The role of teachers' priorities for science education in the enactment of science curriculum reform

Indira Banner[1], Jim Ryder, Jim Donnelly.

Centre for Studies in Science and Mathematics Education, School of Education, University of Leeds, Leeds, LS2 9JT, UK.

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Abstract

This paper examines teachers' priorities for school science and how these priorities condition their responses to curriculum reform. We analyse teachers' responses to a revised science curriculum for 14 -16 year olds in England. A key feature of this curriculum is an enhanced focus on teaching about the nature of science and socio-scientific issues. Six teachers from two schools were interviewed to explore their responses to this curriculum reform. Teachers within each school had similar priorities to one another, but these priorities differed noticeably between the two schools. Teachers' priorities had a clear impact on the way that teachers spoke about their enactment of the course. In particular teachers adapted the course to meet their students' needs; actions characterised here as reflecting 'legitimate professionalism'. Finally, areas for further research are identified, especially in the context of teaching about the nature of science and socio-scientific issues.

Introduction

In England the secondary science curriculum, for children aged 14-1 6 years old, has recently changed to involve explicit teaching about the nature of science and socio-scientific issues in the science classroom. This is mainly in response to a number of reports identifying the need to make the curriculum more relevant and useful for everyday life so that, for example, people are able to use their understanding of science to help make decisions about events happening in their own lives or in society (Driver, Leach, Millar, & Scott, 1996; Jenkins, 1999; Millar, 1996; Millar & Osborne, 1998; Ryder, 2002). Furthermore, several

[1] i.banner@education.leeds.ac.uk

government reports identify a need to increase the number of pupils choosing to take up post-compulsory science courses to provide a pool of potential future scientists, thereby supporting the UK economy (Department for Education and Skills, 2005; HM Treasury, DfES, & Department for Trade and Industry, 2004). These distinct arguments converge on the need for a science curriculum that is engaging for all and flexible enough to meet the needs of pupils whose formal science education will end at age 16 and also those who intend to pursue a future career in science.

In England at age 16 children can choose whether to stay in school[2] or go to college, take training opportunities or to go into the world of work. A major reform of the school science curriculum for 14-16 year olds was introduced in September 2006 with the aim of improving the choice in science education for students, teaching science for everyday life and increasing the number of students studying science post-16. The reformed curriculum structure includes a compulsory science course for all students designed to teach science that will be useful for students as adult citizens taking 10% of curriculum time over two years. There is also the option of taking additional science courses (also 10% of curriculum time). One of these courses focuses on more detailed study of science concepts. Another course focuses on science understanding through work-related contexts. A further option allows for students to take Biology, Chemistry and Physics as separate subjects.

In this paper we focus on the '21st Century Science' suite of science courses (Millar, 2006). Learning and teaching about the nature of science and socio-scientific issues are emphasised within the 'core' 21st Century Science course. For example, the aims of this course include 'understanding scientific ideas and how they develop' and 'evaluat[ing] (...) the benefits and drawbacks of scientific and technological developments' (Oxford Cambridge and RSA Examinations, 2005). The course gives more time for teaching and importantly, in examining, things like data, correlation, developing explanations, scientists, risk and making decisions about science. These issues (in addition to factual science knowledge) are designed to be taught in context and with a suggested emphasis on student-led discussion and group work.

This paper draws upon interviews with three teachers from each of two case study schools. These case studies are taken from a larger project: the Enactment and Impact of Science Education Reform[3] (EISER). This is a three year longitudinal study looking at the responses of teachers and students to the 2006 reform and the new courses. The EISER project includes a quantitative strand, using national datasets to look participation and attainment across the range of available qualifications and matching these to student characteristics (e.g. gender, ethnicity, socioeconomic status). The EISER project also has a qualitative strand which

[2] In England secondary schools typically provide for students either from 11 -16 years, or 11-18 years.

