TEACHERS' AND STUDENTS' 'RELATIONSHIPS WITH KNOWLEDGE': AN EXPLORATION OF THE ORGANISATION OF KNOWLEDGE WITHIN DISCIPLINARY AND EDUCATIONAL CONTEXTS

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Thesis submitted for the degree of Doctor of Philosophy (Ph.D.)

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March 2010

Declaration

This thesis is my own work and has not been submitted in substantially the same form for the award of a higher degree elsewhere.

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Abstract

This largely conceptual thesis explores the epistemological nature of students' engagement with disciplinary knowledge, primarily in further education contexts. The disciplinary nature of students' engagement is frequently obscured by concerns relating to their engagement with educational processes. A model which distinguishes between different forms of knowledge and which places disciplinary knowledge at the centre of the educational context is proposed. This model serves as an organising idea throughout the thesis.

Approaches to theorising educational knowledge, including social realist, sociocultural and situated theories of learning as well as Bernstein's work, are analysed, critiqued and in some cases adapted. A case study of the school science curriculum and scientific literacy explores the principles of recontextualisation of disciplinary knowledge and a key debate concerning the nature of 'authentic learning' is identified.

It is argued that while Bernsteinian and social realist theories are useful in elaborating the role of forms of knowledge within the curriculum, these theories tend to neglect social relations to knowledge in different epistemic contexts. An alternative view which recognises the function of mythological disciplinary narratives is proposed. This conceptualisation acknowledges that disciplinary discourses are only fully meaningful in their authentic contexts and emphasises the role of pedagogy in bridging the meaning that is made between agential participants in the different contexts.

The fully elaborated model for forms of knowledge within the educational context locates a realist theory of knowledge within sociocultural theory and provides an epistemological account of students' relationships with disciplinary knowledge. It provides a theoretical tool for practitioners and those engaged in curriculum development for thinking about students' engagement with disciplinary knowledge. Implications for aspects of policy and practice are discussed, as are opportunities for further research.

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Abbreviations

CBT	Competency-Based Training
ER	Epistemic Relation
FE	Further Education
GCSE	General Certificate of Secondary Education
ICT	Information Communication Technology
Ofqual	Office of the Qualifications and Examinations Regulator
ROSE	The Relevance of Science Education
SCORE	Science Community Representing Education
SR	Social Relation
STS	Science, Technology and Society
TLC	Transforming Learning Cultures

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Chapter 1: Introduction

1.1 Introduction

The questions that form the basis of this study arose from the context of practice in English Further Education (FE). Initially teaching physics, I carried out a number of roles in the sector over a period of ten years. My most recent role in teacher education provided many opportunities for me to observe and engage with colleagues teaching in contrasting organisations and contexts. I encountered a wide variety of forms of teaching and learning and different ‘types’ of students and teachers engaging with the diverse contexts which make up the FE sector and also the wider Learning and Skills Sector (LSS).

Observing teaching and learning in different contexts, in one’s ‘own’ subject and in other subjects, is a fascinating and rewarding experience. It raised questions about the nature of an educational context and what it was that made one context appear to be educationally alive and exciting while another context might seem mechanistic or desolate. It quickly became apparent that my questions were intimately related to the role of knowledge within an educational context. I became concerned with the role of disciplinary knowledge in particular: how students can access or engage with this form of knowledge and what the role of the teacher within this process might be. Much is written about what makes learning and teaching ‘excellent’. But within the general talk about good learning and teaching and student engagement, it appears as though the place of knowledge within the educational context has been forgotten.

This chapter provides an overview of the research project which developed from these concerns about the place of disciplinary knowledge. The sections below discuss the background to the project, outlining the contextual factors which make consideration of students' engagement with disciplinary knowledge important but also problematic. A statement of the project's aims and research questions follows which introduces the term 'relationships with knowledge'. The approach and methodology adopted in the project is then described, focusing on the way in which the nature of the research object was elaborated. An outline of the literatures used in the project then follows. The final section summarises the eight remaining chapters.

1.2 Background to the thesis

The background to this thesis lies in Further Education, although this context reflects the project's inspiration rather than its substantial content. This situation is similar to that described by Muller (2000) when he writes that his essays are *of* South Africa rather than being *about* South Africa. Similarly, my research is initially *of* FE but not largely *about* FE. It is argued that the nature of the FE context and policy developments within FE teacher education highlight a specific set of issues concerning the place of knowledge within a formal educational context. It is suggested that these issues have a much wider relevance to other education sectors.

1.2.1 The FE context: diversity and change

What is it about the FE sector in particular that draws attention to issues concerning knowledge? As a brief illustration, let us first consider what a visitor to a large, general FE college might encounter:

> On approaching the front of the college, the visitor can't fail to observe the new Sixth Form Centre. Peering through a window, she could see a classroom displaying resources relating to Psychology A-level and a small group of 16- and 17-year-old students working together. She might then make her way past a crowd of (mostly) women – still dressed in their pristine Beauty Therapy uniforms – heading for the refectory. Passing an enclosed yard, she could perhaps observe a group of (mostly) men wearing heavy work gear practising bricklaying techniques. On closer inspection, further groups of students might be visible: foundation degree catering students in the library/HE Learning Centre; some older students using the computers; a group of students with learning difficulties working on a gardening project. The visitor might even spy a group of 16- and 14-year-old students (some of whom are wearing school uniforms) studying some indeterminate subject in one of the portacabins at the back of the college. At the end of the day, as younger students depart on college buses, she could also note the incoming cars of students arriving for classes at the end of their working day: dental nurses; pharmacy technicians; trainee accountants and many others…

FE colleges typically consist of a huge range of students and teachers, learning a wide range of subjects for a number of different purposes. Each of the subjects studied involves different practices and different kinds of knowledge, some of which appear to be more valued than others. Although schools and universities also consist of distinguishable groups, classes and subjects, they surely do not match the degree of diversity alluded to above. Diversity within FE, as James & Biesta (2007: 9) observe, is “visible in college-to-college variation and also across the range of activity within individual colleges”. Curriculum diversity encompasses academic, vocational and occupational courses provided through a number of different modes of delivery and at a wide range of levels. Crawley (2005) cited in Fisher & Webb (2006) suggests that up to 200 subject specialisms can be identified in a single college’s prospectus in addition to provision which is aimed at “encouraging particular cohorts of the population to return to some form of education, training or employment” (Bathmaker & Avis, 2005: 4).

Diversity, then, can be identified as one of the defining characteristics of FE provision. The other key feature of FE is the rate of change within the sector (Huddleston & Unwin, 2007). In recent years, FE has become the subject of much greater policy attention. As Ruth Silver, Chair of the Learning and Skills Improvement Service (LSIS) suggests, it is increasingly seen as the ‘adaptive layer’ in the education system (Kingston, 2008), playing a much more focused role within a ‘seamless policy web’ (Gleeson *et al*. 2005: 448) connecting other education sectors. FE provision has been significantly re-directed towards an economic competitiveness agenda through the development of employer demand-led skills and employability (Coffield, 2006; Leitch Report, 2006; Avis, 2007; Finlay *et al*., 2007). The 2006 White Paper *Further Education: Raising skills, improving life chances* insists that “this strong focus on economic impact does not come at the expense of social inclusion and equality of opportunity – the two reinforce one another” (DfES, 2006: 29). However, the understanding of social inclusion in use now is based on social inclusion through skills and economic participation. Social inclusion and economic arguments are frequently cited as the rationale for engaging so-called underachieving or disaffected learners and, in particular, the ‘NEET’ cohort: young people who are not engaged in education, employment and training (Yates & Payne, 2006; Davies & Biesta, 2007; Quinn *et al*., 2008).

1.2.2 The FE context: challenges for teacher education

A range of teaching and learning practices may be found in FE which are influenced by diverse subject- or occupational-specific cultures, creating a “spectrum of fragmented and largely isolated traditions of pedagogy” (Guile & Lucas, 1999: 206 in Cunningham, 2007: 85). The existence of these contrasting practices leads to differing interpretations of FE teachers’ professional values and knowledge base (for an overview see Robson, 2006). As Simmons & Thompson (2008) point out, “FE teachers often saw themselves as subject experts or tradesmen first and foremost, lacking a professional identity *as teachers*” (p. 608, emphasis in original). Simmons & Thompson also suggest that the absence of compulsory teacher training reinforced this situation. Initiatives such as the introduction of courses for 14-year-old students in FE colleges can also bring new challenges. Research concerning 14-16 provision in FE colleges has highlighted issues for teaching staff, including concerns about managing challenging behaviour, inadequacies in teacher preparation and professional identity issues for some FE teachers in working with school age children (Bathmaker & Avis, 2007; Davies & Biesta, 2007; Lumby, 2007).

There has been much recent policy interest in FE teacher training (Lucas, 2002, 2004; Thompson & Robinson, 2008; Holloway, 2009). Following the establishment of the

Further Education National Training Organisation (FENTO) and the production of standards for teaching and supporting learning in further education (FENTO, 1999), teacher training became compulsory for new entrants from 2001. An OfSTED (2003) national survey of FE teacher training identified, among other things, a weakness in the development of trainees' subject/occupational-specific teaching knowledge and skills. In responding to this report, the DfES (2003) proposed the introduction of subject-specific mentoring for trainees which "will ensure that all trainees have access to subject pedagogy" (p. 8). It also introduced a requirement that trainees address a 'minimum core' of literacy, numeracy and ESOL (English for Speakers of Other Languages).

The notion of subject-specific teacher training was an important change for teacher training in the FE sector. Perhaps due to the diverse nature of the sector, FE teacher training had always largely been generic. By focusing on the general principles of teaching and learning it had emphasised the similarities between educational contexts rather than the differences between them. But these reforms raised questions for me as a teacher education practitioner about the nature of subject specialism and its relation to teaching. They highlighted the quite profound differences between the nature of the subject knowledge of different teachers.

A number of specific issues relating to the notion of subject-specific pedagogy emerged as the reforms were experienced in practice. First, it raised questions about what the nature of 'subject knowledge' was for teachers working in generic modes (Bernstein, 2000) – for example those teaching employability, key- or life skills programmes. Second, it brought into question the type of subject knowledge needed by teachers who were working in 'limited roles' – such as those working with pre-prepared materials in learning centres or those in an assessor role. In particular, it highlighted, as in the case of the assessor described in James & Diment's (2003) study, the amount of 'underground working' and informal teaching that took place by those who are employed on assessor-only contracts. Such teachers are required to address a number of 'creative tensions' concerning "how they understand, interpret and intervene in contradictory conditions that simultaneously enhance or restrict their professional practice" (Gleeson & James, 2007: 453). Third, tensions were revealed between the teaching of specific subjects and the 'ethic of care' (Avis & Bathmaker, 2004a,b) and 'schooling cultures' (Bathmaker & Avis, 2007) which are increasingly encountered in the sector. As Ecclestone (2007a) observes, in some cases, teachers need to negotiate between aims of student engagement and participation and the goals of subject-based knowledge. Fourth, the requirement that teachers demonstrate a minimum of level 2 literacy and numeracy was problematic for some. For example, a teacher of motor vehicle engineering who appeared to work very successfully with 'disaffected' students, did not himself achieve level 2 literacy and was unable to correct errors in his own or his students' writing. This raised some very critical questions about the implications for students given the importance of basic literacy to their life chances.

In summary, these reforms in the context of FE raised critical questions about:

- the type of knowledge some college courses aim to impart to students;
- the nature of different teachers' subject knowledge;
- how teachers' subject knowledge relates to pedagogy and to curriculum requirements; and,

- how a teacher education programme might address different trainees' development needs in relation to different subjects.

The degree to which these issues may be explored and addressed within the context of practice is limited by the diversity of subject areas and economic factors (Hankey, 2004; Fisher & Webb, 2006; Simmons & Thompson, 2007). A key mechanism for support for subject-specific pedagogy within new teacher education programmes is the provision of subject mentors for trainees. However, as Tedder & Lawy (2009) point out, the role of the disciplinary knowledge aspect of the subject within this mentoring process is unclear. It also appeared at times that the subject-specific reforms might be more accurately read as a call for 'context-specific pedagogy' rather than simply 'subject-specific pedagogy'. Policy initiatives seemed to be more concerned with proposed characteristics and challenges associated with teaching in specific contexts (such as work-based learning or provision for 14-year-old students) rather than being related to teaching specific subjects. Teacher training programmes, which increasingly adopt technicist delivery models and are more than ever subject to government's 'appropriation' of professionalism (Beck, 2009), afford insufficient space to explore such issues.

More broadly, questions about students' engagement with disciplinary knowledge are often marginalised by the exigencies of everyday practice and the imperatives of policy. Practitioners work in a 'culture of the now' (Scaife, 2004: 1), in a state of 'endless change' (Edward *et al.*, 2007). They work within a managerialist audit culture which can act to distort educational practice (Hodkinson, 2008). A focus on knowledge can also appear to run counter to a progressive and learner-centred 'good practice' conception of teaching. In the FE context in particular with its 'ethic of care', attempts to foreground knowledge can sit uneasily alongside teachers' understandings of the emotional labour they are required to perform (Avis & Bathmaker, 2004a,b; Colley *et al*., 2007; Jephcote *et al*., 2008). The outcome is that there is little opportunity within the context of practice to reflect upon and explore such fundamental issues. It is argued here that these issues are important because they are concerned with the fundamental purposes of education. They are also practically important if teachers are not to be viewed as mere technicians (Hodkinson, 1998), but rather as critical mediators between students and disciplinary knowledge.

1.3 Aim of the study and research questions

1.3.1 General project aims

This study aims to explore how students develop what I have termed a 'relationship' with disciplinary knowledge and what the role of the teacher is in that process. 'Relationship with knowledge' is concerned with how disciplinary knowledge becomes meaningful to students within and through a formal educational context and how students can engage with this knowledge. By 'disciplinary knowledge' I essentially mean organised and formal bodies of knowledge which may either be those that are usually termed 'academic' but also includes those which are labelled 'vocational'.[1] A model for different forms of knowledge in the educational context is proposed in chapter 2 and this project aims to clarify the roles played by participants in the educational context in relation to this model.

[1] Distinctions between these terms and between forms of knowledge such as 'school subjects' and disciplinary knowledge are discussed in chapters 3 and 4.

Therefore, the project does not seek to address the entire range of issues identified in the previous section, nor does it focus on particular aspects of them; rather, its focus is largely conceptual and general. Although the project emerges from the FE context and will draw upon examples of practice from that context to illustrate aspects of the problem under investigation, the scope of the questions addressed here are much broader and more fundamental.

The research aim speaks of an engagement or ‘relationship with knowledge’ and avoids using terms such as ‘teaching’ and ‘learning’ in order to stand back from their general usage, such as might occur within the discourse of contemporary policy and practice. The habitual discourse of ‘teaching’ and ‘learning’ seems to imply, at least, that learning necessarily follows teaching, and that everything that occurs in a classroom is teaching and learning. But in fact the relation between teaching and learning is complex; learning can occur without teaching and teaching can occur without learning (Wenger, 1998; Edwards, 2006). The focus in this thesis is upon knowledge, and this tends to make the term ‘learning’ problematic. I wish to explore the distinction between learning and mere activity or between learning and participation in educational processes: learning needs to be *about something* (Freebody *et al.*, 2008). I also wish to emphasise the importance of being critical about *what* is being learned. Contrary to what seems to be implied in contemporary policy documents, learning is not necessarily ‘a good thing’: as Finlay *et al*. (2007: 140) point out, “[t]he social effects of learning depend on what is learned … It is not recognized sufficiently that learning can also increase inequalities in society”. It is for similar reasons that I generally employ the term ‘student’ rather than the increasingly ubiquitous term ‘learner’.

Many researchers writing from a critical or sociological perspective have observed that opportunities for students to engage with disciplinary knowledge are unequally distributed according to, for example, students' social class, gender and ethnicity. Differential access is an enduring and important challenge for policy and practice, but this is not my particular focus in this project. Although I am also concerned with critical issues about differential access to knowledge, my substantive area of interest is more epistemological than critical, although clearly these concerns are linked. Therefore, this thesis does not engage in a detailed exploration of, for example, social class or gender issues in relation to knowledge. The focus is rather on the epistemological nature of disciplinary engagement itself.

1.3.2 Research questions

This thesis addresses the following research questions:

1. What is the place of disciplinary knowledge within formal educational contexts?

2. How does educational theory distinguish between disciplinary and other knowledge forms and how does it conceptualise their role within educational contexts?

3. What epistemological principles underpin the recontextualisation of disciplinary knowledge within the curriculum and how might these principles influence opportunities for the development of students' 'relationships with knowledge'?

4. Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students' relationships with knowledge in educational contexts?

5. What epistemological account can be given of the means by which students develop a relationship with disciplinary knowledge in educational contexts?
– and what are the implications for aspects of policy and practice?

Research question 1 is the most fundamental thesis question and follows most directly from the project aim outlined above. This first question is also reflected in the remaining research questions which follow from it. At times it appears as though there is a crisis in the place of knowledge in formal educational contexts. This research question is concerned with the nature of that crisis and seeks to provide an new conceptualisation of the place of disciplinary knowledge in the educational context.

Research question 2 examines theoretical resources within the field of educational research and explores whether and how they distinguish between different forms of knowledge and how they conceptualise the place of disciplinary knowledge in educational contexts. Addressing research question 2, then, forms the basis of a critique of educational theory and results in the development of an argument for an epistemological perspective on the place of knowledge in educational contexts.

Research question 3 extends the previous questions' concern with disciplinary knowledge towards an examination of 'school subjects' (i.e. the discipline as it is represented in an educational context). This question seeks to: explore the manner in which school subjects are recontextualised (i.e. derived from their corresponding disciplines); to describe the general principles which govern this process; and, to identify implications of different modes of recontextualisation for students' relationships with knowledge. A case study of the introduction of 'scientific literacy' approaches in the UK school science curriculum is used to examine principles of recontextualisation in practice.

Research question 4 draws on the outcomes of question 3 by focusing on the socio-epistemic nature of disciplinary science and school science contexts. It explores how scientific discourse and practices change on recontextualisation from a disciplinary to school context and examines what implications there may be for students' engagement with disciplinary scientific knowledge in an educational context.

Research question 5 asks how, given the differing socio-epistemic nature of disciplinary and educational contexts, students can develop a relationship with disciplinary knowledge. In answering this question I propose a new conceptualisation of the role played by teachers and students in relation to disciplinary knowledge in educational contexts. Implications for some aspects of policy and practice are also explored.

1.4 Approach and methodology

The approach and methodology adopted in this thesis is characterised by the following features. This research project:

- takes a critical view of educational practice and theorising;
- addresses both 'theory' (theoretical development in the field of academic research) and 'practice' (practitioner concerns);
- is largely conceptual rather than empirical;
- seeks to place knowledge at the centre of the educational process;
- adopts a realist approach to knowledge.

The section below elaborates upon how these characteristics are embedded in the approach taken, by exploring how the nature of the 'research object' was defined.

Starting with the broad aim of exploring how students develop a relationship with disciplinary knowledge, a significant proportion of the project's work has involved developing this aim in terms of clarifying the research object: what is to be researched and the status of the researcher, the researched and empirical data in relation to it. Determining the nature of the research object is an ontological and critical process. It entails defining 'what exists': it is the lens through which a situation or 'reality' is viewed. Establishing the research object determines the nature of the research questions, methodology and methods.

Research objects are not pre-existing entities. Brown (2008: 249) writes that research discourses "inevitably create the analytical frames that we use, which in turn create the objects we research; objects that evolve whether we acknowledge this evolution or not". The process is therefore one of framing and re-framing and revolves around a range of commitments and possibilities which are gradually both either closed off and/or opened up. It is important to be aware of what is being opened and closed and why, in order to avoid being caught in the "grip of the language of … research methodology, which seems self-authenticating and self-legitimating" (Standish, 2001: 505). These observations imply a need to be explicit and critical about the commitments that are made. They also apply both to research practice and to educational practice.

The manner in which the project's aims arose from the context of practice has already been described. In this respect, the approach taken shares some of the characteristics of practitioner action research. There are a number of different variants of action research. Kember (2000) distils the following key aspects of the approach based on the definition provided by Carr & Kemmis (1986: 165-166). Action research is:

- concerned with social practice;
- aimed towards improvement;
- a cyclical process;
- pursued by systematic enquiry;
- a reflective process;
- participative;
- determined by practitioners.

(Kember, 2000: 24)

However, I would hesitate to claim this project as an action research project except in the loosest sense. Although the thesis draws upon the context of practice to identify a research aim, and although it does seek to contribute to the means by which practice may be improved, it does not engage in developing evidence-based practice or attempting to describe ‘what works’ (Atkinson, 2000; Slavin, 2002; Oancea & Pring, 2008). A number of writers have criticised some aspects of action research methodologies and the process of reflective practice, suggesting that it can lead to an uncritical approach which ignores the influence of wider social structures (Ecclestone, 1996; Bleakley, 1999). Elliott (1991), for example, observes that:

> there are signs that action research has become hi-jacked in the service of technical rationality. Teachers are being encouraged to view action research as an inquiry into how to control pupil learning to produce pre-defined curriculum objectives or targets without any consideration of the ethical dimension of teaching and learning.
>
> (Elliott, 1991: 52 quoted in Bridges, 2003: 186)

It is more fitting to say that this project starts from the context of practice and draws on professional concerns of that context, but it does not solely address the ‘problems’ of that context in a narrow sense.

Another departure from a traditional action research model is the nature of the knowledge which I seek to create. My concerns are both practical and theoretical. Reason & Bradbury (2006) state that they:

> see action research as a practice for the systematic development of knowing and knowledge, but based in a rather different form from traditional academic research – it has different purposes, is based in different relationships, it has

different ways of conceiving knowledge and its relation to practice.

(Reason & Bradbury, 2006: 1)

This project departs from this view as it engages more substantially with academic theory and with academic research, although these are seen as also being relevant to practice. For example, I stress that educational knowledge is a practical issue and not only a 'theoretical' one. I acknowledge that the relationship between theory and practice is complex; nevertheless, I aim to explore a conceptual and practical tool for thinking about practice and also to make a theoretical contribution to the field of educational research. This thesis hopes, therefore, to be able to speak back to practice by proposing an alterative means by which teachers, teacher educators and curriculum planners in FE and in other sectors can conceptualise how students' relationships with knowledge may be developed. The intended audience for my research also includes other researchers, particularly those who are concerned with the place of knowledge in the educational context.

