel their work is valid, but at the same time I feel it is more about the situation they are coming from and the experience they bring. (As discussed by SSSS) **My intentions weren't simply to say that teacher's research is valid and therefore academic research isn't (as suggested by Katherine's response) but more to suggest that both should have the same prestige**."

I chose this extract because it still makes me angry, and because it represents my greatest stumbling block in the RPP module. My first response was absolutist: since XXXX had interpreted me as saying that teacher's research was valid and academic research wasn't,

she had failed to understand my concept of validity, this was her fault and she was wrong. My second response was a distorted multiplism: it is indecorous to accuse a colleague I barely knew of being wrong, and I don't have to continue the conversation because our tutor has said that we didn't need to reach a consensus. I convinced myself into 'social multiplism': from 'everyone is entitled to an opinion' to 'no one's opinion should be challenged'. This move has been identified as a block to debate and further discussion in A-Level science courses (Levinson, Hand & Amos, 2007) because it undermines the value of critical thinking (Kuhn, 2005). Indeed, I didn't reply at all. My inability to negotiate between the arrogant absolutism of believing that XXXX was just wrong, and the mindless multiplism which characterised all differences of opinion as fixed and unresolvable (Kuhn, 2005), reduced the criticality of the debate.

Reading Howe and Mercer's (2007) report for the Primary Review revealed an unpalatable possibility. They note that effective group tasks require members to believe that both their own and other's contributions are important, and that the task cannot be completed by individuals working independently. In contrast, XXXX's comment convinced me that her contributions were not important, and that working independently (of her, at least) would be a better approach to understanding the issues of research we were discussing. In online discussion, this move is not necessarily noticed, which avoids the social cost of overtly withdrawing from a group. In this explanation, my decision not to reply to XXXX is based on my concerns about social constructivist pedagogy as 'sharing ignorance'[6].

However, an alternative way to frame the event is to consider Reddy's (1979) criticism of the conduit metaphor: communication requires energy and action from both writer and reader before understanding is reached. The more complex and emotionally-loaded a discussion, the more time and effort it takes to unpack meanings and reach interthinking with others (Mercer, 2000). In this explanation, my decision not to reply was a rejection of the effort needed to establish clear communication in this context. Reaching productive 'exploratory talk' (Mercer, 2000) would have required further questioning or explanation, or meta-level discussion about the role of argument in this context. Social constructivist pedagogies are an act of faith, inasmuch as they rely on a high initial effort which is not immediately rewarded.

Perhaps the deeper question is 'Who do I write for?' In teaching-mode, I write and read for others: to persuade, to explain, to understand. In learning-mode, I write and read to

[6] PDP 1, Philosophical Statement

make sense for myself, and I am very wary of expending effort to explain myself to others unless I am sure that the rewards will outweigh the cost.

Evidence study 6: The Use of Narrative and Teacher Development

The role of teacher narrative

As a teacher, I have always used teacher stories to help my development. The stories I read and tell can be aspirational examples, a way of reviewing and questioning my practice, or simply a form of catharsis. While the last of these helps restore equanimity after a long day, it is the former two which contribute most to my development.

The stories I share with other teachers tend to be aspirational examples: it is tempting to exaggerate for effect, to pretend that I am better than I am. Crossing from classroom to staffroom involves a shift in identity, and adopting a more competent persona than I maintain with my students (Clandinin & Connelly, 1995). Within my teacher training programme, we frequently use aspirational stories about teachers such as Jaime Escalante who have 'raised the bar' for student achievement. Reading Kainan's (1995) account of stories in an Israeli staffroom, I therefore recognized the use of narrative to produce ideal images of teachers and teaching, and the way in which teachers then emulate or internalize those ideals. In my programme, this has contributed to participants perceiving a gap between rhetoric and reality: the stories we share (particularly with the outside world) are carefully selected and framed within our stated 'mission', while some participants feel that their practice does not always reflect those stories, with comments like "Sorry, that's not a very X approach" or "I know that's not really the X attitude, I'm not supposed to think that." These self-critical comments show the power of teacher narratives to deflate, as well as inspire. However, sharing and building on stories of success is a standard Appreciative Inquiry technique (Cooperrider et al, 2008), and if these stories are presented as aspirational rather than as 'minimum required standard', they retain their motivational role.