[3] www.education.leeds.ac.uk/research/cssme/projects.php?project=99&page=1

involves interviewing children and teachers in 19 schools over a three year period. The purpose of this paper is to look at the impact of these reforms and the 21st Century Science course on teachers and teaching within two of these schools. We were particularly interested in the relationship between the intended reform and how this was played out in the classroom. The fact that the curriculum has changed and that detailed teacher guidance, text books and examinations (policy texts) have all been produced does not mean that the curriculum will be 'simply received and implemented' but it will be interpreted in different ways and 're-created' (Bowe, Ball, & Gold, 1992, p22). This means that teachers have a key role in the reform, and the nature of this role will depend on many different factors. Bowe *et al* (1992) talk about different influences on teachers; for example, their own experience and knowledge and that of their colleagues, the style of management within the department and school, the type of pupil intake – all of which will affect the way in which policy texts are enacted. Bowe *et al* (*ibid*.) have called the responses of practitioners to policy texts the *context of practice*. Research evidence also shows that some teachers are not confident in their knowledge of the nature of science and how to teach it (e.g. Abd-El-Khalick, 2005; Hipkins, Barker, & Bolstad, 2005; Leach, Hind, & Ryder, 2003). In addition, factors like assessment processes, time pressures, classroom management issues and lack of resources may act to discourage teachers from translating the curriculum, as intended, into the classroom (Bell, Lederman, & Abd-El-Khalick, 2000; Ryder, 2001). Teachers also have their own priorities and aims which may or may not concur with those of the policy texts and which they may or may not adapt or change.

This paper addresses two research questions. Our first research question (RQ1) is 'what are teachers' priorities in the classroom?' This includes whether teachers felt that there had been a need for the reform and how their priorities related to others in the department as well as between the two departments. Our second research question (RQ2) is 'what are teachers' experiences of the new course and how are these influenced by the teachers' priorities?' This is of interest in terms of impact and enactment in the classroom; what teachers thought about this change in emphasis and the methods or approaches they used in its learning and teaching.

Methodology

Interviews were conducted with three teachers in each of two schools. The choice of these two schools is explained below. One of the teachers in each school was the Head of Science and at least one of the other teachers taught physics. These interviews are the first round in a longitudinal study which will include a further two sets of teacher interviews over the coming two years. The interview schedule was agreed by an iterative process within the team and was piloted with teachers from two additional schools.

The interview schedule was designed to be open in its approach; to elicit a range of responses to a number of issues relating to the reform which may be pertinent to individual teachers or departments. For example, teachers were asked 'How, if at all, have the reforms impacted on your students?' and then a series of further questions, designed to prompt the teacher, only if necessary e.g. 'Have you seen changes in attainment in particular (groups of) students?' This approach enabled RQ1 to be answered as it allowed teachers to talk freely about what they felt was important so highlighting their particular priorities. Many teachers also spoke here about the impact of the increased emphasis of the nature of science and socio-scientific issues in the curriculum. In addition, to answer RQ2, teachers were asked another open question about teaching methods with prompts relating directly to the change in emphasis if teachers had not already referred to it. The interviews were digitally recorded and then transcribed professionally.

Here we examine data from two schools in detail. Both schools had elected to follow the 21st Century Science course and yet interviews with staff showed that teacher priorities and enactment of the course were very different in each school. This choice of schools therefore gives examples of a range of responses to our research questions and shows the capacity for different interpretations of identical policy texts. The schools have some important differences in terms of pupil intake and in tradition and expectations of both staff and pupils. School A is a mixed 11-18 comprehensive school in an urban setting with about 1800 children on role. It is a high achieving school where over 90% of 16 year olds gain five good qualifications[4] with a high proportion of students continuing to study at least one science subject post-16 and very low percentage of children are eligible for free school meals. Parents are closely involved with the children's education and expectations are high from students, parents and teachers. Many of the science teachers are experienced and specialised to teach Physics, Chemistry or Biology. School B is a mixed 13-18 comprehensive school in a rural area with just over 550 children on role. Approximately 55% of children gain five good qualifications at age 16 and again a very low percentage of children are eligible for free school meals. In addition to more traditional Science subjects, the school offers Applied Science qualifications, for children aged 14-16 and post-16, but post-16 take up of Science is low. Teachers frequently teach outside of their specialism in science subjects up to, but not including, post-16 classes.