The approach adopted here, then, reflects some of the typical aims of action research, but not others. This appears to be similar to the position adopted by Mellor (1998) when he concludes that he found the label action research to be inappropriate. Like Mellor, I also find the notion of the reflective cycle and progressive focusing to be a useful one. Many research methodologies may involve processes such as these, although it may be more characteristic of the research which is undertaken by practitioners. What characterises this process is the lengthy and complex process of defining the research object. Mellor's (1998) description of the 'messy method' approach sounds familiar, as does Law's (2004) account of the 'mess of method'.

This is not to say, however, that I support the notion that ‘anything goes’; rather, I am describing a complex process which perhaps distinguishes a practitioner’s engagement with research and researching (Schön, 1983). This entails multiple concerns, priorities, identities and wide-ranging objects for research and it requires a certain amount of ‘letting go’ or unlearning of what is already ‘known’ (Brew, 1993).

In the early stages of research, pilot empirical work was carried out with trainee pre-service and in-service teachers in my own institution. Some of the teachers were new to teaching and some were experienced teachers with 10 years’ teaching experience or more. A group interview with *Skills for Life* teachers and four individual interviews with teachers of different academic and vocational subjects were carried out. In the interviews, the participants and I discussed ideas concerning the notion of a ‘relationship with knowledge’ in terms of the teacher’s own subject and their work with students. We also discussed examples of their teaching which I had observed as part of their PGCE/Cert Ed. teacher training programme.

The pilot empirical work was open-ended and speculative. Kvale (1996) proposes two theoretical modes which underpin approaches to interviews which draw upon the metaphors of interviewer as miner or interviewer as traveller. Under the miner metaphor, the interviewer’s object is buried knowledge which needs to be unearthed and purified and which is “unpolluted by any leading questions” (p. 3). In contrast, under the traveller metaphor, the interviewer enters into conversations with the inhabitants of a specific context in order to generate a constructive understanding which is then reconstructed as a story about the research journey. This conceptualisation of interviews acknowledges that the process is jointly constructed and may result in transformative new understandings and insights on the part of the interviewer and those who are interviewed. In the interviews I adopted the traveller metaphor: the process was a discussion which drew upon shared professional and contextual knowledge and concerns and the participants and I co-constructed new understandings about open-ended questions about knowledge and the educational context.

In conducting interviews, as with other research methods, and in relation to the research process in general which involves a variety of stakeholders, it is important to be mindful of issues of power and of authenticity. Writing about the construction of a research object, Matos *et al.* (2002) suggest the following questions in relation to these concerns:

> Who identifies and defines the research object? To what extent is it the researcher's research object and how are other participants in the community (of mathematics education, education, research, etc.) present in its definition? How are the participants and the educational structures affected by the research and how is their voice heard?"
>
> (Matos *et al*., 2002: 2)

An answer to these dilemmas is provided by interrogating the interviewer's basis for constructing a story of what is 'taken away' from the interview. In this case, it is argued that reasonable judgements can be made on the basis of professional experience as the participants' colleague and co-participant in the context. This would not be the case for *myself* in another professional context – with medical professionals for example. It can also be argued, however, that my aim as a researcher is not only aligned with that context: my concerns are also with educational theory and with the process of conducting a research project. These factors also mediate what is 'taken away' and how it is used.

The pilot research highlighted the importance of ideas about using 'real life contexts' and 'relevant' knowledge in teachers' thinking about how their students relate to knowledge. These then acted as sensitising concepts when I discussed more and less successful teaching sessions with teachers I had observed and interviewed. Differences in how these notions of relevance were embedded in different curriculum subjects and types of curriculum were also highlighted. Chapter 2 draws upon some of the pilot research in the form of vignettes.

In the pilot stage of the research, I also identified that my focus needed to be on the relations between teachers, students *and* knowledge. This will be elaborated upon in chapter 2 and in the next section of this chapter. The focus became the didactic situation: the 'didactic triangle' or the 'instructional dynamic' (Ball & Forzani, 2007) of teacher, student and knowledge. As described in chapter 2, these ideas contributed to the development of a model of the different forms of knowledge within an educational context which is used as a guiding model throughout the thesis.

The pilot research played an important role in developing the research object. It highlighted a number of important guiding concerns which played a significant role in how I engaged with the literature concerning how knowledge is theorised in educational research. It also indicated that an empirical approach to the problem did not align with a general and sometimes meta-theoretical concern with knowledge. This does not deny that qualitative, case study research can generate powerful 'thick descriptions' of situated understandings and meanings which can be generalised and interpreted to illuminate wider issues: in fact it can be argued that this was the outcome of the pilot research. It became clear that my interest was much wider, more general and required a greater theoretical engagement than could be afforded within an empirical project.

Establishing the nature of the research object enabled the project to progress and provided a basis upon which the research questions could be developed. An early commitment was to a realist rather than a postmodern or relativist approach to knowledge and this is discussed in chapter 3. The research questions were reviewed throughout the research process and in the final form they focus on the epistemological aspects of a relationship with knowledge. The research questions themselves are in fact as much an outcome of the research as are the answers to them. They reflect an analytical strategy which follows from the lengthy process of defining the research object and from the theoretical commitments which were made along the way.

This thesis engages with Bernstein's work concerning educational knowledge. Part of the analytical strategy within this project employs Bernstein's notion of the 'language of description' (Bernstein, 2000) which governs the way in which "theory engages with the world" (Moore, 2006: 37). This concept is used in Part II of the project to explore the recontextualisation of knowledge through a case study of the school science curriculum.

1.5 Literatures used

Since this thesis is concerned with fundamental questions about knowledge, it engages with a range of different literatures. Young (2008a) observes that this is necessarily the case as:

> questions about knowledge in education involve issues that overlap with a number of quite distinct specialist literatures (for example, not only epistemology and the sociology of knowledge and educational policy and practice but the wide range of subject knowledges associated with the curriculum).
>
> (Young, 2008a: 6)

Engaging with this wide range can present some difficulties. Different literatures address a range of originating concerns and commitments. Use of terminology can be inconsistent – for example, the meaning of the term 'constructivism' can vary within different approaches (Turner & Sullenger, 1999). Furthermore, as Young (2008a) observes, questions about knowledge and epistemology also relate to an extensive philosophical tradition. However, my focus on epistemology is more closely related to what has been termed a 'social epistemology', which itself has many different definitions (Goldman, 2002) and has not been generally related to educational concerns. I use the term 'social epistemology' loosely to refer to questions about knowledge which emphasise the social dimensions of knowledge (Goldman, 2002: 183). More specifically, my concern is with a social epistemology of education.

Chapter 2 draws upon research relating to policy and practice the FE sector and research concerning knowledge in educational contexts. I argue for a focus on the triangle of relations between students, teachers and disciplinary knowledge and draw upon Ball & Forzani's (2007) model of the 'instructional dynamic'. This focus has two important implications for the range of relevant literatures employed. First, the focus is on what Ball & Forzani (2007) term research *in* education which can be distinguished from research *related to* education. Making this distinction emphasises education as being concerned with the acquisition of disciplinary knowledge in contrast to other areas of study which are only related to that process. Ball & Forzani (2007: 530) give the examples of racial identity, children's conceptions of fairness or historical studies as examples of research which is *related to* rather than *in* education.

Second, my focus is on the relations between all three elements of the instructional dynamic: students, teacher and knowledge. As Ball & Forzani (2007) also observe, many studies only focus on one corner of this dynamic triangle, whereas my concern is with all three elements of the triangle. For example Shulman's (1986; 1987) work on pedagogical content knowledge (PCK) emphasises teacher knowledge and its relation to disciplinary knowledge. This focus therefore emphasises the role of the teacher and that of forms of knowledge within or for teaching. It could not be taken to represent a model of the context which takes into account other forms of knowledge and which views all three elements in a process of interaction. Similarly, other research such as that within the area of personal epistemologies (e.g. Perry, 1970; Baxter Magolda, 1992; King & Kitchener, 1994; Hofer & Pintrich, 1997; Hofer, 2001) tends to focus on either teachers' or students' thinking or conceptions of knowledge and knowing, albeit within different disciplinary contexts. This research tends to take a general view of beliefs about knowledge from an individual psychological perspective rather than focusing on the specific characteristics of disciplinary knowledge which refers to their contextual epistemic practices.

Initial stages of the project concentrated upon identifying theoretical approaches which explore the nature of knowledge in education. I therefore engaged with literature relating to the sociology of knowledge and the curriculum and research on school subjects. I identified Bernstein's (1990; 2000) project which aims to focus on the 'voice' of educational knowledge as being highly relevant. This is contrasted with other approaches, such as sociocultural and situated approaches (e.g. Lave & Wenger, 1991; Wenger, 1998), which, it is argued, tend to under-theorise the form and structure of knowledge.

Much work has been done in the past few years by a number of writers adopting an emerging 'social realist' approach (Moore, 2004; 2007; Wheelahan, 2007a,b; Maton & Moore, 2010a) which aims to 'reclaim knowledge' (Muller, 2000) or 'bring knowledge back in' (Young, 2008b). This work is important in aligning with the aim of pursuing research *in* education, in Ball & Forzani's (2007) terms. It also contrasts with approaches to teacher knowledge such as Shulman's (1986; 1987) and others who are extending this work and developing similar approaches (e.g. Banks *et al.*, 2005; Ellis, 2007) in that it problematises the nature of different forms of knowledge and seeks to explore, from a critical perspective, which forms of knowledge should be included in the curriculum.

In the later stages of the project, it is proposed that the social realist literature tends to neglect social relations to knowledge. Referring to research in science education, a case study of the UK school science curriculum is used to explore models for the recontextualisation of disciplinary knowledge and also the nature of authentic learning. The latter stage of the project attempts to reconcile the sociocultural and social realist approaches and draws on research relating to the epistemology of knowledge practices in different contexts and, to a limited extent, literature within the sociology of scientific knowledge.

1.6 Overview of chapters

Part I of the thesis focuses on '**knowledge in practice**'. Chapter 2 explores the notion of students' relationships with knowledge in the FE context. Vignettes from practice are used to illustrate the complex nature of the meaning of knowledge within specific contexts. The chapter argues for a model of the educational context which places disciplinary knowledge at its centre and positions teacher, student and subject in relation to the different forms of knowledge within the context. Part I thus draws upon the context of practice to clarify the nature of the problem addressed in this thesis and establishes an initial broad conceptual model which is elaborated upon throughout the thesis.

Part II explores '**knowledge in theory**'. Chapter 3 examines the way in which knowledge is theorised in educational research. It is argued that while situated and sociocultural theory provide an insight into the ways in which meanings are locally produced, these theories neglect to consider the difference between everyday and disciplinary knowledge and the structure of different forms of knowledge. The chapter then explores how Bernsteinian and social realist theory seeks to differentiate between forms of knowledge and to place knowledge at the centre of the educational process. Chapter 4 extends this discussion to consider the nature of the 'school subject', or how disciplinary knowledge is recontextualised within an educational context. Arguments relating to the relationship between disciplinary and curricular knowledge structures are examined and the bases upon which disciplinary knowledge is recontextualised are investigated. Two main mechanisms of recontextualisation are identified: those which are based on the principles of contextual coherence and those based on the principle of conceptual coherence. Chapter 5 concludes Part II of the thesis by reviewing the progress made in addressing the project's research questions and in elaborating upon the model for forms of knowledge. The chapter proposes a number of ways in which Bernsteinian and social realist theory are limited, particularly in relation to how the nature of the different social contexts or communities which correspond to the different forms of knowledge are theorised.

Part III addresses the theoretical problems identified in Part II by considering '**knowledge in contexts**'. Chapter 6 examines a case study of the school science curriculum. The focus is specifically upon curriculum reform and the emergence of scientific literacy approaches to the curriculum. This allows for an examination of the two principal modes of recontextualisation discussed in chapter 4 – contextual and conceptual coherence – in practice. An exploration of the debate within the science education literature concerning these different principles of recontextualisation identifies a key issue concerning the nature of authentic learning. Chapter 7 discusses the significance of different epistemic contexts in relation to teaching and learning, with particular reference to science subjects. Epistemic differences between disciplinary and educational contexts are explored by examining the impact of recontextualisation on aspects of disciplinary discourse and practice. It is argued that the epistemic nature of the school context imposes significant limitations on the possibilities for authenticity such that recontextualised science becomes decontextualised and authoritarian. It also gives rise to mythical understandings of science. Chapter 8 explores the role played by mythical understandings of science in the school context in bridging between school and disciplinary contexts. It is argued that such understandings constitute particular 'disciplinary narratives' which serve an important function in communicating science and are intrinsic to the socio-epistemic purposes of the school context. The notion of the disciplinary narrative is used to complete the model for forms of knowledge proposed in chapter 2. A new theoretical perspective is thus provided into teachers' and students' roles in relation to disciplinary knowledge and how relationships with disciplinary knowledge are developed. The notion of the disciplinary narrative is also discussed as a means of reconciling aspects of Bernsteinian/social realist theory and sociocultural theory. Application of this idea to other subject areas and general implications for pedagogy are also considered.

Chapter 9 summarises the project's findings and discusses implications for teacher education. The approach taken and methodology adopted is evaluated. Proposals for further research are also suggested.

PART I – KNOWLEDGE IN PRACTICE

Chapter 2: Practitioner concerns: towards a model for forms of knowledge in educational contexts

2.1 Introduction

This chapter relates the notion of 'relationship with knowledge' to the original professional context in which I started to think about the issue of knowledge. Drawing upon two brief vignettes of practice in an FE context, I discuss how knowledge may be experienced in a way in which is complex, situated and problematic. This chapter shows that an important aspect of exploring the idea of relationships with knowledge is concerned with the meanings which may be associated with knowledge and how these meanings impact upon the ways in which we engage with it. The chapter also starts to identify how different forms of knowledge relevant to the educational context may be distinguished and these are described in the form of a model.

This chapter is organised into the following sections. In the next section, two vignettes from practice in FE are used to illustrate the complex nature of relationships with knowledge. I highlight the importance of the meanings which are attached to knowledge and discuss this in relation to the idea of 'real life' knowledge and the notion of 'relevance'. Section three explores differences between forms of knowledge which may be discerned through the vignettes. An exploration of the nature of an educational context follows in section four, and I discuss how we can think about the place of knowledge in our conceptualisation of the context. In reviewing the chapter, key questions that will be taken forward in the remainder of the thesis are outlined.

2.2 Relationships with knowledge: two vignettes

2.2.1 Introduction

This section discusses two vignettes from my own practice in teacher education in FE. The vignettes are brief accounts of practice and are employed here in order to explore the complex nature of students' and teachers' relationships with knowledge. Each of the vignettes derives from pilot research carried out in the early stages of this project. This pilot research included teaching observations and loosely structured interviews with trainee teachers in which we explored their ideas about the subject they teach and how their students relate to this form of knowledge.

The vignettes are not intended as random snapshots of practice in FE since they are chosen to illustrate a specific set of issues. In relation to the sampling of data from classroom life, Silverman (1993: 163) warns against the 'anecdotal' incorporation of data and the need to provide "a sense of the flavour of the data as a whole". Although it would have been possible for me to select a range of different accounts from practice, the particular focus of the vignettes centres around the specific nature of the issues they embody. The intention is not to illustrate the entirety of practice in FE. The vignettes might be more accurately described as what Tripp (1993) terms 'critical incidents': they are distinguished by their problematic nature to me in my professional context. Although they are based on actual classroom practice, they are also particular narratives (Connelly & Clandinin, 1990) which are only based on that experience: it would have been possible to tell a number of other stories. The vignettes are representative of an initial set of issues which formed the basis of this project's research questions and which illustrate what might be problematic in relationships with knowledge.

Both of the vignettes describe events which took place with students in an FE college who were following broadly vocational courses intended for those students who have not been successful in traditional academic courses in a school setting. Some of the students concerned were released from school from the age of 14 to follow what are regarded as more vocationally relevant courses. Thus, it is not unreasonable to suggest that these students are members of that cohort labelled as 'underachieving' and 'disaffected' in relation to a traditional academic curriculum (Harkin, 2006; Davies & Biesta, 2007; Lumby, 2007). The incidents described here are perhaps most visible – most immediately apparent – within these groups, but this is not to suggest that they are necessarily specific to them.

2.2.2 Vignette 1: Making knowledge relevant

This first vignette is based upon an incident which took place in a teaching session with a small group of 16-19-year-old students following a foundation course in hairdressing.

Vignette 1: Foundation level hairdressing – The wrong letter

In this particular session, students were following an element of the course which intended to develop their key skills. The friendly and interactive group of girls clearly has a good relationship with their tutor, who was also female, and they were generally cooperative with the teacher's proposed activities. However, it was also clear that these students could easily be distracted and, it seemed, would be likely to withdraw their cooperation if they were unhappy. The students were given a worksheet to complete which included an example of a letter which they may write if they were responding to a job advertisement. The activity asked students to use the letter to discuss how they will apply for jobs in hairdressing on completion of their course. All of the students completed this fairly straightforward task with no comment. However, as was clear in the session and as the tutor explained to me afterwards, the wrong letter had been used with this group. The same tutor also taught groups following other vocational courses at the same level and used similar resources. She had forgotten to change the text in the letter from that which she had used with other students following a course in motor vehicle engineering who were envisaged to be eventually applying for a job in a garage. The hairdressing students had used, discussed, copied out and signed this letter which was initially presented to them as one they would use in applying for jobs with no comment whatsoever about the fact that this letter was obviously intended for a mechanic who was applying for a job in a garage. The girls in the group were relatively articulate and had ample opportunity to question this during the session, but yet it seemed puzzling to me and to the teacher, when we discussed this after the session that none of them highlighted the fact that it was clearly the wrong letter.

In considering this vignette, an initial observation can be made about the status of knowledge: its relevance and its meaning. It should be noted that the design of curricula for the 'disaffected learners' that I discuss, is premised on the notion that learning should be 'relevant' and should also relate to 'real life'. As Page (1998: 1) observes, the "value of 'relevant' curriculum is virtually axiomatic: If teachers provide lessons that are pertinent, students will engage".

In relation to the hairdressing students, as the use of the wrong letter went without comment, it seems that this teacher's attempts in principle to make the classroom activities relevant (to courses being studied, and therefore to the students in question) were possibly in fact *irrelevant*, if students do not recognise when this is done incorrectly. This suggests that the meaning that the teacher may intend in contextualising these activities, which are part of a generic key skills type curriculum, may either not be recognised or may be ignored by students. The possibility that this is the case may only become apparent when an error is made.

In that respect, perhaps, as Bernstein (1971) notes, students view course content as 'uncommonsense knowledge': as merely some artefact to be dealt with according to the rules and expectations communicated by the teacher. This may be similar to the procedural or 'ritual' knowledge described by Edwards & Mercer (1987) citing Taba & Elzey (1964). Here, an account is given of a high achieving student who explains the procedures she uses in mathematics as follows:

> I know what to do by looking at the examples. If there are only two numbers I subtract. If there are lots of numbers I add. If there are just two numbers and

> one is smaller than the other it is a hard problem. I divide to see if it comes out even and if it doesn't, I multiply.
>
> (Taba & Elzey, 1964: 132 in Edwards & Mercer, 1987: 96)

It is clear from this example that the student does not have much real understanding of mathematics and does not engage with what Edwards & Mercer (1987) refer to as 'principled knowledge'. The procedure she has developed, however, has been successful for her thus far. The ritual knowledge in this mathematics example is also due to a problem in meaning, and we can speculate about the origin of this divergence in meaning in practice. One explanation could concern a lack of discussion and collaborative learning in the classroom leading to the development of idiosyncratic understandings which remain unchallenged. Another explanation could relate to the desire of the student to strategically achieve right answers in the easiest possible way and to *consciously* avoid thinking about the mathematical problem. The student may in fact be aware of the cost in terms of meaning and appreciation of principled knowledge.

Taba & Elzey (1964) question the validity of pedagogical practices in which "effective teaching is seen as consisting primarily of what we get out of the children instead of what we put into them" (p. 132). They emphasise the importance of developing students' abilities to 'judge' and for students to develop a basis for understanding the importance of knowledge rather than relying on techniques of recall or providing correct answers – a practice which may be based on divining 'what the teacher wants' or on an ability to "recollect what the book said" (p. 131). These practices, in their association with the idea of knowledge as commodity, also recall

Sfard's (1998) acquisition metaphor for learning.

A slightly different perspective is provided by considering examples of classroom practice outlined by Walkerdine (1988). Walkerdine describes a 'shopping game' activity, again in a mathematics classroom. The activity was designed to enable school-age children to practise addition and subtraction. Here it becomes clear to students that the procedures in the game bear little resemblance to real practices and meanings involved in the activity of shopping – they are inauthentic. For example, in real life when all money is spent it is not renewed in the way that it is in the game, and items such as a yacht cost more then a few pence. The result in the 'shopping game' example appears to be that the teacher's general lack of success in her strategy of making knowledge relevant and 'real' from the students' point of view produces a form of detachment and resignation in the students – a disengagement.

In the vignette of the wrong letter we could also speculate about the authenticity of the task. It may be that the students do not relate the activity of responding to a job advertisement to any of their actual goals. It may be that their participation in the course is not related to their career plans. As many writers have observed (e.g. Ball *et al*., 2000; Hodkinson & Bloomer, 2001) the basis for students' course choices are highly complex and do not follow the technical-rational model which underpins aspects of policy. In relation to 14-16 year old students in FE colleges, Davies & Biesta (2007) found that:

> there was little evidence of direct influence from their course on the formation of these young people's vocational aspirations. The happenstance of life, together with their work experience, seemed to be much more significant.
>
> (Davies & Biesta, 2007: 31)

The degree of agency students exercise in initially choosing these courses can also be questioned. There are a very worrying set of issues connected with what may be ideal choices for students and their real choices. Ecclestone (2006: 6) observes in her article *Let the poor do hairdressing* that "'Flexible' options at 14 appear to be reinforcing gender, race and class stereotypes, directing less advantaged social groups into 'suitable' vocational routes". Davies & Biesta (2007) also echo this view, highlighting the extent to which the course choices made by such students may be culturally determined. They observe that the young people in their study:

> without a background of high economic, social and cultural capital appeared to feel more comfortable taking an apparently work-related course instead of another less 'relevant' academic GCSE. Admin/IT was also considered by them to be an appropriately female field, in comparison with, for example, construction, which several students had considered taking but dismissed as 'for the boys'.
>
> (Davies & Biesta, 2007: 38)

It is also not possible to ignore the likelihood that some analyses of the vignette may well suggest students' lack of intelligence or initiative as a significant factor. However, aside from other arguments about resisting unhelpful deficit discourses, other aspects of the situation do not support that conclusion. The students in my vignette had seemed to be able to make well thought out arguments about, for example, the length and timings of breaks and to make comments about other issues. It would seem, therefore, that a basic 'lack of intelligence' does not provide a viable explanation in this case. However, it is important not to ignore these issues and how they are perceived, particularly in respect of teacher education.