The stories I tell myself occur both from surprising experiences in the classroom which provoke me to rethink practice, and from a conscious re-examination of standard and unsurprising practice in order to challenge and evaluate it. The latter form Tripp's (1993) 'critical incidents', where practice is deliberately problematised rather than spontaneously problematic. This problematisation may be aided by comparing teaching experience with relevant theory, policy or other writing. However, deliberately paying attention to the mundane and everyday is often a new process for trainee teachers, and so one of my foci

in running a postgraduate writing course for trainee teachers was to model and give structures for reflective writing which draws on research, policy and practice, and encourages justification of stances through argument with others (see Evidence 1 and 2 below).

Evidence 1: E-mail to Associate Tutor Co-ordinator about the Postgraduate Writing Workshop (March 2009)

Hi Hannah,

Here are my thoughts on the workshop list. In general it looks really exciting and engaging, I really like the thematic strands. I've focused my comments on where I have specific suggestions for improvement.

Have a great weekend!

Katherine

- Diagnostics and Data – this one looks a bit objective-heavy. I ran a similar one last year on Managing Marking, and it's difficult to fit it all into one session. Could the markbook be subsumed under the first objective, as that's one common system for tracking pupils? Also I think objectives (3) and (5) are the same thing – using data formatively to set pupil goals and thus to plan teaching.
- How to Push Pupils to Think Critically – not sure what Gardner's Multiple Intelligences have to do with critical thinking. Though this may be personal prejudice . . .
- Postgraduate Writing – To me, there are two challenges with this. Firstly, there's writing at M-level for the specific group who haven't written essays at university, which tends to be subject-specific, ie mainly mathematicians and scientists. Secondly, there's the particular genre of 'reflective practice and theory' writing, which is a new style even for graduates from essay subjects. There are all sorts of techniques for really interrogating classroom experience which I think it would be helpful to introduce participants to, particularly as they tend to think of reflective writing as fluffy and unrigorous and hoop-jumping, and therefore don't always go beyond therapeutic diary-writing in their use of the journal. Is it worth targeting different workshops at these two groups of participants? The first could focus generally on academic writing (1,4), the second on the genre (2,3) including an introduction to reflective approaches such as narrative enquiry/critical incidents. Or 'critical reflection' could be another theme for a workshop.

One general request from participants last year was that they had easy access to the objectives or an abstract of the workshop, because sometimes the titles require already understanding the edu-speak meaning of words (particularly in Competencies). Though possibly they did have this in one of their handbooks and they just didn't look at it . . .

Evidence 2: Postgraduate Writing Workshop Proposal (April 2009)

Workshop Objectives (what the workshop aims to achieve):

- To equip participants with an understanding of the use of essay writing in gaining QTS / M-Level
- To encourage reflection and highlight the importance of allowing time to make full use of this skill in essay writing.

Suggested title: Writing to Learn

Challenging participants - starting points

- "Theory is all just common sense" – distinguishing between 'Learning to Teach' style books and theory, also unexpected research finding eg grade-free marking (Black and Wiliam)
- "Theory won't help me in September" – theory underpins all classroom management and other September/urgent concerns.
- "More of an intuitive teacher" – How do you think children learn? Everyone has theories . . .
- **"What do I know about teaching? I've only been here for four weeks." You know more about the students you will be working with than the researchers/theorists. You are best-placed to comment on the applicability of research. Building up the skill of reflection is important at an early stage.**
- "Isn't this all just fluff?" Show examples of M-Level critical reflections (eg '07 Learning Logs) and/or participant videos showing how the practice of reflection led to classroom changes.
- "I don't like writing." Focus on thinking rather than writing, using voice recorders/images/storyboards to reduce writing burden.

Session outline:
Identifying learning needed – participants use exemplar M-level material to construct criteria which make it M-level (pairs→fours→class), then traffic light themselves on these key features.

Reflective writing activities

1) Using experience as a starting point for engaging with literature – what evidence of 'educational disadvantage' did you see in your placement school week? Brainstorm theory/policy ideas which are related.
2) **Problematic and value-laden nature of observation: use picture of classroom from Carter et al (1988) and ask what participants see/notice. Then present postulant, novice and expert comments and ask participants to distinguish which is which – how did they know?**
3) Relating research to practice – "Direct Instruction has consistently been shown as an effective way of teaching, and should be used in all schools." **Participants move into 'Line of Truth' and then argue with people of opposing viewpoints.**
4) Hatton and Smith's four levels of reflection – using peer coaching and Concentric Circles sheet to move from 'what went well' to reflecting on teaching as a value-laden and theory-laden activity (link to De Bono's hats?)