Analysis

Issues that were of particular interest, such as teachers' experiences of teaching the nature of science and socio-scientific issues were identified in advance of the analysis of the

[4] This is a benchmark figure used to judge the performance of schools in England. The average was 65% in 2008.

transcribed interviews. Other categories were identified through an iterative process whereby each member of the team read the interviews and suggested possible categories. Here *category* refers to a group of responses classified under a broad heading such as 'departmental response [to the reform]' or 'the process of assessment'. We then discussed the categories, amended the scheme and tried to group the responses again. This resulted in ten broad categories that were not mutually exclusive. This process allowed us to group teachers' priorities as well as identify other factors impacting on the teachers' classroom experiences of the reform and therefore influencing *the context of practice*. A secondary coding process was then undertaken to look in more detail at teachers' priorities. These codes identified issues within the broad categories and were also not mutually exclusive.

Overview of findings

In school A, the overarching response was that the new course was not ideal for the children at this school predominately because it was not considered to prepare students adequately for studying post-16 (A-level) science. All three teachers were concerned about the coverage of science concepts and the examination style followed by this course. They talked about how the course, in these respects, had been made easier than the previous course they had taught. Comments about teaching the nature of science and socio-scientific issues also frequently related back to the suitability as preparation for further study.

At school B the priorities were very different and teachers were more positive about the reform for their students. All three teachers thought that the course was important in learning and teaching science for *all* students, not just for those wishing to have a career in science. All teachers commented that they heard much less frequently from the students 'what are we doing this for?'

The following section examines the main priorities in the two schools, and how these priorities conditioned the teachers' responses to the new course.

Teachers' Priorities for School Science Education

Preparation for Post-16 Study

One of the key priorities for some of the teachers was to make sure that students were properly prepared for further studies in science, both post-16 qualifications at school and in some cases looking ahead to university courses. This was particularly important for all three teachers at School A where a large number of the students choose to take science subjects at post-16 level. Teacher 1 spoke about the department thinking about 'the next stage along' as they are a school for 11-18 year olds.

> we're here thinking at the next stage along, whereas a lot of schools probably will just be 11 to 16 schools. (Teacher A1)

Teacher 3 spoke specifically about preparing students for university courses.

> we have students that want to go off and do Engineering or, or just Physics, or Medicine or, you know, what have you, Veterinary Science and things like that. And (...) you've got to prepare them well. (Teacher A3)

The Head of Science at School A referred to parental influence in what science was taught and referred to it being 'part of the culture' of the school to offer strongly academic science subjects for 14-16 year olds. He also said that maintaining large post-16 numbers in science was important for financing the staffing of the department, an issue not mentioned by teachers at school B.

High academic attainment

It was clear that students' attainment at age 16 was of significance to staff in both schools. A teacher on the senior management team in school B was the most concerned about exam results and highlighted that this was sometimes the over-riding concern for a school.

> This is, as a school, our idea is to get the students the highest exam grades we can. There's a pressure to do that which sometimes can undermine dealing with more diffuse skills based things rather than fact based things. (Teacher B3)

Teacher 1 at the same school talked about the sort of pressure which may prevent teachers from being innovative in the classroom.

> But there is a huge pressure on results so that's why many people play safe. (Teacher B1)

Here, the teacher is referring to staff teaching in a way that they know will get good exam results rather than trying new approaches and taking risks.

In England, this focus on high attainment is important for schools as the data and resulting league tables are published nationally. Schools are often judged by the government and by parents on the basis of these results and poor exam results may lead to falling roles and the threat of closure. It may also be necessary for students to gain good grades at age 16 if they are going to go on to study science afterwards and it is obviously good for students to achieve good pass grades at this level for any future education or employment opportunities.

Science for everyday life

The main purpose of school science education was seen by some teachers as providing students with the understanding and knowledge of science concepts and processes to be able to use science to help them make informed opinions and decisions as adult citizens in everyday life. This includes the contextualisation of many parts of the course so that the science concepts are set in everyday situations and the increase in the explicit teaching of the nature of science and socio-scientific issues. This was only expressed as a priority by teachers in school B, particularly Teacher 1 who spoke about science teachers being 'duty bound' to teach science that will be useful to students in later life.

> Well, 21st Century Science I think, to be really honest, the thing that attracted me to it most was this philosophical idea that what we should be doing for every kid if Science is going to be part of the National Curriculum, it's a requirement that everybody has to do it, is that we should be equipping them for making decisions about Science when they leave not just filling them full of facts.. (Teacher B1)

This was echoed by Teacher 2 who also saw that as school science education is compulsory that it should be useful to the students.