2.2.3 Vignette 2: Controlling relevance

The second vignette is drawn from a particular discussion which took place between a teacher and her students during a session from a course in Information Communication Technology (ICT).

<u>Vignette 2: Entry level ICT – Abbreviations and texting</u>

In this group most of the students were male and there were two female students who worked together. The students were aged between 14 and 19. The teacher was also female and a female learning support assistant was present. The group was clearly a spirited one, with some calling out and students tended to wander around the room. The atmosphere was generally relaxed and friendly, however, and it was clear that the teacher's relationship with the students was informal and familiar and had been built up over time. During the session, students were asked to complete an activity which involved simple acronyms and abbreviations which may be used in business administration, for example in memos and faxes. In a whole class discussion, the students' attempts to compare these acronyms to abbreviations used in texting (on mobile phones) were firmly discouraged by the teacher. The students were very knowledgeable about texting abbreviations and were very enthusiastic in making suggestions about the similarities between the teacher's presented examples and their use of texting. The teacher, however, was unfamiliar with most of the examples they gave and preferred to limit the discussion to her own list of business abbreviations. She referred to the students' mobile phone examples and the activity of texting as 'rubbish', although students did not appear to take offence at this. It seemed that perhaps this would have been a useful way of exploring this topic as texting was an area that the students were clearly very knowledgeable about. But more significantly it could perhaps have been used to understand the topic as a real life issue, for example to discuss how new abbreviations emerge, how certain groups may understand them and others may not and so on – points that the students themselves raised.

In this vignette the notion of 'relevant knowledge' is again highlighted. Here, it is the students' suggestions and their own attempts to make this knowledge relevant which is rejected by the teacher. As I have already suggested, this situation may have provided a good example for the teacher to explore the boundaries between her and the students' own knowledge in order to develop a shared understanding of both.

This is similar to Tochon's (2000) account of the crossing over of knowledge forms which occurs in a dynamic way in the classroom. Tochon refers to the intersection of aspects of students' prior experiences and subject knowledge which can productively come together in a situated process of meaning-making. He writes that "potential associations emerge from this intersection; and it can be postulated that those associations that stand the best chance of being productive in relations with knowledge would be those that "hook into" the learner's experience in learning situations" (Tochon, 2000: 333). Given the dynamic nature of this process, however, Edwards (2001: 167) points out that these experiences are also based on "teachers' agentic actions, control over their own time and capacities to interpret the affordances of particular situations, and to take risks". These limitations may provide some explanations for the teacher's action in my vignette. These might include the teacher's confidence in the subject, her confidence in diverting into unknown territory or the teacher's perception of the necessity of sticking to a lesson plan or to prescribed content. These types of concerns could also relate to my own presence as an observer.

In the texting vignette, the teacher's decisions could also be influenced by a fear of losing control and the emergence of disciplinary issues. Difficulties relating to managing students' challenging behaviour are frequently a concern for teachers in FE who are working with 14-16 year old students (Attwood & Croll, 2004; Lumby, 2007). This possible explanation recalls McNeil's (1986) research, where the "teachers' fears of student disruption made them tighten control of knowledge at the expense of engaging students in the learning process" (McNeil, 1986: 80 quoted in Paechter, 2000: 139). This leads to a situation in which the content is made "so boring that students are unable to engage with (and therefore challenge) it" (Paechter, 2000: 139). The outcome is that knowledge is presented such that it is meaningless to students in any but the school context. The aim is to maintain disciplinary control in a school or institutional culture in which 'good order', or the facade of apparently 'good teaching and learning' is privileged above all else. It can be noted that in this respect it is the meaning which may be interpreted by the teacher in their context of practice which is important, rather than the meaning (or lack of meaning) which is discerned by the students as in the previous case.

Other literatures which are located in a structuralist framework explore the impact of schooling from the perspective of reproduction theories and the hidden curriculum (e.g. Bowles & Gintis, 1976) and point to the controlling role played by school knowledge. It is argued that middle class students, who are destined for employment in professional roles, are taught to solve problems and think independently. This is in contrast to working class students who are taught to comply with the expectations for those working in unskilled or manual jobs. Here, compliance and a tolerance for boredom is important, so as Frykholm & Nitzler (1993: 473) in Colley *et al*. (2003: 476) suggest, working class students follow courses which seek to develop "adjustment, conformity and submission to superiors".

Similarly, Burgess (1984) provides an account of an ethnographic study into provision for students of 'below average ability' (called in that particular school the 'Newsom pupils' following the 1963 Newsom report). Although Burgess' account is from 25 years ago, the context is similar to that of the provision for 14-19 year old students discussed in my vignettes. Both contexts are located in a climate of expansion of young people's participation in education, the raising of the school leaving age and the associated 'problem' of 'non-academic' students. The challenges of student motivation and the attitudes of both students and teachers to knowledge and school subjects resonate with the issues outlined here. Indeed, as Pring *et al*. (2009: 1) also note, in relation to 'Newsom pupils', "today's problems are often repeated from a not so distant past, with lessons unlearnt". In his study, Burgess (1984) observes that the:

> knowledge that was transmitted included simplified versions of subject material and commonsense knowledge that the teachers considered would be relevant to 16-year-olds who would leave school without taking many examinations. For the pupils this was perceived as very low status.
>
> (Burgess, 1984: 190)

As Bathmaker & Avis (2007) also describe, these problems have been widely researched in literature relating to youth transitions and young people's responses to schooling (e.g. Willis, 1977). In the literature relating to the 'new vocationalism' (e.g. Bates *et al*., 1984), many writers have discussed the experience of disadvantaged young people, their alienation from formal education, their positioning in the education system in order to be schooled as a substitute for employment and to 'know their place' (Bates & Riseborough, 1993) in relation to specific occupations, the general demands of employers or to the limited range of possibilities open to them (e.g. in Colley *et al*., 2003). Importantly, as Bathmaker & Avis (2007) point out, young people are aware of how they are positioned. They quote Ball *et al*. who suggest that young people know "what is not possible in a world of possibilities" (Ball *et al.,* 2000: 39 in Bathmaker & Avis, 2007: 515).

Versions of knowledge may be used for the purposes of control, but what are the implications for knowledge? Paechter (2000) in her account of McNeil's (1986) research also adds that an additional strategy aligned to the aim of disciplinary control is that of 'defensive simplification' in which:

> conceptually difficult topics were simplified so that while there was an illusion of dealing with the subject matter, the students were not required to put in the work needed for an understanding of the issues involved.
>
> (Paechter, 2000: 140)

The decontexualisation and simplification of knowledge may be used as a means of disciplinary control and of reproducing the social order. However, this clearly has important implications for the nature of the knowledge which is made available to students. Page (1999), for example, in her account of a study of American high school science classes, highlights the eclipse of subject-matter knowledge. She suggests that a 'muddled' representation of knowledge operates both as a vehicle for inclusiveness and as a medium of control because it alternates between 'relevance' (to students and their lives) and 'rigour' (of scientific knowledge practices). The explanation Page provides points to a range of influences and rationales – political, social and educational – concerning social inclusion, equity approaches and higher education access which impact on teachers' thinking and decision-making. She argues that the outcome in practice is an "ambivalence about the value of knowledge, including school knowledge" (Page, 1999: 588) resulting in a situation in which teachers fail to focus on clear educational objectives. As Page concluded in relation to her observations of biology classes, "After a few weeks in classrooms, I found myself thinking, there isn't any science here" (p. 555).

This section has explored the problematic nature of students' and teachers' relationships with knowledge. I have emphasised explanations which relate to the meaning that is attached to knowledge at different times and for different purposes by both students and teachers. It is interesting to note that there is a symmetry present in the mechanisms of the process of 'relevance' within the vignettes. In the 'wrong letter' vignette we can see that the teacher's attempt to make knowledge relevant to students fails. In this case the students either ignore or do not manage to see the intended relevance to them. In the 'texting' vignette, the reverse is the case: the teacher attempts to suppress the relevance of knowledge that the students themselves suggest. This illustrates that the problem of 'student engagement' is much more complex than the generally accepted understandings which Page (1998) alludes to when she refers to the taken for granted assumptions about a 'relevant' curriculum.

2.3 Interpreting the vignettes in terms of relationships with forms of knowledge

I will now consider the vignettes and my discussion of them so far in terms of the definition that I have already outlined of the 'relationship with knowledge'. I have characterised this concept as the way in which students experience disciplinary knowledge and how they come to engage with that knowledge. In order to start to interpret the vignettes in terms of relationships with knowledge, I will explore in more detail the forms of knowledge encountered in my discussion in terms of the notions of 'relevance' and of 'real life' knowledge. It is argued that it is possible to initially identify three broad categories of knowledge: students' or teachers' owned knowledge, everyday knowledge and formal school knowledge.

I refer to the first type of knowledge as 'students' owned knowledge', which may include knowledge of everyday life and may relate to students' interests. Defining 'owned knowledge' is not straightforward, however, as Paechter notes:

> The characterisation of owned knowledge is problematic, if only because it has generally been defined solely in terms of what is usually seen as its opposite, that pertaining to the school.
>
> (Paechter, 1998: 170)

Paechter's distinction between 'owned knowledge' and what others would term 'non-school knowledge' or 'everyday knowledge' is a useful one. The reason for this, as Paechter points out, is because it identifies a sub-set of what other accounts may refer to as 'non-school knowledge' in the sense of 'everything else'. Thus, Paechter proposes that 'students' owned knowledge' relates to the life interests and students' knowledge which "positions its possessor as an acting subject, able to use his or her own knowledge in a dynamic way" (Paechter, 1998: 174).

The notion of 'owned knowledge' also overlaps to some extent with the notion of 'funds of knowledge' (e.g. Gonzales *et al*., 2005). The emphasis in this literature is on the knowledge and discourses that students experience outside of school, and as Moje (2008: 342) remarks, the construct of funds of knowledge "has been broadly taken up to mean any knowledge that children and youth construct outside of school". This aligns with Paechter's definition as it refers to knowledge that students 'construct', but this definition is less explicit than Paechter with her reference to students' agency. Work in this area examines points of convergence or conflict between home and school knowledge, for example Gutiérrez's notion of the 'third space' which bridges between the counter-scripts of students' everyday lives and the official scripts of their classrooms (Gutiérrez *et al.*, 1995). These discussions also appear to resonate with the work of Tochon (2000).

Students' owned knowledge, then, can be characterised as non-school knowledge, but, following Paechter it should also be distinguished from merely everyday knowledge, the second form of knowledge that I identify. In terms of my vignettes, I suggest that the students' knowledge of texting is a case of owned knowledge. This is the knowledge that originates from students' interests and one which, in line with Paechter's discussion, allows them to use it in a dynamic way. This can perhaps be seen as a counterpoint to the teacher's owned knowledge of abbreviations which she was using to control the classroom activities.

The third form of knowledge that can be identified in my vignettes is 'formal school knowledge'. I have already referred to Bernstein's (1971) characterisation of this knowledge as 'uncommonsense' knowledge. This is the knowledge which is used in school: knowledge which may also be controlled by the teacher for the purposes of disciplinary control. It might include both academic and vocational knowledge which has been recontextualised (Bernstein, 1990) for use within the school or college. It is, perhaps, what Martin & Veel (1998) refer to as the knowledge which, in order to exist in the school, must be:

> in a form that allows the roles of the 'teacher' and the 'taught' to emerge. It must be divisible into the time units allocated (lessons, weeks, terms, years, primary, junior secondary, senior secondary, etc.). … Most importantly, it

> must be able to exist in a form that can be assessed, so that the students can be distributed across a spectrum from 'successful' to 'nonsuccessful'.
>
> (Martin & Veel, 1998: 84 in Sharma & Anderson, 2009: 1262)

In relation to the vignettes, the formal school knowledge is described in the curriculum which underpinned the teaching observed. In the 'wrong letter' example, this could have been the literacy or employability skills that the teacher was hoping to develop or the knowledge of business practices and IT word processing skills for the teacher in the texting example. Formal school knowledge is aligned with the 'school subject' as it is understood in the classroom. It is important to note that although this knowledge may be based upon a specific curriculum it is also 'made' in that context – it is also acted upon by teachers and students. Bloomer (1997: 2) points out that "[s]tudents and teachers 'make' rather than 'take' their roles and the making of the curriculum is their essential business".

It has been suggested that three different types of knowledge may be discerned within the vignettes: owned knowledge, everyday knowledge and formal school knowledge. An important educational problem may be the way in which knowledge which can be said to exist in one form may be transformed into another form, or, in other words, the way in which forms of knowledge articulate (Ensor & Galant, 2005). For example, how does formal school knowledge become owned knowledge, and indeed, is it reasonable to suppose that such a transformation is possible? Furthermore, how does formal school knowledge – the school subject – relate to disciplinary knowledge?

If transformations between forms of knowledge are possible, it appears that they are likely to be critical to the way in which knowledge is experienced in the school context or, in my terms, to the way that relationships with knowledge develop. When writing about academic disciplines, Moje (2008) asserts that they:

> are no different as discourse communities than are students' everyday home discourse communities or peer group discourse communities. They are not immutable, they are not unchangeable. And they are not simply bodies of knowledge to be handed down from expert to novice.
>
> (Moje, 2008: 342)

This raises two critical issues which will be examined in more detail in chapter 3. First, it signals an association with social justice issues and the different ideological perspectives on how the 'indigenous' knowledge of different social groups is valued in educational systems. Second, it raises questions about the basis upon which different types of knowledge may be characterised and categorised.

In relation to the current chapter, it is possible to observe that a key strategy which employed in policy and practice to achieve these processes of transformation involves the notion of 'relevance'. The idea of relevance is bound up in what is construed as the degree of relatedness of school knowledge to students' interests (its nature as owned knowledge) and also to particular contexts. 'Relevance' as it is done, therefore, is intended to mediate between these forms of knowledge.

2.4 A model for forms of knowledge within an educational context

2.4.1 Context as a 'learning culture'

This chapter started out by referring to a specific context and has outlined vignettes from practice within that context. In order to explore the place of knowledge within *this context*, and within *a context* in general, it may be useful to start with the conceptualisation of context which is implied by the Transforming Learning Cultures (TLC) project, and its notion of 'learning cultures'.

The Transforming Learning Cultures project was a large project based 'in and not on' FE, from 2000-2005. The project examined 17 detailed case studies of educational practice in four further education colleges (Hodkinson *et al*., 2007a). The project aimed to explore the complex nature of learning in FE, to identify how learning in the sector might be improved and to develop the capacity of FE practitioners for inquiry into practice (James & Biesta, 2007). The project thus "engages with a series of questions concerning how we can know any context of education" (Peim & Hodkinson, 2007: 388).

The theoretical rationale for the project was based on a concern to recognise the complexity of the relationship between teaching, learning and the wider contexts of learning, based on the view that:

> teaching and learning cannot be decontextualised from broader social, economic historical and political forces, and that addressing this complexity directly is the

> most likely route to understanding that is useful to policy and practice.
>
> (Hodkinson & James, 2003: 393)

The project proposed the notion of *learning cultures* in order to capture this concern with complexity, to focus on wider influences on learning and to conceptualise learning as something more than an individualised psychological process. Hodkinson & James report that the project team:

> conceptualised learning broadly within a situated learning frame, which sees learning as located in the interactions between context, concept and activity (Brown et al, 1989). Learning is an inseparable part of social practice (Lave & Wenger, 1991), closely related to what might be termed the culture of the place of learning.
>
> (Hodkinson & James, 2003: 393)

Drawing on Bloomer's earlier work which explored the importance of students' social context, culture and the significance of other life events on learning – the notion of 'studentship' (Bloomer, 1997) and 'learning careers' (Bloomer & Hodkinson, 2000) – the TLC project's conceptualisation of learning cultures emphasised the mutually constitutive influences of context and the action of individuals. In his previous work, Bloomer suggested that:

> Teachers and students do not merely receive and 'act out' externally imposed prescriptions of their tasks, they 'act upon' those prescriptions in the construction of their own practices. They are *actors,* acting in accordance with their own understandings and constructions.

(Bloomer, 1997: 187, emphasis in original)

Developing this theoretical position, the project drew on the work of Bourdieu in order to establish a conceptualisation of the nature of the teaching and learning context and to develop thinking about how interventions for improvement could be made. Bourdieu’s work was also used to theorise issues concerning structure and agency, employing his notions of *habitus* (a collection of durable, transposable dispositions, Hodkinson & James, 2003: 394) and *field* (a set of positions and relationships defined by the possession and interaction of different amounts of economic, social and cultural capital, p. 394). In foregrounding the mutually constitutive nature of habitus and field, the project then emphasises the “mutual interdependence of social constraint and individual volition” (p. 394). Additional theoretical perspectives such as interdisciplinarity (Hodkinson & James, 2003) and communities of practice theory contribute to a view of learning which is locally negotiated and based in social practice.

The TLC project’s notion of *learning culture* is “the practice through which people—students and tutors—learn” (Hodkinson *et al*., 2007b: 420). However, the project also emphasises that learning cultures may not be invented or manipulated at will. It points to the importance of artefacts and institutions which in addition to being expressions of cultural practices also “embody and reify such practices and thus play an important role in the continuation of cultures” (Hodkinson *et al*., 2007b: 419). Hodkinson *et al*. also observe that:

> governments, policy-makers, employers, administrators, funding agencies and 'the public' have ideas and expectations about the educational system in general, and FE in particular. Such expectations influence, structure and limit what is possible for those working inside the system. Expectations are not necessarily consciously held. They exist as 'ways of doing' and 'ways of being' that are considered to be 'normal'. This, finally, also means that learning cultures are governed by values and ideals, by normative expectations about good learning, good teaching, good leadership, and so forth – and again, these are from 'within' and 'outside' any particular setting.
>
> (Hodkinson *et al.*, 2007b: 420)

The notion of learning cultures resonates strongly with the observations that I have made in relation to the variation in forms of meaning. This is because these meanings are negotiated in a local context, in part formed in the process of immediate interaction, but also shaped by habitual practices and normative expectations. The conceptualisation also recognises the importance of meaning-making by both teacher and students. Teachers' and students' understandings of their roles in the context are clearly related to the learning cultures which have been established in particular classrooms. In general terms, accounts of teaching and learning which draw upon the learning cultures theoretical framework are highly situated and sound like very authentic accounts of life in FE. For example, Colley *et al.*'s (2003) discussion of the development of students' 'vocational habitus' is a rich exploration of some of the issues surrounding vocational learning, in particular in relation to the role played by the performance of emotional labour.

The TLC project also makes some significant theoretical proposals. As Hodkinson *et al*. (2007b, 2008) argue, the learning cultures concept goes some way towards addressing a range of problems surrounding the way in which theories of learning conceptualise the context of learning. Emphasising the project's theoretical affiliations with literatures concerned with situated learning or learning as participation (Sfard, 1998), theories which are usually depicted as being oppositional to cognitive or acquisitionist theories, Hodkinson *et al*. (2007b) discuss ways in which the notion of learning cultures may be used to suggest alternative conceptualisations of a number of problems which are not successfully addressed in the literature on participatory learning. These issues include, for example, the problem of transfer of learning (Hodkinson *et al.,* 2008), the balance between the consideration of individual learning and wider social participation, the holistic conceptualisation of local and wider contexts, considerations of power relations, structure and agency and the balance between a focus on cognition and the embodied nature of learning (Hodkinson *et al*., 2007b). Learning cultures, then, constitute a useful theoretical framework to explore the shared meanings which are experienced in an educational context.

2.4.2 What is learned in a 'learning culture'?

The notion of a learning culture provides a useful tool to explore meanings and practices in specific contexts and the impact on learning. However, I argue that a significant omission within the concept of learning cultures as a theory of an *educational* context concerns the status and nature of knowledge within that context.

Recent work by Kathryn Ecclestone also indicates the importance of this issue. In her exploration of assessment practices in vocational education in FE, Ecclestone (2007a) employs a sociocultural perspective in drawing out some of the implications of contemporary concerns about student engagement. She highlights what is gained by adopting a cultural view of learning, as it is explicated within the notion of learning cultures. Her analysis provides useful insights into students' and teachers' experiences of formative assessment and the way in which these practices and understandings are co-constructed. She highlights how a cultural understanding:

> illuminates how feedback, internalizing the criteria, self-assessment and using detailed grade descriptors and exemplars can, in some learning cultures, encourage superficial compliance with atomized tasks derived from the assessment criteria, bureaucratic forms of self-assessment and high expectations of coaching and support. In the learning cultures discussed in this paper, teachers use these processes to build confidence for learners they see as 'second chance' or 'fragile'.
>
> (Ecclestone, 2007a: 329-330)

These observations also resonate with the notion of ritual practice and the vignette of the wrong letter.

Ecclestone observes that the learning cultures she described in her research were largely positive in the sense that they were supportive: students were active participants and their activities resulted in a degree of success in relation to the assessment criteria. She goes on to suggest, however, that there were negative implications in relation to what she terms the development of 'commitment, compliance and comfort zones'. Ecclestone highlights the stereotypes that surround the expectations about vocational students' characteristics: their needs, wants and abilities. She asserts that "narrow instrumentalism has become central to those expectations" (Ecclestone, 2007a: 330) but also adds that "instrumentalism has contradictory effects: indeed, instrumentalism to achieve meaningful, challenging tasks cannot be said to be 'uneducational' *per se*" (pp. 330-331).