Assessment
Use any of the structures or your own to reflect on a chosen element of your microteaching episode or a classroom teaching experience (peer-assessed).

The text below (Evidence 3) is an example of a recent 'critical incident' which I problematised after talking to a chemistry teacher-educator about the concepts involved. Below the episode description, I have explored my subsequent thoughts.

Evidence 3: Excerpt from professional journal (January 2009)

> Ada, Sufiya and I are looking at the electronic configuration of ions. Neither of them studied A-Level Chemistry, but their GCSE knowledge is fairly good: they know that electrons are removed successively according to how easy they were to pull out. They can't remember which ones got pulled out first, because they have 'forgotten the rule', so they can't get the electronic configuration of the ion from the configuration of the atom. I hear the word 'rule' and sigh inwardly – they aren't thinking about explanations, or trying to make sense of it. I ask them to imagine magnets – is it easier to pull apart magnets that are close to each other, or magnets that are far away? (One day I will have a travelling science set for moments like this.) They think it's easier to pull apart magnets that are far away. I remind them that electrons are attracted to the nucleus, and we write down the electronic orbitals in order of average distance from the nucleus. Despite this, they continue to pick blindly when I ask which electrons need the least energy to escape.

I chose this episode as it illustrates a fairly typical teaching episode and illuminates several ingrained practices in my teaching, which I examine below: my strong objection to students learning 'rules' in chemistry, my use of analogy in teaching science, and an encultured blindness to the complications of science language.

Learning the 'rules'

Seeking 'rules' in science rather than explanations infuriates me, as it is the most obvious and ubiquitous manifestation of superficial learning and performance orientation (Watkins, 2003). To me, asking for the rule is tantamount to saying 'I give up, I am no longer interested in learning'. However, is it reasonable to refuse to allow my students to make that choice for themselves? My objection does not reflect my students' passion for chemistry: they have chosen to study biomedical sciences, and do not particularly enjoy their chemistry course. Nor can I claim that deep learning of chemistry will be vital for success in the rest of their degree: they have no more chemistry courses, and from the module descriptions in later years of the course, they may not need it. My objection does reflect my belief that higher education should develop thinking, but am I helping them by requiring them to think more in chemistry, when this may be at the expense of deeper and more thorough exploration of topics in their biomedical modules? At a more fundamental level, does my taken-for-granted power as a teacher justify me in making those decisions for the young adults I am working with? Examining this incident made me realize how

many of my values I force my students to comply with through my teaching practice, and to begin sharing these explicitly, and even opening them up for debate.

Model and analogy

As I realized that my students were having trouble deciding which electrons would be lost first, the thought running through my head was 'How do I bridge from familiar knowledge to relative ionization energies?' This is such an automatic constructivist strategy that I rarely notice it, let alone question it, but there are many other approaches to this problem, even within constructivism. For example, I could have set up a series of predict-observe-explain experiments (White and Gunstone, 1992) in which we simulated ionization in a range of atoms and observed which electrons were lost first. This would have led to a rule at first (though at least via induction rather than transmission), but probing those empirical rules for why it would be 'easier' to remove a particular electron might have triggered fledgeling theories for further testing. However, I chose an analogical approach and so quickly thought of a familiar situation with a similar energy-distance function: magnets. The difficulty with my use of analogies here is that as a teacher, I have access to several analogies and models for ionization energy, but I only shared one with my students. Without discussion of the limitations of the magnet model, my students are likely to transfer unhelpful elements of the analogy. For example, they may confuse the spin-based phenomena of magnetic charge (magnets) with electromagnetic charge (nucleus). It wasn't until my journey home that I realized I had also been thinking about the planetary model of the atom, and subconsciously comparing ionization energy with the energy required for a rocket to escape the Earth's atmosphere. In initially defining 'the gap between magnets and ionization energy' as the conceptual bridge to make, I ignored a variety of other models which may have been helpful. This conceptual muddle was further complicated by confusions over the language of 'energy' in this context, explored below.