> I suppose it's hard because you've got to say 'What's the purpose of education?' and I think there's a much bigger philosophical question here (...) there shouldn't be an assumption that every kid [that] has to (...) do GCSE Science is going to become a scientist. I think, to me, there was obviously a philosophical question of, 'What Science would it be handy for these students to have so that as adults they've got some good background science that means if they come across a Scientific problem in their life, in their environment, in their community, that they're reasonably well informed'. (Teacher B2)

Meeting the differing needs of children

Most teachers talked about wanting to teach a course that was suited to their students and there was also the issue of trying to meet the needs of a range of students. One way of doing this was having flexibility in the curriculum. For example, Teacher 1 at School B talked about the different combinations of courses available at his school and how these different pathways would meet the different needs of his students.

> I think the idea of splitting it into three [courses] is because there is the Science that everybody should do whether they're going to be a Scientist or not which is in the Science course. And then there is the Science that you need if you're going to potentially be a Professional Scientist (...) And then there's the(...)

> everyday use of Science (...) So the reason for offering all three is because you've got three different sorts of people out there. (Teacher B1)

The impact of teachers' priorities on their responses to the reform

Preparation for Post-16 Study

Teachers at school A were most concerned about preparation for post-16 science courses. All of these teachers felt that the new courses did not prepare the students adequately for further study. It was clear that Teacher 3 at this school felt that the previous course had been perfectly adequate; he said it had been "working well" and that if they had not invested so much money in the resources for the new one, they might change to something "more similar to the old style course". This was similar to comments from the other teachers.

Success at post-16 science is evidently important to the school and is the teachers' main priority as a large number, and proportion, of the children go on to take science A-levels. This is especially true of the Biology course. One of the teachers taught Biology and made this very clear:

> I don't like the fact that I don't think it's very good preparation for [post-16 courses] and that's a really important consideration for this school because we've got 200 [Biology students in the first year of post-16 study]... They are less well prepared than they used to be so for me that is a big concern. (Teacher A3)

Teacher 2 also made this point very clearly, and his opinions are echoed by all three teachers throughout their interviews.

> For me, my focus is 'Am I going to get good [exam] grades, and am I preparing [the students] well for [post-16 science] should they want to take it?'... Yes and no… In that order basically. (Teacher A2)

Teacher 1 reflects on the main reason he feels that the department are not satisfied with the reform.

> I suppose if we weren't such a big sixth form school, we'd be probably more content with the course. (Teacher A1)

These teachers talked about lack of preparation for post-16 study in terms of the content of the course and examinations. The reasons given for this was due to the fact that some of the science concepts in the course had been taken out and more learning about the nature of science and socio-scientific issues had been put in. Teacher 1 at School A described the course as being "dumbed down to too much of an extent". Teacher 2 also used the term

dumbed down to describe the course and said that at this school "more of our students (...) want to know Science rather than, you know, how Science is perceived in the media or something like that". Teacher 1 also referred to the students who had completed the first compulsory course as having "almost had a year off". He commented that students of various abilities noticed the change in the course content and that they didn't like it; students were asking 'what are we doing this for?' because they didn't feel that the socio-scientific issues and nature of science ideas had a place in science lessons.

> I think these changes have been made to, sort of, target, not the top echelons but the, the, sort of, the middle to lower, sort of, sort of, ability range, and to an extent they think that's helped, but even then, some of them feel that it's (...) well, they almost say it's dumbed down a bit, you know? (...) "Is it Science this?" you know, that sort of thing. (Teacher A1)

Similar concerns were voiced by Teacher 3 and again referring back to suitability for further study.

> And I don't think this course is quite as well suited to most of the students we have here (...) So yeah, as Head of Biology it does concern me that they're not so well prepared at [post-16] and it's an even bigger jump up than it used to be. (Teacher A3)

Each teacher stated that the exams were too easy and that this is another reason that students are not properly prepared for further study – due to a lack of experience in writing scientific explanations and student expectations that post-16 science exams will be similar. Teacher 1 suggested that it was more of a general knowledge test than a science exam.

> But, to be honest, you, you look at the [exam] paper, and you wonder how discriminating it is (…) is it testing your Science? I don't know. I think if we give it to some [14 year olds] they could probably have a good go at it, and they won't have done any of it really (…) it's not, honestly, I don't think it's very rigorous in its testing. (Teacher A1)

Teacher 3 also felt that the exams didn't test the 16 year olds properly or give them a chance to explain all that they know. A similar point was made by Teacher 2.