This distinction is an important one, as it highlights the key tension between concerns about the disengagement of particular groups of young people from formal education and concerns about their engagement with subject knowledge. Ecclestone explains that:

> In discussions at conferences about earlier versions of this paper, some argued that the trade-off spreads attainment more widely, enabling disadvantaged students to gain credentials and a positive sense of themselves as successful learners. A contrasting view is that settling for these goals removes aspirations for high quality learning and critical autonomy in clearly defined subject domains, thereby limiting the knowledge and cultural capital available to students in low status tracks.
>
> (Ecclestone, 2007a: 331)

The tension highlighted here relates to a concern with social justice and hinges upon not only the meaning that teachers and students discern within a particular learning context, but also on what I could (with some hesitation) refer to as a more 'fundamental' interpretation of subject knowledge or formal school knowledge. This fundamental meaning relates to the connection between school knowledge and the occupational or disciplinary knowledge to which that school knowledge 'corresponds'.

The notion of learning cultures does provide a useful tool to examine the ways in which meaning is negotiated within a context. However, while it can take account of the wider meanings which are, for example, implicit within the artefacts and institutions which reify practices (Hodkinson *et al.*, 2007b: 419), it has much less to say about the issues raised by Ecclestone. It is worthwhile quoting Ecclestone's closing remarks at length. She suggests that:

> Unless teachers have a strong professional subject expertise and commitment that can interpret these imaginatively, it is logical for narrow, instrumental assessment tasks to fill a curriculum vacuum. Vocational students are undoubtedly 'achieving' but what are they 'learning'? The current rush to develop Specialist Vocational Diplomas is dominated by goals of achievement and motivation. Yet, comfortable, instrumental motivation and procedural autonomy, in a segregated, predetermined track, beg serious questions about the quality of education offered to young people still widely seen as 'second best, second chance' learners.
>
> (Ecclestone, 2007a: 331)

The view that Ecclestone expresses here captures some of the key elements of the concerns about meaning and relevance, discussed earlier. Ecclestone, it seems to me, is also posing questions about the relationship with knowledge, as I have defined it, i.e. as the way in which disciplinary knowledge can become meaningful. Her argument implies that under the conditions she describes, disciplinary knowledge may not become meaningful to some students.

Ecclestone points out that instrumentalism is not ‘uneducational’ *per se*. This raises the question: In what sense can it be educational? A broader question is to ask: In what sense is what is done in the context educational? It could be argued that there is little in the notion of learning cultures that distinguishes it as being concerned with formal educational contexts, and indeed this is probably intentional. It could be the case that, in seeking to acknowledge the learning that takes place in informal contexts, and to validate the knowledge that is acquired in those contexts – in the situated, anthropological approaches such as Lave’s (Lave, 1988; Lave & Wenger, 1991) for example – the role of formal education as being concerned with the transmission and acquisition of a particular type of knowledge is obscured. The manner in which knowledge is acquired, which could for example be through participatory approaches, is a separate issue (see Young, 2008a for a discussion of the difference between curriculum and pedagogy). Lave’s and the learning cultures approach emphasises *learning*, but it should be remembered, as Finlay *et al.* (2007) point out in relation to their critique of policy discourse, that learning does not always have a positive outcome: it can also “weaken families and neighbourhoods if, for example, it takes place in a deviant, gang culture, or if graduates move away from the localities where they were born to find jobs” (p. 140). In other words, it is also critical to consider *what* is learned.

2.4.3 A model for forms of knowledge

To explore these issues, I will draw upon Ball & Forzani's (2007) recent work in which they ask 'what makes educational research 'educational'?'. Their argument is for an approach which focuses *inside* educational transactions and they refer to this as research *in* education in order to distinguish it from research *related to* education. A key theoretical device within this conceptualisation is the notion of the instructional dynamic which is a model of a formal educational context. The instructional dynamic is grounded on the understanding that education is the "deliberate activity of helping learners to develop understanding and skills" (Ball & Forzani, 2007: 530) and in this sense it places the transmission and acquisition of knowledge at the centre of the process. It also emphasises the interactions between teachers and students and content in a specific environment. Ball & Forzani (2007) theorise the interactions that occur with the context as follows:

> By *interactions*, we mean active processes of interpretation that constitute teaching and learning. Teachers interpret and represent subject matter to students, who interpret their teachers, the content, and their classmates and then respond and act. … We consider these multiple interactions, which we call the *instructional dynamic*, to be the defining feature of education.
>
> (Ball & Forzani, 2007: 530, emphasis in original)

This represented in Figure 2.1 below:

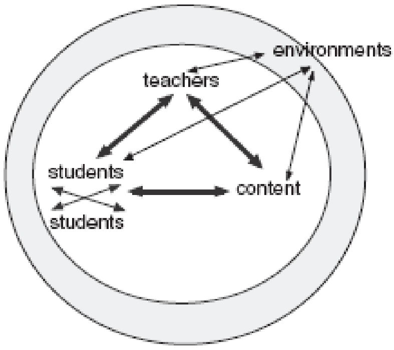

Figure 2.1. The instructional triangle (from Ball & Forzani, 2007: 530)

Ball & Forzani (2007) cite the work of Hawkins (1974), Schwab (1978) and McDonald (1992) to illustrate that the broad notion of a triangular representation of teacher, students and subject is not new. They do, however, argue that what distinguishes their model is its dynamic aspect and mutual interpretation that occurs over time. The model represents a complex and specific phenomenon, which, the writers propose, is the unique province of research in education. It is asserted that, to a significant extent, educational researchers do not seek to highlight and claim this specific focus which is necessary in order to produce principled knowledge within the field of educational research. Ball & Forzani suggest that:

> education research frequently focuses not on the interactions among teachers, learners, and content—or among elements that can be viewed as such—but on a particular corner of this dynamic triangle. Researchers investigate teachers' perceptions of their job or their workplace, for example, or the culture in a particular school or classroom. … Such studies can produce insights and information about factors that influence and contribute to education and its improvement, but they do not, on their own, produce knowledge about the dynamic transactions central to the process we call education. Knowing about

> and understanding teachers, learners, content, or environments—or even knowing and understanding all of these entities—is not a substitute for knowing about and understanding the dynamic relationships among them that constitute the core of the educational process.
>
> (Ball & Forzani, 2007: 531)

Ball & Forzani stress the validity of research which addresses individual aspects of the instructional triangle, and they also acknowledge that this can contribute to research in education. We can apply this point to the learning cultures research. The notion of learning cultures does provide useful insights into the interactions between teachers and students, but does not focus on the *whole* of the instructional triangle because it does not explicitly theorise the place of subject knowledge within the context.

As research by Ecclestone (2007a) discussed above also indicates, the neglect of subject knowledge leads to an incomplete conceptualisation of the educational context. Ecclestone (2007b) also indirectly highlights the implications of research which addresses only a particular corner of the instructional triangle in her editorial in an issue of *Studies in the Education of Adults* which addressed issues of identity, structure and agency. Alluding to her research which has explored therapeutic discourses in education (e.g. Ecclestone & Hayes, 2009a,b), she suggests that a neglect of consideration of structure and an increasing emphasis on identity can give rise to a focus on creating the self and learning about the self as a 'subject'. She argues that this "constructs a new subjectivity but it also creates curriculum content and therapeutic forms of pedagogy and assessment around the self" (Ecclestone, 2007b: 130). Ecclestone also points to an 'invisible strand' in research which is concerned with "agency and progression in ideas, in thinking and learning in relation to specific subjects, skills or crafts" (p. 130). Her view is that:

> The depiction of identity, agency and structure divorced from learning a subject as opposed to learning about oneself raises new questions about how education helps people think and act for themselves and, crucially, what they think and act *about*.
>
> (Ecclestone, 2007b: 130, emphasis in original)

In summary, the notion of learning cultures emphasises the co-constructed nature of the meanings within an educational context. While this provides clear insights into the complexity of specific contexts, it does not place educational knowledge within that context explicitly. I suggest that a more complete conceptualisation of the 'culture' or 'dynamic' of an educational context needs to focus upon the mechanisms by which meaning is made in relation to the subject. Furthermore, the nature of subject knowledge and its relation to occupational or disciplinary knowledge and other forms of knowledge needs to be clarified. I therefore suggest a model for the educational context which incorporates Ball & Forzani's (2007) model and the more nuanced exploration of forms of knowledge outlined earlier in this chapter. This model for the forms of knowledge in an educational context is shown in Figure 2.2.

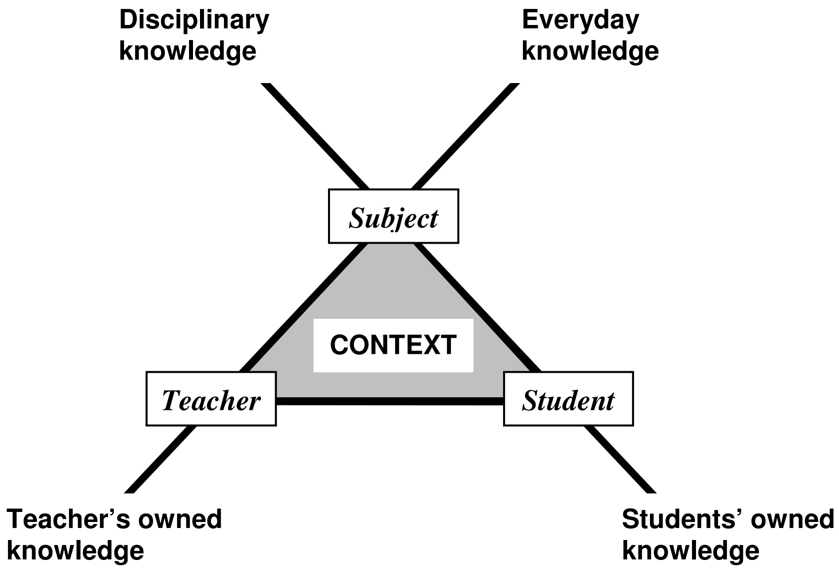

Figure 2.2.Model for forms of knowledge within an educational context

An adapted form of Ball & Forzani's (2007) instructional dynamic is included in the centre of this model. Subject knowledge in this model relates to 'formal school knowledge'. I identified a missing element of disciplinary knowledge and this is included in a triangle of relations between subject knowledge and everyday knowledge. The forms of knowledge identified in my discussion of the vignettes – students' and the teacher's owned knowledge and everyday knowledge – are also placed within this model.

Several key questions remain unanswered in relation to this model. First, differences between the form and structure of the types of knowledge have not been fully considered. Second, although the importance of 'relevant knowledge' was discussed, the ways in which different forms of knowledge may be translated into the other forms has not yet been addressed. Third, although this model is the starting point for an exploration of the development of relationships with disciplinary knowledge, the place of that form of knowledge is not theorised with this model. The proposed model for forms of knowledge and the questions that remain in relation to it will be used as an organising idea for the remainder of the thesis.

2.5 Conclusion

This chapter has given a contextualised account of vignettes from practice in FE. These vignettes illustrate a set of concerns which formed the starting point for the research questions that were subsequently posed relating to the nature of 'relationships' with knowledge. In my analysis of the vignettes I speculated about ways in which ideas about the relevance of knowledge which can be argued to underpin models of student engagement in FE (particularly for disaffected or non-academic students) fails in these cases. Relating my discussion to a range of literatures, I highlighted that this failure of relevance and engagement was a complex process, and seemed to hinge on the meanings which are ascribed to subject matter knowledge. It was suggested that these meanings are diverse, that they may be hidden and misunderstood. They may relate to forms of significance which are other than the subject matter itself and are important in understanding how students engage with knowledge.

It was proposed that three types of knowledge may be identified within the vignettes: students' owned knowledge, everyday knowledge and school knowledge. I suggested that the interrelationship between these forms of knowledge may be a critical factor in the process of 'relevance' as it is done in policy and practice, and highlighted that the transformation of the forms of knowledge is a key challenge within an educational context.

In order to explore the role of formal educational knowledge, an account was given of the TLC project's notion of 'learning culture'. Drawing on Ecclestone's (2007a,b) work in relation to FE, it was suggested that while the learning culture concept provides useful tools to explore ways in which meanings are co-constructed by teachers and students, it does not theorise the place of formal knowledge within that context. It also does not provide for a clear view of the relation between subject knowledge and disciplinary knowledge. I proposed that Ball & Forzani's (2007) notion of the instructional dynamic may be useful in order to re-define the field of inquiry towards one which views the place of subject matter knowledge in educational theory as critical. An adapted form of this model was suggested which maps out different forms of knowledge and the relation between them.

The next chapter expands upon the observations made in this chapter about different forms of knowledge within the educational context. It explores ways in which educational knowledge is theorised in educational research and establishes a clearer conceptualisation of the nature of the differences between these forms of knowledge and the relations between them.

PART II – KNOWLEDGE IN THEORY

Chapter 3: Theorising educational knowledge

3.1 Introduction

My discussion thus far has been more speculative than explanatory and has been concerned with elaborating upon a set of questions derived from a professional context. This chapter starts to address some of these questions by exploring the way in which knowledge is theorised in educational research. It also considers those aspects of the proposed model for forms of knowledge which were not examined in chapter 2, namely:

- What are the differences between the form and structure of these different types of knowledge?
- How might the different forms of knowledge within the model be translated into other forms?
- And, as my concern is with how students develop a relationship with disciplinary knowledge in formal educational contexts, what particular place does disciplinary knowledge have in this model?

Chapter 2 gave an account of the theoretical commitments underpinning the Transforming Learning Cultures (TLC) project and its notion of 'learning cultures'. This project, like other research adopting a sociocultural perspective, emphasises the meanings which are made by participants in a local context. In my discussion of vignettes from practice, I also acknowledged the significance of the meanings that are made by teachers and students in an educational context. However, it was suggested that the notion of learning cultures neglects to address the meaning that is made in relation to different forms of knowledge and in relation to disciplinary knowledge in particular.

The first section of this chapter extends this earlier discussion to consider sociocultural theory more generally. It outlines the key literatures which are associated with the perspective and, focusing on communities of practice theory and the nature of a formal educational context, highlights problems relating to the uncertain place of knowledge within sociocultural theory. In the following sections Bernstein's (1990; 2000) approach to theorising educational knowledge and its extension by social realist theorists is explored. The chapter then returns to the model for forms of knowledge proposed in chapter 2 and discusses how the theoretical perspectives discussed in this chapter may be employed to elaborate upon this model.

3.2 Sociocultural theory

3.2.1 The commitments of sociocultural theory

Mcnamara & Conteh (2008: 203) observe that a variety of different types of studies of teaching and learning claim to be sociocultural. However, they suggest, citing Cole (1985), that what links these studies is an attempt to reveal the complex relationships between 'culture and cognition'. Two broad readings of a sociocultural approach may be discerned in contemporary educational research. The first interpretation draws explicitly upon the work of Vygotsky and his followers in the area of cultural psychology. Here the emphasis is upon "how society or the collective is incorporated into self" (Edwards, 2005: 51): how social interaction between individuals, or between individuals and cultural products (e.g. books) contribute to meaning-making and learning. Vygotsky (1987) argued that language plays a key role in the process of internalisation where individuals appropriate and use for themselves new conceptual tools. The more powerful and less situation-specific tools that can be acquired in this way are termed 'scientific concepts' which can be distinguished from commonsense, more concrete 'everyday concepts'. Vygotsky's ideas have been developed by Engeström (2001) within activity theory, shifting the focus towards wider activity systems. Engeström's interventionist methodology proposes a model for the development of 'expansive learning' within a system, encompassing participants, tools, objects and rules, by identifying contradictions with the system.

The second sociocultural approach is more broad and general, deriving perhaps from Vygotsky's work and also from the practice or linguistic turn in the social sciences. This is the perspective that I concentrate on here. Edwards (2005) in her discussion of two different strands of 'participationism' identifies an interactionist or dialogic strand, and my reading of a general sociocultural approach is aligned with this strand. It encompasses Lave's (e.g. Lave, 1988) anthropological approach to theorising learning in informal contexts and the literature concerning situated learning or social practice theory (e.g. Brown *et al.,* 1989; Lave & Wenger, 1991; Wenger, 1998). The theoretical approach adopted with the TLC project described in the previous chapter is a good example of research within this broad sociocultural approach.

Key commitments within this perspective include the importance of context and situated understandings to participants' experience of meaning and actions within a context. The approach recognises the significance of histories within communities which act to reproduce those communities. It locates knowing within the transformation of participants' identities and through shifting relations between participants, practices and artefacts within that community (Lave & Wenger, 1991: 122). The notion of the 'community of practice' is a key conceptual tool. Derived from studies of non-school settings (Lave & Wenger, 1991; Wenger, 1998), communities of practice theory describes a model of learning within communities and is centred around the idea of 'legitimate peripheral participation' within those communities and the development of particular identities. Most importantly perhaps, this approach recognises the co-constructed nature of meaning within a context, the "relational interdependency of agent and world, activity, meaning, cognition, learning, and knowing" (Lave & Wenger, 1991: 57). Within the TLC project this mutual constitution of the context and how it is experienced also resonates with Bourdieu's (1993) theorisation of habitus, field and practice in order to develop an analysis of the nature of a 'learning culture' and how it may be transformed and enhanced.

An important commitment for those working from a sociocultural perspective is contextual contingency: the recognition of the influence of context on the processes of teaching and learning. In the literature, this approach often depicted as a counterpoint to perspectives which foreground individualistic, psychological or decontextualised approaches to theorising learning. For example, Vygotsky's work is frequently contrasted with Piaget's individualistic in-the-head approach (e.g. Anderson, 2007). In science education research literature, sociocultural approaches are compared with and sometimes positioned as oppositional to (Tytler, 2007) or as successors to cognitivist or conceptual change theory (Treagust & Duit, 2008).

It may be the case, however, that viewing one theoretical approach as a successor to another – from cognitivist or acquisitionist view to a social or participatory view – reinforces a dualist conception of the two processes which itself might be problematic. The two approaches are positioned as theories in conflict, inviting 'ideal type' representations of each extreme. For example, Sfard (1998) highlights problems resulting from the danger of choosing only one metaphor for learning – either as acquisition or participation. Similarly, Hodkinson *et al.* (2008) call for more holistic approaches to social and individual views of learning, warning of the associated dualisms of "the splitting of mind and body, the division between the individual and the social, and the split between structure and agency" (p. 32).

These dualist readings – which are the subject of numerous debates in educational research literature – are outcomes of ways in which teaching and learning are framed within an educational context. However, as was argued in previous chapters, it is important to first examine how the educational context itself is framed, and in particular to ask about the nature of a *formal* educational context. How sociocultural or situated learning approaches, particularly that of Lave *et al.,* address the formal educational context is discussed below.

3.2.2 Sociocultural theory and the formal educational context

An important theme in Lave's work, and in that of other situated learning theorists (e.g. Brown *et al*., 1989), is the avoidance or 'dismissal' (Fuller *et al*., 2005) of formal educational contexts; in other words, "steering clear of the problem of school learning" (Lave & Wenger, 1991: 39). Lave & Wenger (1991) give a number of reasons for adopting this position. First, they report that they wished to avoid the interrelation of schooling and learning that has taken place in our culture. This appears to be consistent with observations made in chapter 1 about the dangers inherent within habitual understandings of teaching and learning within an educational context. Wenger (1998: 266) makes a similar point when he suggests that "[m]uch learning takes place without teaching, and indeed much teaching takes place without learning". Instead, Wenger prefers the notion that learning is "an emergent, ongoing process, which may use teaching as one of its many structuring resources" (p. 267). The intention, then, in this work is to avoid the influence of the institutional context. Second, Lave & Wenger suggest that implicit within formal educational contexts is the assumption that knowledge can be decontextualised and that this is inconsistent with the fact that schools themselves constitute a specific context. Third, they propose that what is generally claimed as being effective in schooling contradicts their situated perspective and they did not want their focus to be guided by this. Rather, they wanted to "develop a view of learning that would stand on its own, reserving the analysis of schooling and other specific educational forms for the future" (Lave & Wenger, 1991: 40).

This avoidance of the formal educational context has several important implications in relation to the current project since the focus here *is* on the formal or institutional context. This is not to imply that Lave and Wenger's work is irrelevant; rather, it is to suggest that it is essential to be sensitive to the influence of the formal context. Clearly this observation applies to any research drawing upon this theory.

In his later work, Wenger (1998) does examine the influence of the institutional context. He stresses the importance of identities and modes of belonging for students in preference to concerns relating to the transmission and acquisition of ‘information’. However, in his discussion, Wenger does not address either the practical or the *epistemological* implications of this focus in relation to specific disciplines, other than emphasising for example, that:

> teachers need to “represent” their communities of practice in educational settings. This type of lived authenticity brings into the subject matter the concerns, sense of purpose, identification, and emotion of participation. It is not, however, something that I have seen emphasized in our schools. Yet for students, it is the kind of access to experience they need in order to feel connected to a subject matter. This principle suggests that being an active practitioner with an authentic form of participation might be one of the most deeply essential requirements for teaching.
>
> (Wenger, 1998: 276-277)

However, this statement at best appears to be vague and at worst it may be contradictory. It raises a number of questions: how can teachers represent their communities of practice; what in fact are their communities of practice; and how might authentic forms of participation be possible?

Similar reservations are explicitly recognised by Lave & Wenger (1991) in their example of high school physics students. They ask what community of practice these students are engaged in and question whether, instead of reproducing the discipline of physics, the students participate only in processes which reproduce the high school itself (p. 98). They make a critical distinction between "talking *about* a practice from outside and talking *within* it" (pp. 106-107, emphasis in original), suggesting that:

> the didactic use of language, not itself the discourse of practice, creates a new linguistic practice, which has an existence of its own. Legitimate peripheral participation in such linguistic practice is a form of learning, but does not imply that newcomers learn the actual practice the language is supposed to be about.
>
> (Lave & Wenger, 1991: 108)

This starts to highlight some of the difficulties inherent in transporting communities of practice theory into a formal educational context (or an 'ambient community" in Lave & Wenger's terms). This ambient community in fact consists of multiple communities of practice which relate in complex ways to what could be referred to as a 'target' community of practice (the disciplinary community of practice, for example).

It would be possible to argue that multiple communities of practice are also present in the vignettes described by Lave & Wenger (1991), but these are not coupled in such a problematic way with the knowledge and skills which are to be acquired as is the case in a formal institutional context. Compare, for example, the examples described by Lave & Wenger: Yucatec Mayan midwives, non-drinking alcoholics in Alcoholics Anonymous, and so forth – here the community is arguably more or less defined by the knowledge which is to be acquired. Because this is not the case in a formal educational context, a number of problems relating to theorising student engagement are suggested. The first problem concerns the different communities of practice which exist in some relationship to an educational context, already alluded to above; the second relates to the way in which knowledge may or may not be decontextualised; and the third concerns judgements about the value of knowledge. The section below considers these problems in more detail.