Language in science

While 'energy' is a fundamental organizing principle in science, it is particularly challenging for learners because of several characteristics. It has an everyday meaning which has overlap with the scientific meaning but does not completely match it, which forces students to negotiate different uses of the same vocabulary in different contexts. It can be handled both qualitatively and quantitatively, though it is usually introduced at least semi-quantitatively, which can lead to difficulties in understanding qualitative approaches later on. It is entirely abstract. It has many different forms. Given all of these difficulties, I am not sure why I thought that bringing in energy was a good way to resolve their confusion. I suspect that I failed to empathise appropriately with my students, and

since it was the simplest and most 'common sense' explanation to me, after over a decade of studying science, I assumed that it would be equally easy for my students to grasp.

In this instance, if we consider any two electrons in different orbitals, one will have 'higher energy' as it moves in its orbital, but it is the other electron which will need 'higher energy' to remove it from the atom. Mathematically, this fits together (a fixed amount of energy is needed to move any electron from the nucleus to infinite distance) but linguistically it is a rather fine-grained distinction. This might explain why both Ada and Sufiya made seemingly contradictory decisions about which electron was likely to be removed first.

However, there are several other possible explanations. First of all, my deliberate unwillingness to give immediate feedback to their answer (as I wanted them to understand, rather than develop a rule) and my requests to explain 'why they chose that electron' is unfamiliar from their university experience, and so might have been interpreted as 'wrong answer, try again'. Alternatively, it may be that the students did not recognize the different examples I presented as fundamentally the same, as novices and experts often use different criteria to classify examples (Chi, Feltovich & Glaser, 1981). A third option might be that their conceptions are internally contradictory, or that they have fragmented sets of ideas which they are applying to the different examples (phenomenological primitives, as discussed by diSessa (2000)). Certainly, diagnosing learner's ideas on the assumption that they are structurally similar to mine will lead to errors in judgement.

Uncertainty in learning

Ending with more questions and fewer answers is a disconcerting but familiar feature of my narrative enquiries. However, the process primes me to pay closer attention to features of teaching, and clears away some of my preconceived answers, so that I can be more open-minded to all the evidence my classroom holds. Narrative enquiry is very uncomfortable for me, because I hate uncertainty, but is truer to the complexity of teaching than hiding behind false certainties.

Critical appraisal of a book: Finding Flow

Csikszentmihalyi, M. (1997), *Finding Flow: The Psychology of Engagement with Everyday Life*. New York: Basic Books

Summary

Csikszentmihalyi explores the patterns of human attention and engagement. He demysticizes 'peak experiences' in which we are caught up in our activity by explaining them as immersive attention, and identifies the necessary conditions for these peak experiences, which he calls 'flow':

> *"When goals are clear, feedback relevant, and [high] challenges and skills are in balance, attention becomes ordered and fully invested."* (p31)

Chemical analogies for flow

My first thoughts on reading this book was that chemistry provides several analogies for discussing flow. (Chemistry and psychology have always been closely linked for me, as they both involve theorizing about the principles underpinning observed behaviour, and asking 'Why did that happen?') Specifically, the initial investment of energy for flow corresponds to the activation energy required for bond-breaking in exothermic reactions such as burning. In my experience, and as suggested in the quote above, most students are familiar with rewarding activities which require extra initial effort. I have asked students to annotate the same energy graph with a description of both flow and combustion to show the structural similarities. Similarly, a well organized classroom which stimulates flow can be compared with a solid catalyst which reduces the activation energy by adsorption, via an activity such as a graphic organizer. While these activities have worked well in providing a familiar model for chemistry and in stimulating students' metacognition, my analogical approach stems partly from an uneasiness in teaching psychology during A-Level chemistry. This reflects my uncertainty about the 'teachability' of these attributes, and whether they are skills or dispositions. However, irrespective of whether I teach flow explicitly, these ideas present a number of more implicit challenges for my teaching practice if I wish to foster flow.

Fostering flow in my pupils

> *"The typical teenager admits that biking, or playing basketball, or playing the piano are more enjoyable than roaming through the mall or watching TV. But, they say, to get organized for a basketball game takes time . . . each of the flow-producing activities requires an initial investment of time before it becomes enjoyable."* (p67-8)

While flow is self-sustaining, it isn't self-starting. As a teacher, I can mediate flow for students by scaffolding the practice required to reach flow – providing goals, stimulating interest or emotion, and providing an extrinsic reason to stay 'on task' through rewards and deterrents. However, for independent learning and self-direction, students need to learn to do this for themselves (Watkins, 2003, p16). Many students struggle with organizing large tasks such as coursework, and it's easy for me to produce task breakdowns for them. However, I have learnt that it is far better to model this process, and elicit students' techniques for motivating themselves, as this metacognitive engagement builds their strategies for self-direction.