> [A] weakness is the style of the exams, I wish they were... Sometimes you feel they've not been very well tested in terms of the style of the questions, sometimes I'd just like them to have a bit more space for the students to express their understanding the questions rather than tick boxes. (Teacher A3)

Responses of teachers to questions about learning and teaching the nature of science and socio-scientific issues also referred to post-16 study. All three teachers at school A were

quite positive about this aspect of the course as something for the 'majority of people in the country' but not for the children at this school.

> I think the focus on the [nature of science and socio-scientific issues], and that nature of it, and various principles keep coming up (...) and things like this, which is fine enough, but it's not really relevant to [post-16 courses] in all fairness. Certainly not the [courses] that we choose. (Teacher A2)

Interestingly, despite school B offering post-16 courses in science, there was very little comment from teachers about how the 14-16 course prepares students for post-16 study. Teacher 1 mentioned slight concern from the Chemistry teachers about whether the students were properly prepared for post-16 study but this was not mentioned by one of the teachers who taught Chemistry. There is evidently a clear difference in the number of responses of the teachers from the two schools regarding further study. The reasons for this may be simply because there are only a few students taking post-16 courses at School B, or it may be because teachers do not think that the new course at 14-16 years old will have any particular impact on students taking post-16 science.

High academic attainment

This priority was not emphasised as much as might have been expected, possibly because all teachers interviewed reported an improvement in examination grades since starting the new courses. Reasons given for this were generally different in the two schools. Teachers from school A thought that the increase in attainment was a result of exams and the science concepts in the course being easier. Teacher 3 explained this unambiguously and it reflects what the other teachers interviewed here also thought.

> Our A's and A*'s[5] went through the roof I think to about 70% last year (...) They were at about 45% under the old course. Now, that can't be our teaching and it can't be the students, it must be the course (...) I think the exams are easier, as I said, to get an A (...) I think the content is easier. I don't think they're required to learn as much. (Teacher A3)

The views of the teachers about this increase in attainment at School A also related back to post-16 study. Teachers were of course pleased that grades had improved but saw it as a potential problem as students were applying to take post-16 science courses on the back of their previous exam results when perhaps they were not really capable of this level of science study. Teacher 1 called the increase in results a 'double edged sword' and questioned whether "an A on this course worth an A in another course, and you, sort of, you wonder" .

[5] In England the GCSE examinations are graded A* (highest attainment), A, B, C etc through to G and U (fail).

> I think we're picking up more students at [post-16] who have enjoyed it, weaker students who have enjoyed [the new course] and have coped well with it, and I think that's a two-edges sword because I think we're getting students who can't cope with it who got a B at [aged 16] who are really not up to doing [post-16] Biology (Teacher A3)

This contrasted quite starkly with Teachers 1 and 2 at School B who thought that courses well-suited to students, both in terms of scientific content and assessment methods, would mean students attained more highly.

> Our results have got a lot better since we did 21st Century Science and I think there are probably a lot of reasons for that, but I'm sure that one of the reasons is that students, to some extent, feel that they've got a bit of a choice and they're doing an appropriate course. ... I'm sure that giving kids appropriate courses is a key to getting them to do well. (Teacher B1)

Teacher 2 at school B stated that the content of courses had not become easier and gave examples of physics in the Science course which clearly wasn't "dumbing down".

> It's Science but it's different Science (...) It's getting [people] to understand that different isn't necessarily worse (...) that never used to happen with Double Award, you wouldn't have foundation level children doing titrations and doing calculations. (Teacher B2)

The senior manager at this school was more inclined to say that the course and exams were more 'accessible' and that this had helped with the improvement in results for Science.

> Well, certainly there's an impact in terms of the results, those have gone up. I think the Core is very accessible to students and success breeds success without a doubt (...) I think the exam is very accessible in terms of the language demands (...) In terms of the content, yeah, I think it is accessible in terms of the level of demand. (Teacher B3)

The Head of Science also stated that the style of exams and the modular nature of the course might contribute towards higher exam grades, but this was considered secondary to the view that it's 'an appropriate course and the kids finding it interesting'.