3.2.3 Communities of practice and the ambient community

The relation between different communities of practice which may be represented in the ambient community and the sense in which students may belong to these communities tends to be under-theorised. Ashwin (2009) suggests that research which applies communities of practice theory to a higher education context can fail to recognise how disciplinary knowledge practices are mediated within an educational context. He argues that some research appears to assume that:

> the discipline-as-research is the same as the discipline-as-curriculum, in that the knowledge practices of research activities in a particular discipline are assumed to be the same as the knowledge practices involved in the higher education curricula related to that discipline. In this way, it tends to obscure the processes by which disciplinary knowledge practices become situated in teaching-learning interactions in higher education.
>
> (Ashwin, 2009: 44)

Also in a higher education context, Solomon's (2007) account of mathematics students' relation to a disciplinary community of practice points to a complex relationship between disciplinary and ambient communities. Solomon presents evidence of potentially conflicting communities of practice, which may be accounted for by the presence of a performance orientation towards ability and ownership of knowledge embedded within the institutional culture. In other words, a student's identity as legitimate peripheral participant with the disciplinary community may not align with an identity as participant within the ambient community, i.e. as a successful student.

These findings appear to be related to Edwards' (2005) observation about the relation between engagement in the practices of a community and the link between this and the nature of belonging. Wenger (1998) for example, characterises a community of practice as involving the experience of a joint enterprise, shared values, purpose and rules of engagement. However, Edwards observes that "[b]eing held up in traffic at the same bottleneck each evening might thereby produce a community of practice, as indeed might holding a department store's loyalty card" (Edwards, 2005: 57). The concept, Edwards suggests, needs tighter boundaries. The examples Edwards gives might, under Wenger's definition, indicate a community of practice, but the nature of belonging and engagement is not necessarily indicative of the presence of a community *per se*.

As Ashwin (2009) and Muller (2009) observe, research relating to higher education contexts can tend to assume that what is taught is the discipline itself. In non-higher education contexts, by contrast, subjects are studied at a lower level and teachers within those contexts, unlike many of those working in higher education, do not have dual roles of teacher and researcher. This means that further issues relating to disciplinary engagement may be more visible in non-higher education contexts, though I would argue these issues are not entirely limited to those contexts. In the context of low classification and framing, integrated curricula (Bernstein, 1971) – for example that aimed towards 'low achieving and disaffected' students in FE – it can be unclear what the 'target' disciplinary community of practice might be. A subject such as 'life skills' does not appear to derive from any specific discipline. Rather, the target community of practice may be much wider, and may derive from educational goals related more broadly to social inclusion – a non-disciplinary community of practice.

Students' perceptions of or aspiration towards a target community of practice may differ from that which is implicit within the curriculum they are following. Ashwin (2009) draws attention to the way in which research literature employing communities of practice theory tends to assume that the function of higher education programmes is to produce disciplinary researchers, when in fact students' imagined destinations may be unrelated to the discipline. A similar, but contrary, situation is found in Swain's (2005) account of numeracy courses in FE. Swain's research suggests that the motivations reported by students may contradict the fundamental reasoning behind models of student engagement in functional mathematics. For example, Swain quotes Alan Wells, former director of the Basic Skills Agency who reports that in his experience "a lot of people who want to learn numeracy want it for a specific purpose … they've got to do a test to get a job – or something numerical regularly comes up in their job and it didn't used to" (Whittaker, 2004, quoted in Swain, 2005: 311). The target community for numeracy students by this account relates to what Dowling (1998) refers to as the 'public domain' of mathematics which consists of real-world problems and localised skills. This contrasts with the abstract and generalisable mathematical skills of the esoteric domain. But Swain reports that one of the most important findings of his study was:

> students' liking of algebra, which some people might find surprising given its widely accepted lack of applicability to the practical world. However, for many of the students, this was part of the attraction. For many, algebra has the status of being like a foreign language, and with its abstract nature and (seemingly) mystical codes, it is one of the starkest signifiers of Dowling's esoteric domain.
>
> (Swain, 2005: 313)

In other words, students "want to be able to enter, and gain access to what they see as being an esoteric and privileged practice … they want to be able to open the door and join the mathematicians' club, with its connotations of eliteness" (Swain, 2005: 312). Dowling (1998) suggests that this esoteric domain text acts to apprentice the student to the mathematician – in stark contrast to the aims of a numeracy curriculum with its emphasis on real world problems and goals of social inclusion and employability.

Since curricula such as numeracy, life skills and vocational courses in FE have a significant, or in some cases only nominal, relation to 'real life' or workplace contexts, the place of the 'target' community of practice is further confused. More fundamentally, some writers have pointed to flawed interpretations of workplace itself as a target community of practice. Wheelahan (2007a: 199) proposes that in Wenger's (1998) approach, the workplace is "defined unproblematically as constituting an undifferentiated collective entity". Fuller *et al*. (2005) also highlight a number of limitations inherent within the communities of practice perspective when it is applied to the contemporary workplace, for example the way in which power relations are theorised.

These observations indicate that links between target communities of practice and ambient communities are highly complex and they highlight the danger in making simple assumptions about the nature of students' 'belonging' in relation to them both in practice and in research.

The second implication for application of communities of practice theory to educational contexts concerns the issue of 'decontextualisation' that Lave & Wenger (1991) identify as an important theme within their model of situated learning. They state that "the organization of schooling as an educational form is predicated on claims that knowledge can be decontextualized, and yet schools themselves as social institutions and as places of learning constitute very specific contexts" (p. 40). We can compare Lave & Wenger's use of the term 'decontextualisation' with Bernstein's (1990) notion of the process of 'recontextualisation' discussed later in this chapter. The position advanced by Lave & Wenger relates to the situatedness of knowledge, implying that it is not possible for knowledge to be divorced from its context: knowledge is contextual.

Many of the insights of sociocultural theory support the view that knowledge is always contingent upon its context, and this is clearly the case. Upon closer inspection, however, a number of problems arise. The implication in Lave &

Wenger's (1991) work is that knowledge cannot be decontextualised, but it is clear that this is not strictly true. Otherwise, knowledge generated in one context would never be able to be relocated to another context. But we know this must happen: it surely forms the rationale for education as whole, and it is the basis of all learning both for individuals and for communities – research communities for example. The nature of the process by which students may relate what they have learned to other contexts, however, is highly complex, as the literature on 'transfer of learning' demonstrates (e.g. Vosniadou, 2007). Furthermore, situated learning theory with its emphasis on the specificity of learning and context, appears to militate against the possibility of drawing out general principles about learning. However, as Haggis points out, "Lave and Wenger (1991) nonetheless formulate two general principles which apparently apply to *all* types of situated learning: 'community of practice' and 'legitimate peripheral participation' (Haggis, 2009: 45, emphasis in original)." The point I wish to make is that although knowledge is contingent upon its context, this does not mean that it literally *cannot* be decontextualised and thus recontextualised within another context. However, this is not to suggest that there are no consequences for the nature of that knowledge.

The third implication concerns the ideological associations that are made between knowledge and different contexts. Here I refer to the substantial body of research concerning mathematics in out-of-school contexts (e.g. Lave, 1988; Nunes *et al.*, 1993; Nasir, 2007), but will focus on Lave's (1988) work on 'cognition in practice' which is perhaps the best known and most influential contribution to the field.

Greiffenhagen & Sharrock (2008) make a number of important observations concerning the validity of Lave's (1998) study. They question her conclusion about the abilities of people who do not perform well in school mathematics but yet who are successful in solving mathematics problems in everyday contexts – in the context of engaging with the practices of food measurement in dieting or in the context of shopping. They raise important questions about the status of mathematical knowledge encountered within these contexts, focusing upon the widely reported differences between the different types of knowledge within the different contexts. It is suggested that "the distinction between 'school' and 'everyday/street' mathematics is at best misleading and at worst mistaken – and to speak of a radical or wide gap or chasm is hyperbole rather than careful description" (Greiffenhagen & Sharrock, 2008: 5). Instead, they stress the importance of the difference between the aims and purposes of the studies' participants in the different contexts; these differences, they argue, are located in the situations rather than in the mathematics.

Greiffenhagen & Sharrock argue that the motivation for Lave and others working in this tradition derives from an ideologically-driven aim to show that mathematical competences can be acquired in non-school and in non-Western contexts. They suggest that Lave is attempting to emphasise the alienating nature of formal contexts, such that: "[s]chools were … seen as perpetuating an ideology of mathematics as definitive of rationality with the result that those doing badly in school mathematics see themselves not just failing at a particular subject in school, but as being generally less 'intelligent'" (Greiffenhagen & Sharrock, 2008: 3-4). In her emphasis on recognising the intelligence of 'just plain folks', it is argued that Lave both exaggerates the mathematical demands of activities such as shopping and also over-emphasises the sophistication of the non-formal mathematical solutions arrived at by people in everyday contexts:

> It is one thing to counter the view that only people who are good at formal (school) mathematics are intelligent (i.e., to use mathematics as the sole indicator of rationality), but is quite another to argue that shoppers and carpenters are as good as professional mathematicians at *doing mathematics*. People can be said to be ingenious and inventive in finding practical solutions … for the problems they encounter, but this does not mean that their solutions are *that* ingenious (unless you start off with the view that people are astonishingly dim) or constitute a contribution to mathematics.
>
> (Greiffenhagen & Sharrock, 2008: 18, emphasis in original)

This section has pointed to a number of important considerations which arise from situated learning and communities of practice theory's emphasis on non-formal contexts. These considerations constitute important limitations for the way in which sociocultural theory can be applied to formal contexts, particularly in relation to how knowledge may be theorised with that context. Let me summarise the arguments put forward in this section.

First, the role played by the complex webs of different communities of practice related to an educational context needs to be acknowledged. Students may appear to be part of a community of practice but what they take away from that context may not necessarily be what that community 'knows'. Varied forms of membership are possible (Lave & Wenger, 1991: 41). Indeed, defining what that community knows may also be problematic: disciplines may not be unitary entities; rather they develop in a dynamic fashion as their participants debate the nature of their object of study and methods of inquiry. It is possible to make similar observations about workplace communities. The nature of the knowledge that students are expected to acquire needs to be explicitly theorised in relation to the ambient community – a point that Lave & Wenger (1991: 41) also acknowledge. Ford & Forman (2006) summarise this point very effectively when they observe that:

> Research conducted in a sociocultural framework tends to articulate *how* learning occurs in classroom communities (e.g., via participant structures, narratives, or argumentation) but rarely examines *what* students take away or how they are changed by those experiences.
>
> (Ford & Forman, 2006: 10, emphasis in original)

Second, sociocultural theory, as it has been discussed here in terms of situated learning and communities of practice theory, also gives rise to questions about the relation between context and knowledge and the way in which knowledge may transfer between contexts. In emphasising that knowledge is contextual, the theory fails to acknowledge ways in which it must be possible to decontextualise knowledge at least to some degree and in some way. Sociocultural theory does not recognise that there may be differences in the contextual contingency of different forms of knowledge and does not consider the implications for education where students may need to acquire knowledge which is not contingent upon the context[2].

[2] Although Vygotsky acknowledges the difference between everyday and scientific contexts, he does not discuss the basis upon which selections for inclusion in a curriculum can be made, i.e. "what are the non-arbitrary grounds for curriculum choices?" (Young, 2008b: 80).

Third, there is no place within sociocultural theory to examine the ideological basis upon which assessments of the value of knowledge may be made. In this way, the perceived status of knowers can be confused with the status of knowledge. This point is supported by the supposed differences between everyday and formal mathematics – differences, it was argued, which are more to do with interpretations of the nature of the context, rather than with epistemology.

In summary, although sociocultural theory provides a number of valuable theoretical tools for understanding learning as a practice, there are a number of important limitations on how the theory can be applied to a formal educational context. My argument is that if an educational context is framed in terms of the development of students' relationships with disciplinary knowledge, sociocultural theory, because it does not theorise a *formal* educational context or distinguish between the form and structure of different types of knowledge, does not provide a complete account of student learning.

3.3 Bernstein's approach to educational knowledge

3.3.1 Introduction

Before proceeding to explore the way in which Bernstein theorised the place of knowledge within an educational context, it is worthwhile to first make some comments about the nature of the theoretical work that Bernstein is expected to do in this thesis. First, as I pointed out in chapter 1, many writers have theorised the way in which either students or teachers relate to knowledge. In relation to teacher knowledge, I have previously cited Shulman's (1986; 1987) work concerning pedagogical content knowledge. In relation to students' conception of knowledge, I cited research in the area of personal epistemologies (e.g. Perry, 1970; Baxter Magolda, 1992; King & Kitchener, 1994; Hofer & Pintrich, 1997; Hofer, 2001). Although these research areas differ in a number of ways from my own, the key difference is their focus upon only one part of Ball & Forzani's (2007) instructional dynamic. Chapter 2 argued for the importance of theory which addresses all the elements in the process of interaction between students, teacher and knowledge. Because Bernstein focuses on the educational context as a whole, his work provides the possibility for consideration of all the elements in the instructional dynamic. Furthermore, Bernstein's approach (1999, 2000), in a unique way, encompasses both micro and macro levels of interaction (Singh, 2002). These levels of interaction are also implied in the model I have proposed of forms of knowledge in an educational context.

Second, drawing upon Bernstein's work and that of those theorists advocating a 'social realist' approach to the sociology of knowledge and curriculum, provides useful theoretical tools to address the constructed *and* constructing nature of knowledge. It is proposed that relationships with knowledge are not only concerned with the *knower's* subjective experience; they also reflect the way in which aspects of the engagement with knowledge are, or may be viewed to be, contingent upon the characteristics of the knowledge itself. This view serves to develop a focus not only upon *knowers*. It also recognises that we need to acknowledge the significance of what that knowing is about: as Maton observes, "knowledge claims are *by somebody* and *about something*" (Maton, 2004: 220, emphasis in original). Such a conceptualisation accepts that knowledge may be socially constructed through practices, relationships or knower characteristics, but also seeks to explore ways in which it is possible to think about knowledge as being socially *constructing*. If the constructing nature of knowledge were not recognised, then it would be possible to argue that relationships with knowledge could be developed in entirely arbitrary ways.

The next section explores how Bernstein's later work provides for a focus upon knowledge in an educational context.

3.3.2 The pedagogic device and the 'voice' of knowledge

In volume 4 of *Class, Codes and Control*, Bernstein (1990) outlined a critique of research within the sociology of education which focused upon the social reproduction of inequalities and the analysis of power relations. He suggested that these theories take for granted the pedagogic discourse that they analyse, arguing that they see pedagogic discourse only as a medium for other voices defined by race, class or gender. Bernstein suggested that:

> It is often considered that the voice of the working class is the absent voice of pedagogic discourse, but … what is absent from pedagogic discourse is its own voice.
>
> (Bernstein, 1990: 165)

Bernstein was referring to theories of cultural reproduction and to the wider body of work within the then 'New Sociology of Education' exemplified perhaps by Young's

(1971) influential edited collection *Knowledge and Control*. Both micro level studies and macro level theorisations which address the issue of social reproduction and the hidden curriculum – for example, Bowles & Gintis (1976), Bourdieu & Passeron (1977), Willis (1977) and also the 'new vocationalism' literature (e.g. Bates *et al*., 1984) – broadly share a perspective which is centrally concerned with the influence of ideology. This work, because of its focus on the socially constructed nature of knowledge and its analysis of the means by which dominant discourses are reproduced, seems to imply that pedagogic discourse is only the means by which others speak, as if the medium through which it is relayed were "somehow bland, neutral as air" (Bernstein, 1990: 169). Bernstein observed that:

> It is as if pedagogic discourse is itself no more than a relay for power relations external to itself; a relay whose form has no consequences for what is relayed.
>
> (Bernstein, 1990: 166)

Instead, Bernstein argued, what is needed is a means of analysing *relations within* pedagogic discourse, rather than only analysing what he termed *relations to*. These 'relations within' pedagogic discourse, are what he described as the 'voice' of pedagogic discourse itself. Bernstein did not seek to dismiss such analyses, however. Rather, he aimed to show that they only present a partial picture: such studies provide a strong analysis of 'relations to', but a weak analysis of 'relations within'.

Bernstein (1990) sought to describe such 'relations within' by means of the *pedagogic device* which is a set of rules by which pedagogic communication is produced. It describes the generative principles through which knowledge is made available to be transmitted or acquired. This takes place, Bernstein suggested, through three hierarchically related rules: distributive, recontextualising and evaluative rules, each of which are derived from the other. Three main fields of the pedagogic device were identified which were associated with each set of rules. These three fields comprise: the field of production where new knowledge is constructed through research; the field of recontextualisation where knowledge from the field of production is selected and adapted to become educational knowledge; and the field of reproduction where knowledge is transmitted and acquired in its pedagogised form. Each of these fields and the associated rules constitute a "crucial arena of struggle for control, as it is a condition for the productions/reproductions of culture *and* of their interrelations" (Bernstein, 1990: 190; emphasis in original). Within this arena of struggle, different groups attempt to control the pedagogic device in order to gain power over the 'symbolic ruler of consciousness' (Bernstein, 1990: 180). This ruler operates in two senses: "of having power over consciousness and measuring the legitimacy of its realizations" (Maton & Muller, 2007: 20).

The pedagogic device describes the means by which pedagogic discourse is produced. It is the principle for "appropriating other discourses and bringing them into a special relation with each other for the purposes of their selective transmission and acquisition" (Bernstein, 1990: 183-184, original emphasis removed). In other words, pedagogic discourse, Bernstein argued, removes or delocates "a discourse from its substantive practice and context, and relocates that discourse according to its own principle of selective reordering and focusing" (Bernstein, 1990: 184). This process transforms knowledge from the primary context of production of discourse – an actual practice – to virtual or imaginary practice, to create what Bernstein terms 'imaginary subjects' in the secondary context where the discourse is reproduced. Thus, there is an *instructional discourse* which transmits specialised competences and skills and a *regulative discourse* which creates specialised order, relations and identity, where instructional discourse is embedded in regulative discourse. Bernstein discusses the example of the recontextualisation of the discourse of physics, which:

> undergoes a complex transformation from an original to a virtual/imaginary discourse. The rules of relation, selection, sequencing, and pacing (the rate of expected acquisition of the sequencing rules) cannot themselves be derived from some logic internal to physics nor from the practices of those who produce physics. The rules of the reproduction of physics are social, not logical, facts. The recontextualizing rules regulate not only selection, sequence, pace, and relations with other subjects, but also the theory of instruction from which the transmission rules are derived ... The strength of the classification and framing of recontextualized physics is itself ultimately a feature of regulative discourse. In this way, order, relation, and identity in the transmission of instructional discourse are themselves embedded in the principles of order, relation, and identity of regulative discourse.
>
> (Bernstein, 1990: 185)

The theory of the pedagogic device, then, starts to provide the means by which a focus on knowledge may be developed. In arguing that reproduction theories of knowledge privilege 'relations to' knowledge, Bernstein sought to explore how the voice of knowledge itself may be described. Maton & Muller (2007) argue that approaches which treat knowledge as if it only exists to reproduce inequality present an overideologized image of knowledge, which, while providing useful insights into ways in which the production, recontextualisation and reproduction reflect the social relations of power, neglect to consider the internal ordering of symbolic forms. Maton & Muller suggest that in this way, "[a]ll questions of '*what* knowledge is at stake?' give way to the question: '*whose* knowledge?'" (Maton & Muller, 2007: 21, emphasis in original).

More recent approaches within the field of educational research and elsewhere such as poststructuralist, postmodernist and feminist standpoint epistemology theories (e.g. Harding, 1991) also adopt a position similar to those critiqued by Bernstein. Moore & Muller (1999) argue that such approaches adopt a discursive concern with the explication of 'voice', arguing that "its major distinction is that between the dominant voice and those ('Others') silenced or marginalised by its hegemony" (p. 190). These approaches, they argue, tend to reduce knowledge to categories of knowers, producing a sociology of knowers rather than of knowledge. Similar observations could also be made in relation to the widespread concern with 'learner identities' in contemporary educational research.

Over a number of years, Bernstein's work addressed different parts of the pedagogic device. Moore & Maton (2001: 154-155) point out that Bernstein's focus moved cumulatively from the analysis of pedagogic transmission and acquisition in the field of reproduction, to the structure of pedagogic discourse and to the knowledge structures from which pedagogic discourse is recontextualised.

The theory of the pedagogic device itself, however, does not in fact bring knowledge to the centre of the focus. While the pedagogic device might establish the conditions for the way in which pedagogic discourse is constructed, it does not address the form and nature of knowledge: as Bernstein (1999: 157) himself recognised, there is no analysis within the pedagogic device of the "discourses subject to pedagogic transformation".

Reflecting on the distinctions that are made in the field of educational research between school(ed) knowledge and everyday common-sense knowledge, or 'official' knowledge and 'local' knowledge, Bernstein (1999) attempted to produce a language of description, or theoretical model, which conceptualises the way in which these forms of knowledge may be differentiated. Bernstein outlined a model which describes the characteristics of 'common-sense' or everyday knowledge or 'horizontal discourse', and academic knowledge or 'vertical discourse'. Horizontal discourse, Bernstein proposed, could be characterised as "oral, local, context dependent and specific, tacit, multi-layered, and contradictory across but not within contexts" while vertical discourses (which includes disciplinary knowledge) are described as possessing "coherent, explicit, and systematically principled structure" (Bernstein, 1999: 159). An important distinction between these forms of knowledge is the way in which knowledge circulates within the two discourses. Bernstein suggests that within horizontal discourse, the 'knowledges':

> are related not by integration of their meanings by some co-ordinating principle, but through the functional relations of segments or contexts to the everyday life. It then follows that what is acquired in one segment or context, and how it is acquired, may bear no relation to what is acquired or how it is

acquired in another segment or context.