Similarly, one of my worries about teaching 'engaging lessons' is whether my students ever internalize engagement with science – whether my own enthusiasm actually hampers their discovery of what interests them in science. I certainly have several students who leave their motivation behind when they leave the classroom, and so I have introduced 'question boards' in the classroom to help students find and pursue their own interests. Hollingsworth (2006) has created a book of activities to increase flow in the classroom, but many of these are heavily teacher-directed. These are likely to cause teacher flow, but mitigate against student experiences of flow. (Hektner et al, 2007, p251). This is significant for our own reflections on lessons, as it is easy to project teacher emotions onto students. I remember realizing that the lessons where I felt intuitively that students had learned a lot were often those where I had constantly been directing them and learning the material myself – I was projecting my own awareness of learning onto the students. Both of the classes where I observed the highest student flow were art classes in which the teacher was quietly working with individuals. In the first, the task was deliberately designed to promote flow: students were asked to 'construct the most interesting sculpture you can from a single piece of paper'. From this I learned that good task design does not always entail complex design, it can simply set a challenge which will appeal to students and encourage diverse outcomes. The second art class I observed was with my most troublesome class. Students I had judged as undirected and distractable worked quietly for 45 minutes on their own art project, and then gave detailed commentaries on

their peers' work. This highlighted the key role of motivation in self-direction and other metacognitive skills which develop during adolescence (Kuhn, 2006), which implies that learners become expert in things they choose to pay attention to. More worryingly, the variety of activities which induce flow in different people implies that a "broad and balanced curriculum" (Education Act 2002) may hinder pupils from achieving flow. For example, Hektner (2007) notes that off-task behaviour can involve high levels of engagement and attention, which reminds me of students who are so wrapped up in their chosen 'distraction' that they don't notice me approaching. If we fail to value the concentration that students show on their own goals, even if we do not support their goals, students may not see concentration as important. However, I am not suggesting that I allow students to spend science lessons braiding each others' hair. What I am beginning to realize is that many students have no experience of explicitly considering and evaluating their choice of goals. The Ignatian practice of discernment, of sifting desires to find the most worthwhile , may provide a useful starting point (Hughes, 1996).

Csikszentmihalyi skates around the tensions between intrinsic and extrinsic motivation, firstly suggesting that we should do all things 'for their own sake', but later suggesting that we take up activities to learn to control our attention. This mirrors the confusion I feel when reading about Summerhill (Vaughan, 2006). Summerhill relies entirely on students' own goals, and while this should foster flow, it can also lead to boredom and apathy if students lack impetus or control over their attention. I often use the extrinsic motivation of commitments to provide impetus for flow, whereas being entirely self-directed leads to excessive DVD-watching.

Duckworth (1996) dissolves the intrinsic-extrinsic tension by posing a practical question: how would we teach if pupil motivation for further study was a valued outcome? This allows for extrinsic motivation but only in the service of building intrinsic motivation. While I have always hoped, it is only recently that I have started including it as an objective in some lessons, and sharing this with pupils.

Bibliography

Blanden, J & Gregg, P (2004) "*Family Income and Educational Attainment: A Review of Approaches and Evidence for Britain*" Bristol: University of Bristol

Bruner, J. (1985) Narrative and paradigmatic modes of thought. In E. W. Eisner (ed.), *Learning and Teaching the Ways of Knowing*, 84th Yearbook, Part 2, of the National Society for the Study of Education. Chicago: University of Chicago Press, p97-115

Bunyan, P. (1998) Comparing pupil performance in key stages 2 and 3 science SATs, *School Science Review* 74 (266) p39 - 42

Chi M T H, Feltovich P J & Glaser R (1981) Categorization and representation of physics problems by experts and novices. *Cognitive Science 5:*121-52.