Science for everyday life

This priority was a key feature of the responses of teachers from School B. Teachers 1 and 2 were especially enthusiastic about the new course and how it met their philosophical ideas about school science education. There were two important factors here; one was that students were being educated and prepared for using science in everyday life as adults.

> I think 21st Century Science does really well because it encompasses the ideas about [the nature of science and socio-scientific issues] just naturally within the topics, and so our kids consider things like hazard risks and benefit. So, when a chemical company down the road has got steam coming out of its chimneys they can read a report and work out is it pollution? Is it carbon dioxide? Is it whatever? Is that pollution? Is that a problem? Is that any worse than…? Hopefully we give them those skills. (Teacher B2)

Teacher 1 also made the link with possible careers and other interests in the students' lives and also came back to the point that students doing something they enjoy do better.

> There are some students for whom learning the nitty gritty of Newton's Laws of Motion and the Bohr model of the atom are just not for them and if they don't have to do it but they can do something else and they can find out about the kind of Science that is used in hairdressing or... I've got one who is doing paint spraying because his Dad's a paint sprayer and, you know, if they can fit that in and it's something they're interested in then they will do better. (Teacher B1)

The other important factor highlighted by the teachers at school B was that learning and teaching science for everyday life, in contextualised situations, meant that students see the value of it. All three teachers mentioned that students were no longer asking 'what are we doing this for?'

> And just the contexts into which things are set are more sensible now, a lot less abstract (...) I've got to hold on to this and remember this for us six years ago, not only for us but people all over the country, as a Chemistry teacher you would have classes of not very bright students and you'd be teaching them about protons and neutrons and they'd be saying, 'Why are we doing this?' and you'd be thinking, 'I don't know, why are they doing it?' That has gone. (Teacher B3)

Teacher 1 also felt this was important, for himself as a teacher as well as for the students.

> I was very conscious, maybe I was just acutely conscious of it but when I was doing [the previous course] sometimes kids would ask, 'Why are we doing this?' Sometimes the best answer I could come up with was, 'Well, it will be on the exam'. And I always felt like a bit of a fraud then because (...) it doesn't seem like a really good reason for doing it. I know that exams are important, qualifications are important, but there has to be a better reason for doing Science than it's going to be in your exam. (Teacher B1)

Teacher 3 commented on how s/he thought this course was an improvement from the old 'very dry and traditional' course. Teacher 1 explained that the staff in the department were ready for a change and his excitement about starting the new course is evident.

> It was no worries really, people just... I think people were ready for change, I honestly think they were (...) I have to say, it was exciting, it was great, I wouldn't have missed it for the world. (Teacher B1)

Attitudes to these issues were distinctly different in School A. Their responses were influenced by the importance of post-16 science courses at School A; all teachers felt that the increase in this aspect of the course had a negative impact on preparing students for further study. One teacher also stated that teaching some of the nature of science concepts was difficult and there was still confusion as to what was expected by staff and students.

> It doesn't come naturally to a lot of scientists because we've never done it before and we've never been trained in it and it's not quite clear what the students are supposed to come out of it with. (Teacher A3)

Teacher 3 went on to question whether students really could make informed decisions about socio-scientific issues using science concepts learnt at school.

> And also do they really understand enough Science to be able to discuss some of these things properly? (Teacher A3)

Such a view has been developed elsewhere (see Donnelly, 2005).

Flexibility in the Curriculum to meet the needs of all children

Reference to meeting the needs of their students was important to all teachers interviewed but meeting the *differing* needs of a range of students was not a priority in school A. When asked about the possibility of offering the work-related course to students at this school Teacher 1 indicated that parents were very keen for their children to take the 'normal' qualifications. Teacher 2 related the issue back to post-16 study.

> We were looking at doing the [work-related course] for a particular group. I don't think for our (...) cohorts that it would really appeal to them, to be honest (...) I think they're… It's not going to be as good preparation for [post-16], and I think at the start of Year 10, to elect for something that, essentially, doesn't count you in for [post-16 study] it's a big decision to make at the start of Year 10. (Teacher A2)

However the department did use the flexibility of assessment procedures to teach a year's science course (three modules) in about four months to their most academically able

students. This was seen as being beneficial to students to stop them being bored and to give more time for other modules considered to be more challenging.