(Bernstein, 1999: 160)

The context-specific and segmentally-structured nature of horizontal discourse is contrasted with the nature of vertical discourse, which is integrated at the 'level of meanings':

> Vertical discourse consists not of culturally specialised segments, but of specialised symbolic structures of explicit knowledge. The procedures of vertical discourse are then linked, not by contexts, horizontally, but the procedures are linked to other procedures hierarchically. The institutional or official pedagogy of vertical discourse is not consumed at the point of its contextual delivery, but is an on going process in extended time.
>
> (Bernstein, 1999: 161)

Bernstein also theorised that vertical discourse consists of two forms of knowledge structure. The first form of knowledge structure is hierarchically organised (hierarchical knowledge structure) and could be represented as shown below:

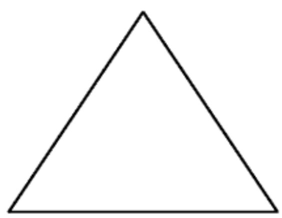

Figure 3.1 Bernstein's model of a hierarchical knowledge structure

This knowledge structure builds up by means of an 'integrating code': knowledge at lower levels accumulates to create more and more abstract levels of propositions and theories. The second form of knowledge structure takes the form of a series of incommensurable specialised languages (horizontal knowledge structure). Bernstein represented this structure as:

$$L^1, L^2, L^3, L^4, L^5, L^6, L^7 \ldots L^n$$

Figure 3.2 Bernstein's model of a horizontal knowledge structure

Within this structure, knowledge proliferates into a series of specialised languages by means of serial or collection codes to create different languages with "specialised modes of interrogation and criteria for the construction and circulation of texts" (Bernstein, 1999: 162). Examples of disciplines which show the different knowledge structures are suggested, with the natural sciences representing a hierarchical structure and sociology representing a horizontal structure. The difference lies in the way in which the two disciplines are thought to develop, or the nature of their 'verticality' (Young & Muller, 2007: 187); hierarchical structures integrate and subsume, whereas horizontal structures accumulate new languages (Maton & Muller, 2007). Bernstein also distinguishes between horizontal knowledge structures which have, what he terms, strong and weak grammars. Grammar refers to the degree to which the constituent languages relate to empirical descriptions and the extent to which they are capable of producing empirical models. Examples of knowledge structures with a strong grammar are mathematics, linguistics and economics and knowledge structures with a weak grammar are sociology and cultural studies.

As Maton & Muller (2007) note, Bernstein also explores some of the possible implications of these knowledge structures for the shape of intellectual fields. In physics, for example, as the paradigm case of a hierarchical knowledge structure, Bernstein suggests that “the acquirer does not have the problem of knowing whether she/he is speaking physics or writing physics, only the problem of correct usage” (Bernstein, 1999: 164). Within horizontal knowledge structures, by contrast, particularly those with weak grammars, Bernstein proposed that because acquirers encounter a number of different languages it can be less clear to them that they are speaking within that discipline. Bernstein suggests that acquirers need to develop a distinctive ‘gaze’: a particular means of recognising and realising what counts as legitimate with that discipline. He also discusses the social basis of horizontal languages in order to indicate that:

> choice here is not rational in the sense that it is based on the ‘truth’ of one of the specialised languages. For each language reveals some ‘truth’, although to a great extent, this partial ‘truth’ is incommensurate and language specific.
>
> (Bernstein, 1999: 164)

The implication is that the different types of knowledge structures develop in different ways, giving rise to, for example, the phenomenon of short-term obsolescence of knowledge and a circular re-emergence of ideas as horizontal knowledge structures are “more vulnerable to the changing winds of intellectual fashion” (Maton & Muller, 2007: 24).

3.3.3 Limitations and development of Bernsteinian theory

Bernstein's theory of the pedagogic device and his model of knowledge discourses and structures provide the means by which a focus on knowledge may be developed. This section explores some of the questions raised about his theory of knowledge structures and outlines some of the possible limitations which have been suggested in relation to Bernsteinian theory.

First, as Maton & Muller (2007: 28) point out, a "discipline is more than just its structuring of knowledge; the concepts of 'knowledge structures', therefore, shed light on disciplinary development but are not the whole story". Maton & Muller suggest that the role played by the state, social structure or struggles between actors in the field also needs to be taken into account.

Second, the notion of grammar within horizontal knowledge structures requires some elaboration. It will be recalled that the notion of grammar refers to the way in which horizontal knowledge structures relate to the empirical. Maton & Muller (2007) argue that a strong grammar may explain how some horizontal knowledge structures tend to progress more strongly than others. O'Halloran (2007) proposes that mathematics with its horizontal structure and strong grammar may play a key role in promoting the hierarchical nature of the natural sciences. The precise nature and role played by grammar, however, remains unclear.

Third, as Maton & Muller (2007) argue, it may be that the distinctions that Bernstein makes are too clear-cut. Knowledge structures in practice might display characteristics of both hierarchical and horizontal structures. The key problem relating to this question is the way in which knowledge builds up over time within the different structures. Within hierarchical structures the model clearly shows how knowledge builds over time, but it is less easy to describe how verticality develops within horizontal knowledge structures (Muller, 2007: 83). Maton & Muller observe that:

> It can seem as if Bernstein is suggesting that the development of horizontal knowledge structures is characterized by permanent cultural revolutions that leave no trace of the past. This would make discovering even the smallest degree of continuity of problems, themes or terms within a discipline appear to be a sign of a hierarchical knowledge structure. However, such a discovery is only to be expected: for an intellectual field to exist, it must have a degree of continuity across time and space.
>
> (Maton & Muller, 2007: 25)

Maton & Muller (2007) point out that verticality is defined by the way in which new theories integrate past theories. Even if the languages within a horizontal knowledge structure address similar problems, employ the same themes or terms, or reference the same authors, this does not necessarily imply the integration of existing theories to create new theory which is more abstract or generalisable. This raises questions about the holistic 'identity' of a discipline which derives from a horizontal knowledge structure. On the other hand, it can be argued that hierarchical knowledge structures may, to some degree, also consist of horizontal elements: hybrid knowledge structures may be possible (O'Halloran, 2007). For example, O'Halloran suggests that a more realistic picture of physics may be represented by a series of triangles within triangles, where the sub-triangles represent areas of specialisation – nuclear physics for example. Young (2008a) also acknowledges the possibility that Bernstein's typology of knowledge discourses and structures may oversimplify and appear as dichotomous ideal types. However, he suggests that they nevertheless provide useful conceptual resources which should be used analytically rather than merely descriptively. Young (2008a: 21) argues that they "do not tell us definitively how the world is; they identify trends and enable us to ask questions and propose hypotheses about the world".

Fourth, Bernstein concentrated upon students' and others' *social relation* to knowledge rather than on *epistemic relations* (Wheelahan, 2007b: 637-638). Beck & Young (2005) note that Bernstein's focus on knowledge relations takes two forms. First, Bernstein was more concerned about relations between knowledge domains and the classification and framing of the boundaries *between* them rather than on the contents of knowledge. As Beck & Young observe, this contrasts with approaches such as that of Hirst (1974) who asserted that different 'forms of knowledge' were differentiated by specific logical differences. Second, Bernstein emphasised social relations in his concern with relations *to* knowledge, or the "consequences for the *identity* of both practitioners and learners, of different knowledge structures" (Beck & Young, 2005: 185, emphasis in original). Bernstein is less concerned with the epistemic relations of knowledge – the *aboutness* of knowledge, or how truth claims can be made (Wheelahan, 2007a: 25).

Moore & Maton (2001) propose that Bernstein's theory may be developed in order to address this epistemic relation through the notion of the 'epistemic device'. The epistemic device is a model for the regulation of the legitimacy of knowledge within a particular field by changing relations between arbitrary and non-arbitrary aspects of knowledge. In other words, the epistemic device describes "whether knowledge claims are legitimated on the basis of external relations of power or by principles intrinsic to knowledge itself" (Moore & Maton, 2001: 156). Moore & Maton (2001) suggest that the relations between the arbitrary and non-arbitrary dimensions within each field of the pedagogic device represent *principles of legitimation* which are defined in terms of the 'epistemic relation' and the 'social relation' of knowledge:

> The epistemic relation is the relation between knowledge and that part of the world of which knowledge is claimed (its proclaimed object of study). The social relation is between knowledge and its author, the subject making the claim to knowledge. Languages of legitimation are conceptualised in terms of the strength of boundaries around (classification) and control over (framing) *what* knowledge may be claimed and *how* (epistemic relation), and *who may* claim knowledge (social relation). Crucially, the forms these relations take within languages of legitimation may vary independently of each other; each may be strongly or weakly classified (C) and framed (F)."
>
> (Moore & Maton, 2001: 164-165, emphasis in original)

Using the concept of classification and framing, four principal legitimation codes may be identified:

- a *knowledge code* (ER^+, SR^-), which emphasises possession of specialized knowledge, skills or techniques;
- a *knower code* (ER^-, SR^+), which foregrounds dispositions, whether

‘natural’, cultivated or related to social background;

- a *relativist code* (ER^-, SR^-), where one’s identity and consciousness is ostensibly determined by neither knowledge nor dispositions; and,
- an *elite code* (ER^+, SR^+), where legitimate insight and membership is based not only on possessing specialist knowledge but also having the right kinds of dispositions.

(Maton, 2006: 53, adapted from original)

Maton (2007) uses the humanities and science ‘Two Cultures’ debate (Snow, 1993) to illustrate the nature of the dominant codes within each discipline. There is strong classification and framing of the epistemic relation (ER^+) and weak classification and framing of the social relation (SR^-) in science. In the humanities, by contrast, there is a dominant knower code, with strong classification and framing of the social relation (SR^+) and weak classification and framing of the epistemic relation (ER^-). Maton suggests that the two forms of knowledge structure (hierarchical and horizontal) imply two different *knower structures* which are essentially the inverse of the knowledge structure. The hierarchical knowledge structure (science) implies a horizontal knower structure and the hierarchical knowledge structure (humanities) implies a horizontal knower structure. This theory provides an insight into the basis of (or the ‘rulers’ of) achievement in a specific context (knowledge production or reproduction) by providing a description of what is a legitimate knowledge claim, performance or competence in a certain context in which:

> actors may emphasize the knowledge structure, the knower structure, neither or both as the basis of distinctiveness, authority and status; conversely, their

> identity, relations and consciousness are shaped in different ways by these two kinds of structures.
>
> (Maton, 2006: 49)

Alternatively this may be expressed in terms of thinking about 'what matters' – is it:

> one's demonstrated possession of specialist knowledge or 'what you know' (knowledge code); one's sensibilities and dispositions or 'what kind of knower you are' (knower code); both (elite code); or neither (relativist code).
>
> (Lamont & Maton, 2008: 270)

The epistemic device is then described as the means by which actors may alter which legitimation codes are dominant within a specific domain. Although Moore & Maton (2001) provide an example of the action of a 'switch' in the epistemic device – an intellectual field moving from a focus on 'perspectives' to 'paradigms' – which shifts the focus from a knowledge code to a knower code, the principles which determine *how* a switch in the epistemic device may occur remain unclear, although as Moore & Maton point out, control over the epistemic device may be an ongoing struggle within the field. However, these theoretical resources are useful for my own project which aims to explore relationships with knowledge and the constructing and constructed nature of knowledge. As Maton (2007: 87) observes in relation to legitimation code theory, "instead of simply showing how identity shapes knowledge, this approach also reveals how knowledge itself specializes identity, consciousness and relations".

3.4 The social realist approach

In his model of knowledge discourses, Bernstein (1999) explores the differences between everyday knowledge (horizontal discourse) and theoretical or disciplinary knowledge (vertical discourses). Bernstein also draws attention to tendencies within the school curriculum to appropriate segments of horizontal discourse, recontextualise them and insert them into the contents of school subjects in order to make specialised knowledges more accessible and more relevant to students. He points to some of the possible implications of this practice: that such segmental competencies may "not be activated in its official recontextualising as part of a vertical discourse, for space, time, disposition, social relation and relevance have all changed" (Bernstein, 1999: 169). He also suggests that such recontextualisations are mediated by the distributive rules of the school, noting that "[r]econtextualising of segments is confined to particular social groups, usually the 'less able'" (p. 169). Another motive for these strategies, Bernstein suggests, may be that horizontal discourse is seen "as a crucial resource for pedagogic populism in the name of empowering or unsilencing voices to combat the elitism and alleged authoritarianism of vertical discourse" (p. 169).

In the past few years, a number of theorists have developed Bernstein's work, advancing a 'social realist' approach to educational knowledge (Muller, 2000; Moore, 2004; Wheelahan, 2007a,b; Young, 2008b). This theoretical position "puts knowledge as an object centre-stage in thinking about education" (Maton & Moore, 2010b: 2). It addresses in more detail the problems highlighted by Bernstein, namely the problem of the interface or articulation between horizontal and vertical discourse and the place of these forms of knowledge in the curriculum. In the section below I summarise the key aspects of social realist theory.

In examining and contrasting sets of assumptions about knowledge and the curriculum in contemporary curriculum policy, Young (2008a) identifies three key approaches to curriculum. These include, first, *conservative traditionalism* which essentially views knowledge as ‘given’ – a foundationalist approach. This approach includes both an explicitly elitist and conservative stance (Young cites Chris Woodhead, 2002) which focuses upon a ‘return to basics’ and traditional disciplines. It also encompasses approaches within educational psychology, for example, which do not problematise the question of knowledge, and thus also view it as ‘given’. Second, *technocratic (or pragmatic) instrumentalism* which stresses the relevance of education for the economy, seeing the curriculum and knowledge as a means to an end – for example the arguments advanced in the Leitch Report (2006) in relation to skills. Third, *postmodernism* which appears to take the question of knowledge as its central problematic, suggesting that traditional approaches rely on arbitrary distinctions about knowledge and that all knowledge is embedded in the interests of ‘knowers’. Such approaches, however, imply that all knowledge is of equal value, meaning that debates about the curriculum are reduced to debates about whose experience should underpin it. This leaves no principled grounds for the selection of curriculum content. Young argues that because postmodernist approaches have no theory of knowledge as such:

> they can do little more than expose the way that curriculum policies always mask power relations. Furthermore, by depending on an irreducible notion of experience, they neglect the uneven distribution of the experiences that the curriculum needs to take account of if students from diverse backgrounds are

> to have opportunities to acquire knowledge that takes them beyond their experience.
>
> (Young, 2008b: 23)

Young suggests that this typology of approaches to educational knowledge illustrates the nature of the problem faced by the sociology of education. Young proposes that this presents us with an 'educational dilemma': "either the curriculum is a given or it is entirely the result of power struggles between groups with competing claims for including and legitimizing their knowledge and excluding that of others" (Young, 2008b: 28).

Young, and other social realist researchers, argue that an alterative 'social realist' view of the curriculum provides a means to overcome this dilemma. The social realist view, in contrast to postmodernism and the other approaches described above, holds that the objectivity of knowledge is provided by its social character but that this does not deny that knowledge is also influenced by interests of power. Young argues that:

> the objectivity of knowledge is in part located in the social networks, institutions and codes of practice built up by knowledge producers over time. It is these networks of social relations that, in crucial ways, guarantee truth claims, and give the knowledge that has produced its emergent powers.
>
> (Young, 2008b: 31)

It is in this way that knowledge, while being acknowledged to be socially constructed, is viewed as not being reducible to those who produced it: knowledge is "*emergent* *from but irreducible to* the practices and contexts of is production" (Maton & Moore, 2010b: 5, emphasis in original).

In exploring the nature of knowledge in the curriculum, Young (2008a), makes an important distinction between *knowledge of the powerful* (elite knowledge, or the knowledge possessed by the ruling class) and *powerful knowledge*. Powerful knowledge is not defined by the status of those who have access to it; rather, it is defined by the intellectual power that it affords those who are able to access it. This form of knowledge "provides more reliable explanations and new ways of thinking about the world and acquiring it and can provide learners with a language for engaging in political, moral, and other kinds of debates" (Young, 2008a: 14). This powerful knowledge is specialised knowledge, or disciplinary knowledge – the objective knowledge which is the object of a social realist view of knowledge. If schools and other educational institutions are concerned with the transmission of knowledge, then a social realist view of knowledge provides the grounds upon which decisions can be made about the selection of – or differentiation of – knowledge in the curriculum. Young proposes that key questions for curriculum design will therefore concern: the differences between types of specialized knowledge; the difference between this knowledge and everyday knowledge and how they relate to each other; and how specialist knowledge is 'pedagogised' – "how it is paced, selected, and sequenced in the curriculum for different groups of learners" (Young, 2008a: 14).

An important condition for the transmission of powerful knowledge, Young argues, is a clear distinction between *context-dependent* and *context-independent* knowledge. Context-dependent knowledge is everyday knowledge, or Bernstein's horizontal discourse. It is acquired in the course of everyday life and is bound to specific contexts, such as the home. Context-independent knowledge, by contrast, is not generally acquired in the home; rather, it requires curriculum structures and the support of teachers. It "provides a reliable basis for moving beyond particulars and therefore beyond one's experience" (Young, 2008a: 15). Young suggests that:

> Teachers have to ask the question, "Is this curriculum a means by which pupils can acquire *powerful knowledge?"* For children from disadvantaged homes, active participation in school may be the only opportunity that they have to acquire *powerful knowledge* and be able to move, intellectually at least, beyond their local and the particular circumstances. It does them no service to construct a curriculum around their experience (context-dependent knowledge) on the grounds that everyone's experience is equally valid, at least for them; if schools do no more than validate the experience of pupils, they can only leave them there.
>
> (Young, 2008a: 15, emphasis in original)

A number of writers have explored the 'articulation' (Ensor & Galant, 2005) of everyday and specialised forms of knowledge. For example, Wheelahan (2007a,b) has examined competency-based training (CBT) in an Australian context. She suggests that CBT, because it atomises aspects of disciplinary knowledge in order to relate it to specific vocational contexts, delocates knowledge from its vertical discourse such that "meaning of that content is exhausted by the context" (Wheelahan, 2007b: 648). She argues that "[u]nless students have access to the generative principles of disciplinary knowledge, they are not able to transcend the particular context." (p. 648). Since students from low socio-economic groups are under-represented in higher education and since vocational courses are more representative of the broader community, Wheelahan suggests that, by these means, disadvantaged groups are denied access to the generative principles underpinning disciplinary knowledge thus reinforcing class divisions.

In relation to school mathematics, Dowling (1998) examined textbooks which were differentiated for 'able' and 'less able' children. The textbooks for the less able included examples based on everyday situations in order to make the mathematical content more relevant to everyday life. Textbooks aimed at higher ability students, by contrast, acted to apprentice those students into the esoteric and generalisable discourse of mathematics. Dowling identifies two problems which were associated with the use of the real life examples in the textbooks for the less able student. First, the recontextualising principles at work do not succeed in reproducing an accurate depiction of real life. Students, therefore, do not recognise the 'real life' nature of such references. Second, the way in which everyday life examples are used in textbooks for less able students represents a 'localizing strategy' which positions mathematics as a set of specialised and algorithmic solutions to specific problems rather than as a generalised and context-independent body of knowledge. As Muller (2000: 68) observes, the "'lower-ability' student is, paradoxically, left free to be a local individual but a failed mathematics learner". In criticising constructivist and progressive approaches to the curriculum, which emphasise the use of everyday knowledge in the curriculum in order to promote student inclusion, Muller (2000: 71) suggests that "there is no everyday short cut to competence in the discipline of school mathematics. A curriculum premised on such a short cut can only turn out to be a new impediment". Rather, students need to be empowered to recognise and to navigate the lines or boundaries between different kinds of knowledge (Wheelahan, 2008), because otherwise students are "at the mercy of the power inscribed in the line" (Muller, 2000: 71).

In summary, a social realist view provides the means to adopt a realist view of knowledge in contrast to a relativist or postmodern approach. However, it avoids a foundationalist model of knowledge which is premised on the notion that knowledge is somehow 'given'. In emphasising the sociality of knowledge as grounds for the basis of its objectivity, it thus provides an argument for the status of disciplinary knowledge as powerful and context-independent knowledge. Young (2008b: 165) suggests that "instead of concentrating solely on ideology critique, a social realist approach to the curriculum seeks to identify the social conditions that might be necessary if objective knowledge is to be acquired". It is argued that because constructivist or progressive approaches to curriculum do not have a robust theory of knowledge, counter-productive consequences may occur. In conflating everyday and disciplinary knowledge such approaches fail to recognise the importance of students' access to powerful knowledge.

It is important to stress one final point in relation to the differentiation of educational knowledge in social realist theory. While this theory argues for the inclusion of powerful knowledge in the curriculum it does not suggest that teachers should not use everyday knowledge for pedagogic purposes. In his discussion of a social realist approach, Young (2008a) emphasises the importance of distinguishing between curriculum and pedagogy. While distinctions between everyday and disciplinary knowledge may provide a principled basis for the sociology of the curriculum, it does not translate into specific recommendations for pedagogy, since "while pedagogy necessarily involves the teacher in taking account of the non-school knowledge that his/her students bring to school, the curriculum explicitly does not" (Young, 2009: 202).

3.5 Sociocultural theory, social realist theory and the model for forms of knowledge

According to Young (2008b), social constructivism may be interpreted in two very general ways. One interpretation may be characterised as 'interest-based', which recognises underlying power relations in the production, selection and acquisition of knowledge and the privileging or marginalising impact on certain social groups. The second 'process-based' interpretation of social constructivism emphasises the contextual or situated nature of knowledge (i.e. broadly, a sociocultural approach). Young suggests that these approaches represent partial perspectives because:

> In focusing only on either the interests or practices involved in the processes of acquisition and production of knowledge, knowledge can easily be reduced to or equated with the interests or practices of groups of knowers; as a result, content becomes arbitrary (at least in theory).
>
> (Young, 2008b: 146)

Therefore, while social constructivism may be powerful in exposing power relations and in highlighting the significance of contexts, it is limited in its ability to theorise the place of knowledge within an educational context.

The previous sections have explored these arguments by presenting a critique of the treatment of knowledge within sociocultural theory and by exploring the basis of Bernstein's approach to theorising the 'voice' of educational knowledge and how this has been developed by the social realists. Social realist theory acknowledges that knowledge is socially constructed but suggests that those social origins also provide the basis for its objectivity. Social realism provides for an epistemological perspective on the differentiation of knowledge, which is not made visible within social constructivist or sociocultural approaches.