Clandinin, D.J and Connelly, F.M. (1995) *Teachers' Professional Knowledge Landscapes* New York: Teachers College Press

Clarke, D & Hollingsworth, H (2002) "Elaborating a model of teacher professional growth" *Teaching and Teacher Education*, 18(8), p947-967

Claxton, G (2006) Thinking at the edge: developing soft creativity. *Cambridge Journal of Education* 36(3), p351-362

Cooperrider, D, Whitney, D & Stavros, J (2008) *Appreciative Inquiry Handbook: For Leaders of Change.* 2nd edn. San Francisco: Berrett-Koehler

Denscombe, M (2002) *Ground Rules for Good Research*. Milton Keynes: Open University Press

diSessa, A (2000) *Changing Minds.* Cambridge: MIT Press

Duckworth, E (1996) *The Having of Wonderful* Ideas 2nd edn. New York: Teachers College Press

Education Act 2002 (c.32) London: HMSO

Furlong, J., Barton, L., Miles, S., Whiting, C. and Whitty, G. (2000) *Teacher Education in Transition: reforming professionalism*? Buckingham: OUP

Hatton N & Smith D (1995) "Reflection in Teacher Education: Towards Definition and Implementation". *Teaching & Teacher Education*, 11(1), p33-49

Hektner, J, Schmidt, J, & Csikszentmihalyi, M (2007) *Experience Sampling Method: Measuring the Quality of Everyday Life*. California: Sage Publications

Hollingsworth, P & Lewis, G (2006) *Active Learning: Increasing Flow in the Classroom*. Carmarthen: Crown House Publishing

Howe, C. & Mercer, N. (2007) *The Primary Review:* Research Survey 2/1b, Children's Social Development, Peer Interaction and Classroom Learning. Cambridge University.

Kainan, Anat (1995) "Forms and functions of storytelling by teachers" *Teaching and Teacher Education* 11(2), p163-172

King Rice, J (2003) *Teacher Quality: Understanding the Effectiveness of Teacher Attributes* Washington DC: Economic Policy Institute

Kuhn, D & Udell, W (2007). Coordinating own and other perspectives in argument. *Thinking and Reasoning*, 13 (2), 90-104

Kuhn, D (2006) "Do Cognitive Changes Accompany Developments in the Adolescent Brain?" *Perspectives on Psychological Science*, 1(1), p59-67

Kuhn, D and Park, S (2005) "Epistemological Understanding and the Development of Intellectual Values" *International Journal of Education Research*, 43(3), p111-124

Kuhn, T (1962) *The Structure of Scientific Revolutions* Chicago: University of Chicago Press

Levinson, R, Hand, M and Amos, R (2007) *Research Study of Perspectives on Science* [Unpublished report]

Mercer, Neil (2000). *Words and Minds: How We Use Language to Think Together.* London: Routledge

Messick, S (1993) *Foundations of validity: Meaning and consequences in psychological assessment.* Educational Testing Service. Princeton, New Jersey

Patrick, H., & Pintrich, P. R. (2001). Conceptual change in teachers' intuitive conceptions of learning, motivation, and instruction: The role of motivational and epistemological beliefs. In B. Torff & R. J. Sternberg (Eds.), *Understanding and teaching the intuitive mind* (pp. 117-143). Hillsdale, NJ: Lawrence Erlbaum.

Popper (1959) *The Logic of Scientific Discovery.* London: Routledge

Posner, GJ, Strike, KA, Hewson, PW & Gertzog, WA (1982) Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66(2) p211

Reddy, Michael J. (1979): 'The Conduit Metaphor: A Case of Frame Conflict in our Language about Language'. In Andrew Ortony (Ed.): *Metaphor and Thought.* Cambridge: Cambridge University Press

Scott, D (2000) *Reading educational research and policy*. London: Routledge

Stenhouse, L (1975) *An Introduction to Curriculum Research and Development* London: Heinemann

Tooley, J., Darby, D. (1998) *Educational Research: a Critique,* London: Ofsted.

Torff, B. & Sternberg, R.J. (2001) *Understanding and Teaching the Intuitive Mind: Student and Teaching Learning.* New Jersey: Routledge

Tripp, D. (1983) *Critical Incidents in Teaching* London:Routledge

Tsai, C (2007) "Teachers' scientific epistemological views: The coherence with instruction and students' views." *Science Education*, 91(2), p222-243

Vaughan, M. (2006) *Summerhill and A.S. Neill* Milton Keynes: Open University Press

Watkins, C. (2003) *Learning: a sense-maker's guide*. London: Association of Teachers and Lecturers.

White, R & Gunstone, R (1992) *Probing understanding*. London: Routledge