> I sense that the really bright kids don't enjoy it as much, they really liked the content-rich [year before] and then are then wondering what's happened, 'What am I supposed to be learning?' I think that's been helped by condensing [modules] 1, 2 and 3 into a short period of time so they're challenged just by the pace of it. (Teacher A3)

Teachers in school B however spoke of the way in which the different options were suited to the different students and how this was a positive thing in terms of students being more interested and enhanced attainment. Students were allowed to choose the course that they wanted to do – with guidance from staff.

> What we hinge it on is where the students see their progression routes going and it's trying to match them to... Well, partly to their current interest now but also to where they hope to be going in the future with Science. (Teacher B3)

Teacher 3 at school B particularly saw the work-related course as being an important option for many students as it was 'more practical' and 'less abstract' than other options. This was also important to the other two teachers at the school.

> So last year we got several A's for our [work-related] course because we let kids do it. We even suggested to kids, 'You'll get a better grade if you do this. You're hard working, you're good at coursework, 50% of this is coursework, it's really up your street.' The other thing I think about the Applied course, obviously I didn't know this when we started, but it is good at motivating kids to keep going. (Teacher B1)

Discussion

The analysis above clearly shows that teachers have strong priorities and many different commitments that underpin their approach to school science education. These are heavily influenced by the context in which they work, particularly the student intake and the priorities that teachers see as being important for those students. Our analysis suggests that there are strong influences within schools, and from other teachers within specific departments, affecting what teachers think is important, how they perceive this reform and how they implement the associated specifications. However, it is also evident that, within a department, teachers have different ideas about the changes, that this is still developing, and that teachers are still learning about what it means and deciding how to adapt their teaching, if indeed they feel any adaptation is necessary.

The priorities that teachers have prior to the reform condition their responses to the course. Teachers in the high attaining school, school A, evidently judge virtually all aspects of the course against suitable preparation for post-16 study. On this basis they feel that the revised curriculum is not adequate. However, , all of the teachers from this school were positive about the course *for other schools* – but not for them. One of the responses to the reform in this department was to teach the science course, which contained the explicit teaching of the nature of science and socio-scientific issues, in about four months rather than one year. They did this by changing the course to teach most concepts just once and by adapting practical and other activities in order to accelerate the teaching and learning.

Teachers within school B had different priorities from those within school A. For example, it was a priority for two of the teachers at this school that students learn science that will be useful for their future lives as adult citizens. In this department teachers were positive about the revised specifications and were keen to establish the best way to organise the courses so that the teaching of the nature of science and socio-scientific issues could run through both years.

Our case studies illustrate the variation in the impact of a reform and associated courses, arising from a single set of policy texts, on departments and teachers. The responses of these teachers to the course and the close relationship of these responses to teachers' priorities shows that teachers are concentrating on what about the course they see as being suitable, or not, for their students. This can be described as legitimate professionalism with teachers adapting the course and themselves in order to teach the course to best meet the perceived needs of their students. The teachers may not be teaching the course as intended by the developers, but are using their professional judgements to make decisions and take actions to do what they see as 'the best thing' in their schools. For example, the notion of having a 'relevant' science curriculum is perhaps easily stated. However, relevance will mean distinct things for different students. The policy texts are used by these teachers in a 'writerly' fashion meaning that teachers in each school are interpreting and re-creating the reform in ways that suit them (Bowe et al., 1992). This isn't to say that course designers have little influence on what goes on in a classroom; these texts provide the fundamental guidelines and structure which teachers are obliged to follow if their students are to be successful in their exams. For example the department in school A was able to teach the compulsory course in a reduced time because the students were able to complete it and attain highly in exams within that time. Therefore design of policy texts, particularly assessment materials, will be very influential in guiding the nature of what and how science is taught in schools.

Teaching the nature of science and socio-scientific issues is of particular significance in the context of our case studies. Teachers at school A were most sceptical of this aspect and there is evidence to show that some teachers were confused about what students needed

to learn and how they might teach it. Teachers from both schools questioned whether it was something that more able children could just 'pick up'. One teacher asked whether the students really learn enough about science concepts to be able to make important science related decisions anyway. The importance of teachers understanding the aims and content of teaching the nature of science and socio-scientific issues links to a more general point: if teachers are going to re-create a course, or part of a course, in the way it was intended they need to understand and appreciate the aims of the course and see how it meets their priorities and the perceived needs of their students.

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