At the start of this chapter, I summarised a number of questions relating to knowledge in relation to the model for forms of knowledge proposed in chapter 2. The theoretical resources that I have explored in this chapter help to address some of these questions.

First, I posed a question about the differences between the form and structure of different types of knowledge. Bernstein's theory has provided important insights into the differences between the form and structure of everyday and disciplinary knowledge. Bernstein's model of horizontal and vertical discourses and structures provides an account of the nature of these forms of knowledge, how they develop and implications for social relations. The nature of other forms of knowledge in my model has not been considered to the same extent. Teachers' and students' owned knowledge (particularly students' owned knowledge) may be related to aspects of horizontal discourse or to students experience as knowers. However, this does not wholly address the specifically agentic nature of owned knowledge which chapter 2 suggested is a critical aspect of owned knowledge. In relation to subject knowledge, although discussion of Bernstein's pedagogic device illuminates some aspects of the process of recontextualisation there has not been a substantial focus on the nature of subject knowledge – this will be considered in the next chapter.

Second, I suggested that it was important to theorise how different forms of knowledge may be translated into other forms. In my discussion of social realist theory, I explored ways in which everyday knowledge and disciplinary knowledge are used in an educational context. I highlighted issues concerning the use of everyday knowledge within the curriculum and how this might have unintended consequences for specific groups of students. The studies this chapter has discussed suggest that it is important that the boundaries between different types of knowledge are maintained and that students should be given access to an understanding of the nature of the boundaries between them. In other words, a set of critical issues have been highlighted concerning the way in which these forms of knowledge may *not* be transformed or translated into other forms. An account was also given of Bernstein's theory of the pedagogic device which provides a model for how disciplinary knowledge is recontextualised through the fields within the device (production, recontextualisation and reproduction). This chapter did not address the transformation of other forms of knowledge within the model, and this will be considered later in this thesis.

Third, in my questions about the model for forms of knowledge and in my exploration of sociocultural theory, I posed a question about the place of disciplinary knowledge within the educational context. Social realist theory, in its account of the distinctive nature of disciplinary knowledge, addresses this question. This theory embodies a realist but not foundationalist account of knowledge, and provides a rationale for the place of disciplinary knowledge within an educational context.

3.6 Conclusion

Chapter 2 argued that the meanings that are made by participants in an educational context are crucial in understanding the nature of that context. Sociocultural theory, with its emphasis on the local construction of meaning offers some insights into this process, but it does not address the nature of the formal context and the place of knowledge. Bernsteinian and social realist theory does aim to explicitly provide an account of the place of knowledge. This chapter has offered a critique of sociocultural theory and has suggested ways in which Bernsteinian and social realist theory help to illuminate the model for forms of knowledge, principally in terms of the differentiation of knowledge and its place in the curriculum.

It is not suggested that Bernsteinian and social realist theory replaces sociocultural theory; rather, that in some respects it can provide a more complete account in relation to the place of knowledge. However, as this chapter has started to argue, there are also some limitations within Bernsteinian (and also social realist) theory. Later chapters return to sociocultural and social realist theory once more and discuss ways in which a realist theory of knowledge may be located within sociocultural theory.

This chapter has also explored ways in which it is possible to discuss the constructing nature of knowledge in addition to its constructed nature. Maton's Legitimation Code

Theory (Moore & Maton, 2001; Maton, 2007), his model of the social and epistemic relation to knowledge and Bernstein's theory of knowledge structures, provides a means by which the structuring potential of relations to knowledge may be identified.

In the next chapter I turn to the special case of school subjects and explore how the theory discussed in this chapter may be employed to address the epistemological bases of subject knowledge.

Chapter 4: Knowledge and school subjects

4.1 Introduction

This chapter explores the nature of school subjects and their relation to disciplinary knowledge. The term 'school subject' is used here in a generic sense and much of the discussion applies to any sector of education, not just to 'school'. The focus in this chapter also develops the previous chapter's principal concern with curriculum to also address implications for pedagogy.

The next section considers the general nature of the school subject and refers to the significant tradition of research which has explored the nature of the subject from a social constructionist perspective. The second part of the chapter, which is the more substantial focus, discusses the epistemological bases of school subjects, further developing the theoretical work addressed in chapter 3. The implications that Bernstein's theory of knowledge structures may have for curriculum structure and for pedagogy are explored. Finally, a broad model for curriculum forms is derived through an examination of the principles of recontextualisation.

4.2 The social construction of school subjects

Chapter 3 gave a brief account of research within the New Sociology of Education which emphasised the social construction of the curriculum. Theorists such as

Goodson (e.g. Ball & Goodson, 1984; Goodson 1983, 1988) have also explored the historical and social construction of school subjects. As already discussed, such accounts are frequently founded upon a relativist view of knowledge and arguments relating to an alternative social realist approach have already been explored. I do not intend to rehearse these arguments again here. It is, however, important not to wholly dismiss the insights provided by a social constructionist perspective. Although a social realist approach to education emphasises that "knowledge has its own causal powers and tendencies" and "different structurings of knowledge possess different affordances – they lend themselves more to certain forms of pedagogy, evaluation, identity, change over time" (Maton, 2009: 55), it also recognises that knowledge is also socially constructed. Power and vested interests also play a significant role, although social realist theory does not reduce knowledge to such factors.

In addition to attending to these theoretical concerns, recognising the socially constructed nature of school subjects is also important for the field of practice. The social construction of school subjects – in the sense in which I outline below – plays a significant role in mediating the way in which subjects are experienced in an educational context. Bloomer (1997: 189) argues that the curriculum (and the school subjects within it) are 'made' and not 'given' – they are 'acted upon'. This means that practical limitations are always imposed upon what might be characterised as solely epistemological accounts of knowledge and school subjects. It is therefore necessary to develop some theory of how such construction takes place in a practical context. Such theory also provides the basis for a contextually sensitive understanding of the processes of change. Bell & Donnelly (2006: 1403) observe that "all curricular innovations are to some degree underdetermined by policy: they are realized within the power relations, material circumstances, traditions, and purposes of the participants". Although the processes of social construction may have arbitrary implications for knowledge, the implications for practice in terms of, for example, implementation of policy or the enhancement of practice are not.

4.2.1 Subjects and the struggle over power and identity

In his account of the classification and framing of educational knowledge (Bernstein, 1971) and in his discussion of singulars, regions and generic forms of knowledge (Bernstein, 1990, 2000), Bernstein explored the implications for power and identity of the boundaries between types of knowledge – a key concern within Bernstein's work (Beck, 1999). As has already been noted, this earlier work in particular focuses upon the *social relations* to knowledge rather than *epistemic relations*. Bernstein (1971) outlines the implications for power relations of the differences between the degree of classification and framing of different school subjects. Strongly classified 'collection' curricula consist of subjects which are well insulated from each other, and the boundaries between the contents of subjects are strong. Weakly classified 'integrated' curricula, by contrast, consist of subjects which have a more open relationship to each other. The concept of framing refers to the "strength of the boundary over what may be transmitted and what may not be transmitted, in the pedagogical relationship" (Bernstein, 1971: 50), or the degree of control that students and teachers have over the selection, organisation and pacing of knowledge. A key feature of Bernstein's analysis is the relative rather than absolute nature of these distinctions:

> The speciality of each category is created, maintained, and reproduced only if

> the relations between the categories of which a given category is a member are preserved. What is to be preserved? The *insulation between the categories.*
>
> (Bernstein, 1990: 23, emphasis in original)

There are two inter-related consequences which arise from such an analysis. First, the maintenance of boundaries between subjects reflects the operation of power relations and is frequently the subject of the 'arena of struggle' within the pedagogic device (Bernstein, 1990). Subjects which are strongly classified and framed, such as the sciences, are generally seen as high-status subjects. Goodson (1983: 33) suggests that "there is a clear hierarchy of status which is based partly upon assumptions that certain subjects, the so-called 'academic' subjects, are suitable for the 'able' students whilst other subjects are not". Whitty *et al.* (1994 cited in Paechter, 2000) observe that these high status subjects resist being 'polluted' by lower status subjects in order to maintain their boundaries.

Changes in classification and framing through prescriptive policy change, for example, may alter the distribution of power, marginalising some participants and empowering others. Paechter (2000: 4) notes that until quite recently curriculum changes were generally gradual processes, emerging from initiatives by teachers or academics. She contrasts this with contemporary curricular changes which are more likely to be externally imposed by government, leaving teachers with less room for negotiation. Under such circumstances, teachers have less autonomy, such that: "to refuse to take part in ongoing change is, essentially, to opt out of teaching altogether" (Paechter, 2000: 4).

While some teachers or subject groups may see their power and status enhanced by such reforms, others may be increasingly marginalised. The impact of such struggles and the effects of externally imposed changes are amply illustrated within Jephcote & Davies' (2007) account of the fate of the subject of economics in the compulsory curriculum.

The second consequence of subject classification and framing concerns implications for identity. Bernstein suggests that:

> it is the subject which becomes the linchpin of identity. Any attempt to weaken or *change* classification strength may be felt as a threat to one's identity and may be experienced as a pollution …
>
> (Bernstein, 1971: 56, emphasis in original)

This link between the classification of knowledge and the experience of identity accounts for the way in which "debates about the school curriculum have a tendency to become heated" (Moore, 2000: 17). Conflict about the content of curricula is commonplace in the media, particularly in relation to debates about the dilution of traditional subjects, the decline in standards and 'dumbing down'. The debate surrounding the report from the think tank Reform is one recent example (Bassett *et al.*, 2009). This report criticises the 'ersatz' A-level, suggesting that these qualifications now provide "hollow preparation" for university since they focus less on the retention of knowledge and require less independent thought from students. Another recent debate prominent within the media has been that concerning the nature of the school science curriculum and its increasing emphasis on scientific literacy (e.g.

Perks, 2006; Warnock, 2006).[3] This debate is considered in more detail later in this thesis.

Debates concerning the curriculum also reflect societal changes, particularly at times of educational expansion and relate to aspects of national identity. For example, post-war expansion in higher education reflects significant social class struggles. Moore (2000) notes that:

> curriculum debates inevitably become enmeshed with broader debates mediated by politicians and the press. What is taught in schools can never be a neutral or innocent decision or simply an outcome of changes in educational theory. Because we are what we know (though by no means all of what we know comes from school), school knowledge will inevitably be contentious to varying degrees depending upon circumstances.
>
> (Moore, 2000: 18-19)

4.2.2 Subjects and generic modes

Bernstein's later work applies a similar analysis to the development of what he terms singular, regional and generic modes. While Bernstein again emphasises the importance of the subject as a source for identities, he also points out the implications

[3] The prominent role played by think tanks such as the Institute of Ideas in these debates is also interesting, reflecting perhaps the political nature of the debates – although the majority of think tanks are (nominally at least) not officially affiliated with political parties. Alternatively, it may be possible to suggest that think tanks provide the space for wider and more open public debate which is not afforded elsewhere, for example in professional arenas or within the field of academic research (e.g. see Hayes, 2008), which is itself shaped through political means.

for identity of new generic modes. Bernstein (2000: 52) defines singulars as "knowledge structures whose creators have appropriated a space to give themselves a unique name, a specialised discrete discourse with its own intellectual field of texts, practices, rules of entry, examinations, licenses to practice, distribution of rewards and punishments (physics, chemistry, history, economics, psychology, etc.)". They are therefore insulated by strong boundaries. Regions, by contrast, are created by the recontexualisation of singulars towards fields of practice: "the interface between disciplines (singulars) and the technologies they make possible" (p. 52). Examples of regions include medicine, engineering and business studies. Bernstein (2000: 52) notes that "[i]ncreasing regionalisation necessarily is a weakening of the strength of the classification of discourses and their entailed narcissistic identities and so a change of orientation of identity towards greater external dependency". He also points to the persistence of singulars as an organising principle in schools in spite of increasing regionalisation in higher education[4].

Singular and regional modes may be contrasted with the increase in generic modes, originating in FE, but increasingly encountered elsewhere (Young, 2010). Generic modes such as 'key skills', for example, are frequently linked to perceived demands of the market and to changing conditions of employment. This is in contrast to the 'inwardness' and 'inner dedication to knowing' characteristic of singular modes, which "generate strong inner commitments centred in the perceived intrinsic value of

[4] However, consider the recent Rose Review of the primary curriculum (Rose, 2009). Although it appears that the Review seeks to retain subject disciplines' key place in the curriculum – "the essential knowledge and skills all children should be taught … can be organised through clearly visible subject disciplines, such as history, geography and physical education" (p.10) – they are, in the Review, in an uncertain position in relation to other recommendations such as the implementation of "challenging cross-curricular studies" and an emphasis upon children's personal development and well-being.

their specific knowledge domains" (Beck & Young, 2005: 185). The move towards the generic, the associated concept of 'trainability' and the functionalist purposes of knowledge, however, signals for Bernstein a move to a situation where 'the outer becomes the inner'. These modes have "no inwardness, only an ability to respond to every new pedagogic initiative" (Young, 2008b: 157). The focus for identity within these generic modes thus becomes displaced towards the market, such that "other signifiers of valued identity may become increasingly attractive" (Beck, 1999: 234).

Although the proliferation of generic modes provides grounds for the emergence of teacher and student identities which are not related to specific subjects, the subject remains an important element in teachers' professional identity. Research by the General Teaching Council (GTC) suggests that teachers' 'love of the subject' is "the first reason for them wanting to teach and third in the line of the factors behind continued motivation" (GTC, 2003: 1 quoted in Fisher & Webb, 2006: 339-340). Siskin (1994: 153) suggests that "[t]eachers frequently explain who they are, what they do, or how they do it by anchoring their identities, actions, and understandings in the subject matter itself".

Subjects are also instrumental in the organisation of the school since teachers are generally located within subject departments which provide an immediate community (Ball, 1981; Siskin, 1994; Stodolsky & Grossman, 1995), although these communities are frequently fractured by internal struggles (Ball & Goodson, 1984). As Siskin (1994) observes, subject departments are "micro-political arenas where critical 'material endowments' of funding, time, and space are 'defended' and distributed" (p.113). Some writers note the influence of the school subject on the nature of pedagogy (e.g. Stodolsky, 1988; Grossman & Stodolsky, 1995), although Bloomer (1997) suggests that such distinctions are based on a 'crude yet widely held belief'. Rather, Bloomer reports that in relation to the range of post-16 subjects in his study, he "found far greater variation in classroom organisation, classroom discourse, students' learning tasks, assessment practices and teachers' pedagogic plans to exist within A-level courses and within vocational courses than between them" (p. 5).

4.3 The epistemological structure of school subjects

The previous section outlined a social constructionist view of school subjects and pointed to a range of issues concerning power relations and identity. Such considerations act to mediate the way in which subjects are organised and taught in a practical context. The second part of this chapter adopts a more epistemological approach, focusing on the implications of Bernstein's model of knowledge structures for curriculum and pedagogy. Unlike, for example, Becher & Trowler's (2001) exploration of the characteristics of disciplinary tribes and territories, such an approach emphasises the difference between the nature of school subjects and disciplines. Other theorists have also made a distinction between subject and discipline. Dewey, for example, refers to the 'psychologising' of the discipline and Schwab outlines a process of 'translation' from discipline to subject (Deng, 2007). However, unlike these previous analyses, a Bernsteinian and social realist approach seeks to specifically explore the nature of the link between the epistemological structure of the discipline and the structure of the school subject.

4.3.1 The relation between knowledge structures and curriculum structures

A useful starting point is provided by exploring the sets of questions raised by Maton & Muller (2007) concerning the relation between knowledge structures and curriculum structures. Maton & Muller (2007) raise two key questions: first, can a curriculum structure be discussed in the same way as a knowledge structure; and second, what is the nature of the link between a knowledge structure and a curriculum structure?

In relation to the first question, Maton & Muller (2007) point out that Bernstein's theory of knowledge structures refers specifically to the field of production of knowledge – to the structure of disciplines themselves. They observe that "in terms of Bernstein's concepts as they currently stand, one would not describe a school curriculum in terms of exhibiting a horizontal or hierarchical knowledge structure" (p. 28). They note, however, that Bernstein's work "foresees its own reformulation", indicating that perhaps it would have been Bernstein's intention to make a more explicit connection in later work. If a curriculum structure can be discussed in the same way as a knowledge structure then this provides the means by which the way that knowledge progresses in the curriculum can be explored: does it follow a scheme whereby knowledge builds upon past knowledge as it does in a hierarchical knowledge structure, or does it build up by adding separate languages as it does in a horizontal knowledge structure?

Several theorists do discuss curriculum structures in these terms. For example, Muller (2007) and Christie & Macken-Horarik (2007) discuss the degree of 'verticality' which is present in different curricula: the extent to which elements of the curriculum structure integrate past elements, thus providing “an expanding sense of a coherent knowledge base as students move through their schooling” (Christie & Macken-Horarik, 2007: 157). These writers are concerned with how aspects of cumulative knowledge may be built into the curriculum and how this might be made explicit and visible to students in order to minimise the exclusionary implications for disadvantaged students of an ‘invisible pedagogy’ (Bernstein, 1975 – see also section 4.4). This theme is also picked up by Maton (2009) in his exploration of the possibilities for segmented or cumulative learning within specific curricula. Segmented learning is described as learning where “students learn a series of ideas or skills that are strongly tied to their contexts of acquisition, problematising transfer and knowledge-building” and cumulative learning is described as learning where “new knowledge builds on and integrates past knowledge” (Maton, 2009: 43). A model of curriculum structure as analogous to a knowledge structure is therefore implicit in these studies.

The second question raised by Maton & Muller (2007) concerns the nature of the link between a knowledge structure and a curriculum structure and the extent to which the form of a specific knowledge structure determines the form of the corresponding curriculum structure. Maton & Muller (2007) acknowledge that knowledge structures are not curriculum structures, but suggest that this “raises the question of the degree to which the latter reflect the former” (p. 28). Bernstein’s position on the nature of this link, outlined in his theory of the pedagogic device (1990; 2000), was to emphasise the separation of academic knowledge and curriculum and the ‘imaginary’ nature of school subjects. As I have previously noted, in relation to physics, Bernstein argued that:

> As physics is appropriated by the recontextualising agents, the results cannot formally be derived from the logic of that discourse. Irrespective of the intrinsic logic which constitutes the specialised discourse and activities called physics, the recontextualising agents will select form the totality of practices which is called physics … But these selections cannot be derived from the logic of the discourse of physics…
>
> (Bernstein, 2000: 34)

Muller (2007) speculates that Bernstein opposed the idea of a link between recontextualised discourse (i.e. the school subject) and the discourse of academic knowledge (e.g. research knowledge) in order to "stay true to the postulate that all symbolic formations were specific to a context with its specializing practices. That context is conditioned by a society's regulative or moral order" (Muller, 2007: 80). Muller (2007) goes on to ask, however, how, if we accept that Bernstein's position was true, it is that specialised knowledges are reproduced – as clearly they are reproduced: scientists, for example, are trained through engagement with a school curriculum. In relation to mathematics, Muller (2007) observes that students' performance in school maths predicts their performance in university maths. Citing Gee (2001), Muller (2007: 80) suggests that "school maths competence 'precurses' university maths competence, which 'precurses' real maths adeptness". Maton & Muller (2007) also observe that:

> Since the specialized knowledges in the realm of production rest directly on the material base, there must surely be a limit to the amount of recontextualizing they can bear before defeating their purpose. This is made clear by the focus in Bernstein's account of the pedagogic device on ‘evaluative rules’; these may be pedagogized artefacts, but if the criteria they construct bear no relation to their parent knowledges in the realm of production, then schooling will undermine its role as a relay of specialized knowledges.
>
> (Maton & Muller, 2007: 28)

Muller (2007) therefore argues that a relation between knowledge structure and curriculum structure must be necessary. He emphasises the importance of hierarchy and progression in curriculum, concluding that although, “we cannot stipulate a once-and-for-all-path [through a curriculum], we would still have to concede … that there are a specifiable necessary minimum set of steps that must be pedagogically traversed” (Muller, 2007: 82). He also notes the importance of such an explicit mapping of the path through a curriculum for socially equitable outcomes.

Following this argument, it is reasonable to assume that to learn a specific element of a curriculum (Newton’s Laws of Motion for example), a typical path through physics ‘content’ would be indicated. This might include learning specific vocabulary and its scientific meaning (of the terms ‘force’, ‘speed’ and ‘velocity’, for example) and learning how to apply these ideas appropriately. In the realm of physics in particular it is also important to have acquired particular mathematical knowledge, without which a full understanding and certainly full application will not be possible to achieve.

However, it is also important to note that such a learning trajectory is not necessarily linear, since “particular topics, even for the most hierarchical of subjects, are repeated across learning levels” (Muller, 2007: 81). The subsumption of disciplinary elements is therefore imperfect: the same specific topics play a number of roles in acquiring different general understandings. The relation is more open than would be implied by a simple linear path. Muller (2007: 82) asks, “How are these different cognitive logics to be braided into the artifice called curriculum and pedagogy? This is the nub of pedagogy.” The exact nature of the link between knowledge and curriculum structures therefore remains unclear. Ashwin (2009: 95) suggests that “[i]t seems likely that how close this relation remains is dependent on the dominant voices in determining the rules for recontextualizing disciplinary knowledge into curriculum”. Maton & Muller (2007) propose that the nature of these links is a key area for future exploration.

4.3.2 Principles of recontextualisation

An alterative approach to exploring the link between disciplinary structure and curriculum structure may be to examine the broad principles upon which disciplines are recontextualised. This approach differs from the analysis outlined above because instead of thinking about parts of the subject, or specific aspects of content, it considers the subject as a whole. It considers the subject as an ‘emergent’ entity.

In order to explore this approach, two quite different accounts of research will be outlined which seek to identify the nature of curriculum in contrasting subject areas: one which, in Bernstein's terms, is derived from a horizontal knowledge structure and one from a hierarchical knowledge structure. First, I give an account of Roberts' (1982) research relating to the science curriculum and the notion of differing 'curriculum emphases'. I then discuss Christie & Macken-Horarik's (2007) work which has explored contrasting forms of school English. The range of subjects and research addressed here is extremely limited, but this discussion is not intended to be a systematic overview. The interesting similarities that I point out between these analyses are intended to illustrate differing principles of recontextualisation.

4.3.2.1 Curriculum emphases in science

Roberts' (1982) research in relation to 'curriculum emphases' derives from an analysis of the 'distinguishing characteristics' or 'all-pervasive themes' within North American physics textbooks. He proposes that different 'curriculum emphases' may be discerned within instructional material which communicate to students a range of explicit or implicit messages about science. Curriculum emphases are defined as:

> a coherent set of messages to the student *about* science (rather than *within* science). Such messages constitute objectives which go beyond learning the facts, principles, laws, and theories of the subject matter itself-objectives which provide answers to the student question: "Why am I learning this?"
>
> (Roberts, 1982: 245, emphasis in original)

Such approaches to the analysis of science curricula have also been undertaken by other writers who adopt more historical perspectives. Roberts' approach is intended to be more general and less historically rooted and as such may also be applied to more general issues such as policy debate and curriculum development and implementation. Roberts reports that seven distinct, but not necessarily mutually exclusive, categories of curriculum emphases may be identified which underpin the broad orientations within textbooks which can be assumed by science education. A list of these categories and a brief description of them is given below.

1. Everyday coping – suggests that science is an important means by which one can understand one's natural or technological environment and stresses the importance of the application of scientific knowledge.

2. Structure of science – emphasises the intellectual growth and development of science, the use of theoretical models and the relation between evidence and theory, the self-correcting nature of scientific knowledge and the role of conceptual principles.

3. Science, technology and decisions – this compares with the 'everyday coping' emphasis because it recognises the limits on scientific knowledge in addressing practical concerns. It stresses the distinction between science, technology and personal and political, value-laden concerns.

4. Scientific skill development – de-emphasises the acquisition of knowledge, focusing upon the importance of the application of robust scientific processes in order to determine valid scientific products (i.e. scientific knowledge).

5. Correct explanation – contrasts with scientific skill development emphasis and its concern with processes, as it focuses upon the importance of acquiring the products of scientific knowledge which have been established by the scientific community.

6. Self as explainer – focuses upon science as a cultural institution which provides one account among many others of explaining natural phenomenon. In addition to a cultural approach this also consists of an individual approach, where the student is viewed as constructor of their own knowledge.

7. Solid foundations – this approach emphasises the student's role in being prepared for future instruction in higher level scientific courses.

In addition to discussing the ways in which such curriculum emphases may be embedded within particular textbooks and policy reforms, Roberts (1982: 255) suggests that a particular curriculum emphasis can be a "a science teacher's whole way of construing his professional craft – his whole purpose in teaching". He also notes that the emphases 'solid foundations' and 'correct explanations' are characteristic of the traditional science curriculum – what Roberts refers to as the 'default' emphases (van Driel *et al.*, 2008). Roberts also suggests that difficulties associated with policy reform processes may be explained in terms of shifts in dominant curriculum emphases.

4.3.2.2 Curriculum models in English

I now turn to the work of Christie & Macken-Horarik (2007) who have examined different models of curriculum within the subject of English. Unlike that of Roberts, their analysis is not based on textbooks, and their focus is broader and much more general, although the categories that they identify provide useful points of comparison. Christie & Macken-Horarik identify six different models of curriculum which have developed since the nineteenth century. These are summarised below.

1. Basic Skills – the focus here is upon the acquisition of key technical skills of reading and writing, emphasising correct grammar and spelling.

2. Cultural Heritage – emphasises students' access to the literary canon and the development of students' sensibilities in relation to such cultural products.

3. Personal Growth – a progressive and constructivist focus, taking students' individual learning and their personal journey of discovery as a central concern.

4. Functional Language Studies – emphasises language as a contextualised social product and its role in structuring experience. Such approaches recognise the relevance of dialect and register and the range of ideologies embedded in texts.

5. Cultural Studies – views the texts of popular culture as literary texts, and also encourages the exploration of the values and ideologies embodied in texts which can be read in multiple ways.

6. New Literacy Studies – emphasises the link between situated social practices and literacy and associated ideological positionings.

Christie & Macken-Horarik (2007) argue that these curriculum models are present in contemporary English school curricula but that criteria within these programmes for successful performance can remain unclear, and this disadvantages certain types of student. They argue that the subject of English has evolved such that:

> its tendency has been to diminish the status of overt teaching of knowledge about language, while promoting various valued subject positions, though the tools for their expression have become increasingly invisible.
>
> (Christie & Macken-Horarik, 2007: 179)

They argue that assessment criteria need to be made more explicit, thereby enhancing the degree of verticality within the subject. Christie & Macken-Horarik's (2007) concern is with strengthening verticality or, in other words, exploring how aspects of cumulative knowledge may be built into the curriculum. What is of interest for the moment, however, is the identification of different bases for the curriculum and the manner in which these different emphases are generated in ways which are not solely accounted for by the influence of ideology.

4.3.2.3 A general model: conceptual and contextual coherence

Similarities may be discerned between the curriculum emphases in science and the different models of English in spite of their focus upon different subject areas. It is proposed that these different curriculum forms may be placed into two broad categories which are defined by the form of internal coherence that they display.

Chisholm *et al.* (2000 cited in Muller, 2009) suggest two modes of curriculum coherence: that of *conceptual coherence* and *contextual coherence.* Conceptually coherent curricula are organised into abstract, internally logical, hierarchical structures which contain clear knowledge signposts. Contextually coherent curricula, on the other hand, are "segmentally connected, where each segment is adequate to a context, sufficient to a purpose" (Muller, 2009: 216). Muller proposes that the more vertical a curriculum is, the more important is conceptual coherence and the more the sequence of the contents matters. Sequence matters less in contextually coherent curricula, where the context and external requirements play a greater role. Muller (2009: 215) suggests that "conceptual coherence curricula are regulated by adequacy to truth (logic); contextual coherence curricula by contextual adequacy, to a particular specialised form of practice".

While curriculum formats may be arbitrary in that curriculum designers may impose one form of coherence or another, it is nevertheless possible, argues Muller (2009), that a particular curricular form may be more compatible with specific disciplinary structures. He suggests that conceptual coherence is analogous to the notion of verticality within disciplines and that it maps to Becher & Trowler's (2001) categorisation of from 'hard to soft', whereas contextual coherence maps to 'pure to applied'.

The curriculum forms identified by Roberts and by Christie & Macken-Horarik may be aligned with the notion of conceptual and contextual curriculum coherence. The different curriculum models may be identified as either broadly conceptually or contextually coherent, as shown in Table 4.1 below.

	Roberts' Science Curriculum Emphases	**Christie & Macken-Horarik's Models of English**
Conceptual coherence	Structure of science Correct explanation Solid foundations (Scientific skill development)	Basic Skills Cultural Heritage
Contextual coherence	Everyday coping Science, technology and decisions Self as explainer (Scientific skill development)	Personal Growth Functional Language Studies Cultural Studies New Literacy Studies

Table 4.1 Alignment of Roberts' and Christie & Macken-Horarik's curriculum forms with conceptual and contextual curriculum coherence

I wish to stress that these different curriculum models are best thought of as being aligned with each form of coherence rather than being a strict member of each category. I also suggest that the curriculum emphasis 'Scientific Skill Development' may span each category, as indeed other models of curriculum might in certain circumstances.

In his more recent work, Roberts (2007) subsumes the notion of his seven curriculum emphases into a model for science education/scientific literacy[5] which is composed of two visions for science education, defined as follows:

> Vision I gives meaning to [scientific literacy] by looking inward at the canon of orthodox natural science, that is, the products and processes of science itself. At the extreme, this approach envisions literacy (or, perhaps, thorough knowledgeability) *within science.* Vision II derives its meaning from the character of situations with a scientific component, situations that students are

[5] Definitions of scientific literacy will be discussed in chapter 6.

likely to encounter as citizens. At the extreme, this vision can be called *literacy* (again, read *thorough knowledgeability) about science-related situations* in which considerations other than science have an important place at the table.

(Roberts, 2007: 730, emphasis in original)

Roberts' description of these visions for science education also appears to concur with the broad categorisations of conceptual coherence (Vision I) and contextual coherence (Vision II) proposed above.

A further point to make concerns the nature of contextual coherence. It may be possible to suggest that the categories conceptual coherence and contextual coherence themselves may be aligned with Maton's notion of knowledge and knower codes discussed in chapter 3. Conceptually coherent curricula align with a knowledge code, while contextually coherence curricula align with a knower code. This suggests that it could be possible to propose two bases for contextual coherence which is also indicated by the different curriculum models that I have placed in the contextual coherence category. Contextual coherence may be achieved by means of alignment with a specific external context or with an internal context – the characteristics of knowers, for example. My suggested categorisation is shown in Table 4.2 below.

	Roberts' Science Curriculum Emphases	Christie & Macken-Horarik's Models of English
Contextual coherence – external context	Everyday coping (Science, technology and decisions) Scientific skill development	Functional Language Studies Cultural Studies New Literacy Studies
Contextual coherence – internal context (knowers)	Self as explainer (Science, technology and decisions)	Personal Growth

Table 4.2 Internal and external forms of contextual coherence

The above discussion has illustrated the broad principles of recontextualisation of disciplinary knowledge structures:

- Conceptual coherence – which emphasises an abstract and internally coherent structure. This principle of recontextualisation emphasises a knowledge code in Maton's terms and may align with a traditional curriculum or 'canonical' content.

- Contextual coherence – which aligns with specific contexts of application *or* the characteristics of knowers (a knower code) and which contains segmentally organised knowledge. Contextual coherence may also be said to draw upon characteristics of everyday knowledge to provide the basis of recontextualisation.

4.4 Implications for pedagogy

The final section of this chapter explores some of the possible implications for pedagogy which follow from the preceding discussion of disciplinary knowledge structure and curriculum structure links. I have already discussed the role of vertical knowledge within the curriculum in terms of enabling students to gain access to powerful theoretical knowledge which transcends to context of its acquisition (Dowling, 1998; Muller, 2000, Wheelahan, 2007b; Young, 2008b). This chapter has explored the nature of verticality within the curriculum itself. As Muller (2007), Christie & Macken-Horarik (2007) and others argue, a strong vertical structure within the curriculum can provide the basis upon which students may learn in a cumulative rather than in a segmented fashion (Maton, 2009) which enables new knowledge to be built upon previous knowledge.

It is important that the vertical nature of the knowledge within the curriculum is visible and equally accessible to all students. Bernstein (1975) characterises invisible pedagogies as being realised by weak classification and framing while visible pedagogies are realised through strong classification and framing. He suggests that:

> The basic difference between visible and invisible pedagogies is in the *manner* in which criteria are transmitted and in the degree of specificity of the criteria. The more implicit the manner of transmission and the more diffuse the criteria, the more invisible the pedagogy; the more specific the criteria, the more explicit the manner of their transmission, the more visible the pedagogy.
>
> (Bernstein, 1975: 116-117, emphasis in original)

Such invisible pedagogies also act to blur the boundary between everyday knowledge and subject knowledge and to mask the authority of the teacher (Morais & Neves, 2001). Most crucially, perhaps, invisible pedagogies can further disadvantage marginalised students since those students may not have access to the 'recognition and realisation rules' (Bernstein, 1990: 102) which are necessary to decode the teacher's criteria for a successful performance. Muller (2007) suggests that:

> invisible pedagogies can work, but only for middle-class pupils and usually only in the lower grades, and exactly how they do that is still being unearthed. For the majority of poorer children, the evidence increasingly suggests, clear and explicit articulation of evaluation criteria is *sine qua non* …
>
> (Muller 2007: 82, emphasis in original)

An explicit vertical curriculum structure therefore has a key role to play within a visible pedagogy. A high degree of verticality within the curriculum may be provided by applying a conceptual form of coherence upon recontextualisation, but as Muller (2009) points out, all curricula consist of elements of both conceptual and contextual coherence. The pedagogical task, then, lies in ensuring an appropriate balance.

The second implication for pedagogy concerns the manner in which a discipline is recontextualised – the forms of coherence that I discussed in the previous section – and the degree of alignment between different elements in the educational context. Students and teachers may have different beliefs about the nature of coherence within a curriculum. If these beliefs are different it may represent an important barrier to communication and provide the potential for confusion about the nature of a successful performance in assessment. In relation to such problems, Freebody *et al.* (2008) ask:

> Is the 'problem of knowledge,' as students construe it, about cumulative learning? Or about performance on disconnected segments of information and procedure? How might these issues differ depending on 'what matters' in the subject area?
>
> (Freebody *et al.*, 2008: 196)

In this respect, problems may arise which are similar to those which are discussed in the literature relating to deep and surface learning or 'approaches to learning' (e.g. Marton *et al.*, 1997). For example, Lamont & Maton (2008) use legitimation code theory to explore the dominant codes – the "dominant basis of success" (p. 271) – within the UK school music curriculum. These codes may be, as I outlined in chapter 3, a knowledge code, knower code, elite code or relativist code. They suggest that:

> within any context a specific code may dominate as the (unwritten) rules of the game, but not everyone may recognise and/or be able to realise what is required, and there may be struggles over which code is dominant. One can thus talk of a *code clash* between the code characterising … a pupil's ways of thinking and being … and that of the educational context. This may lead to difficulties in achievement and thence alienation, boredom and a sense that 'this is not for the likes of me'.
>
> (Lamont & Maton, 2008: 271, emphasis in original)

They also propose that there may be a *code shift* between different stages of a curriculum which alters the dominant legitimation code and thus changes the basis for success. Some students may find themselves to be less successful in the new regime. If this code change is not made explicit to students, then "the inexplicable loss of form of pupils whose habituses do not match the new code may lead to disincentive, bewilderment, alienation and a sense that 'this is no longer for the likes of me'" (Lamont & Maton, 2008: 271). Lamont & Maton argue that a code change from a knowledge code to an elite code occurs in the school music curriculum between Key Stage 3 and GCSE, which, they suggest, accounts for the low uptake of music at GCSE.

This implies that teachers need to be aware of these changes in code – changes in the principles of legitimation – and to make these changes explicit to students. Such changes may occur at times of transition, as Lamont & Maton (2008) highlight. Similarly, Shay's (2009) analysis of the history curriculum in South African higher education identifies a broad shift in legitimation codes from a knowledge code to a knower code over a number of decades. She points to a possible code mismatch between the school curriculum and the university curriculum. This may result in students being inadequately prepared for the dominant codes in the higher education curriculum. As Shay's study shows, such a code mismatch may explain why some students, even in their third year, "simply 'don't get it'".[6]

Maton's (2009) analysis of the codes within professional education at university and in school English also points to the importance of aligning the dominant code in the

[6] Another example of such a code mismatch may have occurred for the unfortunate student George Carmody in Malcolm Bradbury's *The History Man* (1975).

curriculum with the code embedded within assessment tasks, and, importantly, that these are made explicit and visible to students. Where this does not occur, Maton suggests that the result in the case he examines is a “code mismatch: the attempt to achieve knowledge code outcomes using knower code means” (p. 54).

While Lamont & Maton and Shay discuss such changes in terms of legitimation codes, a similar analysis could be carried out in terms of conceptual and contextual coherence. As has been suggested earlier, the notion of conceptual and contextual coherence may also be aligned with Maton’s legitimation codes.

4.5 Conclusion

This chapter has focused upon the nature of school subjects: first, by exploring the social construction of subjects and the resulting implications for power and identity; and, second, by examining subjects’ epistemological bases. I have attempted to draw together a range of research which addresses the epistemological nature of subjects and the link between discipline and curriculum. Considerable scope remains for theorising the nature of these links.

The key conclusions of this chapter are as follows. First, epistemological considerations are always mediated by social construction. Following social realist theory, I suggested that social constructionist perspectives, in addition to providing lessons for practice, may act to mediate, but may not totally determine, the nature of school subjects. Second, even though Bernstein emphasised the separation of the structure of the discipline and the structure of school subjects, there is nevertheless likely to be a link between them, although the precise nature of this link may be unclear. Third, it may be more useful to address the nature of the subject as an emergent whole rather than limiting discussion to elements of a curriculum. In this way, it is possible to focus upon recontextualising principles which highlight the link between discipline and curriculum more clearly than is afforded by detailed analyses which focus on a narrow range of curriculum content. Fourth, drawing on evidence provided by a range of research which distinguishes different models of curriculum, this chapter concludes that it is possible to discern broad principles of recontextualisation which give rise to two general forms of curriculum coherence: conceptual and contextual. Finally, this chapter has argued that different curriculum structures, and different forms of curriculum coherence, are likely to have important pedagogical implications.

Chapter 5: Review and critique of Bernsteinian and social realist approach

5.1 Introduction

This chapter concludes Part II of this thesis which has focused on ''knowledge in theory'. It acts as a pivotal point between engagement with and critique of extant theory and the development of a new theoretical perspective. Three key sections follow this introductory section. The second section takes stock of what progress has been made in the preceding chapters in addressing the project's aims and research questions. The third section presents a critique of Bernsteinian and social realist theory in relation to the aims of this project. It is argued that while sociocultural theory under-theorises the place of knowledge, Bernsteinian and social realist theory tends to neglect social relations to knowledge within epistemic contexts. In the final section, an investigate strategy is delineated which aims to address these theoretical issues. A rationale for a case study of the school science curriculum is outlined which provides the basis for exploring the significance of epistemic contexts.

5.2 Taking stock: the contribution of Bernsteinian and social realist theory

5.2.1 Review of the preceding chapters

The preceding chapters have built upon a set of practitioner questions which emerged from the context of FE to consider them in a much more general and abstract way.

Drawing on vignettes from practice, a number of concerns relating to the place of knowledge in the educational context were highlighted. Chapter 2 pointed to the complex and situated way in which diverse meanings may be attached to knowledge. A model for forms of knowledge in an educational context was established which placed knowledge at the centre of the educational process and which acts as a guide for this conceptual inquiry. An overall project aim was proposed which set out to explore ways in which students develop a 'relationship with knowledge', or how disciplinary knowledge becomes meaningful to students within and through formal educational contexts and how students can engage with this knowledge.

Given the initial starting point in the FE sector, it was fitting to draw upon research which explicitly addresses that context. The Transforming Learning Cultures project is significant as it was the first large research project to focus upon the traditionally under-researched FE sector (James & Biesta, 2007). Hodkinson *et al*. (2007b: 420) define a learning culture as "the practice through which people – students and tutors – learn". Chapter 2 acknowledged the insights that this focus on situated understandings in practice can provide. However, questions were also raised about the place of educational knowledge within this theoretical framework.

Chapter 3 considered theoretical approaches to educational knowledge more generally, initially focusing upon sociocultural approaches – the approach adopted within the Transforming Learning Cultures project – and then on Bernsteinian and social realist theories. This theoretical path was continued in chapter 4 which considered the nature of the school subject. My concern in chapters 3 and 4 was to explore approaches to theorising the educational context which placed a realist theory of knowledge at its centre. I argued that sociocultural approaches tend to under-theorise the place of knowledge within an educational context.

The previous chapters have also discussed some of the current debates and limitations surrounding Bernsteinian and social realist theory. These issues include: the tendency for knowledge structures within Bernstein's model to be idealised; uncertainties relating to how the epistemic relations to knowledge (i.e. what knowledge is about) may be explored; and, uncertainties regarding the relation between knowledge structures and curriculum structures. In relation to this last point, chapter 4 argued for the treatment of a curriculum structure of a school subject as an emergent whole rather than as a path of discrete knowledge components, and a model for the general principles of recontextualisation was explored.

5.2.2 A note about challenging orthodoxy

The literature reviewed in the previous chapters represents an important shift away from more orthodox forms of contemporary educational thinking. It is worthwhile to make some comments at this point about the commitments which underpin the social realist position and the notion of placing knowledge at the centre of the educational process.

Bernstein frequently remarked upon the tendency for his work to be 'misrecognised', or to be misread (Bernstein, 2000; Davies, 2001; Dowling, 2009). Similar misreadings are also possible in relation to the Bernsteinian and social realist approaches to knowledge discussed in earlier chapters. I have emphasised the key function of education as being concerned with the acquisition of knowledge. However, such a framing of the educational context is problematic for two key reasons. First, these viewpoints can appear to run counter to a progressive and learner-centred 'good practice' conception of teaching. Similar observations are made by Jenkins (2000: 13) and Alexander (2003) about the European concept of 'didactics' – broadly, the study of school subjects and the way that they are taught. Didactics usually employs a model of the didactic triangle of teacher, subject and student – the central element of the model for forms of knowledge that I have proposed. The problem, particularly in a UK context, is that the term 'didactic' is associated with a chalk-and-talk, transmission model of teaching and hence can appear not to be learner-centred, to be unsophisticated and even to be 'unfeeling'.

Second, there is a political aspect to a focus on knowledge which can easily be misinterpreted. This is not only the *subject* of the discussion in chapter 3, but it is a key impediment to its articulation and implementation in practice. A focus on knowledge can appear to be conservative or elitist. However, the social realist approach itself also critiques conservative and traditionalist approaches to curriculum content (Young, 2008a). Indeed, social realists argue that constructivist or progressivist approaches which seek to counter elitist and exclusionary approaches in fact may act to exclude particular groups of students from accessing 'powerful knowledge' (Young, 2008a).

It is argued here that without framing the educational context as being about students, teachers *and* knowledge, what occurs in classrooms tends to become detached from its educational purpose. Educational processes are then open to be usurped for other purposes. Further, a focus needs to be maintained on *what* students are learning in addition to and alongside how they learn, otherwise, among other things, we may not recognise differences in access to knowledge by different student groups. This is not to say that teaching cannot also be 'learner centred': it is not suggested that teachers should not also have a concern for their students and it does not mean to imply that teachers should ignore students' prior knowledge and experience.

It is important, then, that these two objections are borne in mind and the position taken in this thesis in relation to them are worth reiterating as part of the review within the current chapter since they challenge such enduring orthodoxies.

5.2.3 Review of the model for forms of knowledge

Chapter 2 discussed vignettes from practice which showed how teachers' and students' understandings of knowledge in particular contexts may be diverse, contextually contingent and may have a number of meanings. Curriculum is 'made' in a specific context rather than 'taken' (Bloomer 1997: 2). The central triangle of CONTEXT in the model for forms of knowledge (shown again in Figure 5.1 below) acknowledges the significance of constructed understandings and localised practices. In this model, the central triangle of context can be understood to encompass the notion of a 'learning culture' (understanding a "learning location as a practice constituted by the actions, dispositions and interpretations of the participants", Hodkinson *et al*., 2008: 34) – a sociocultural model.

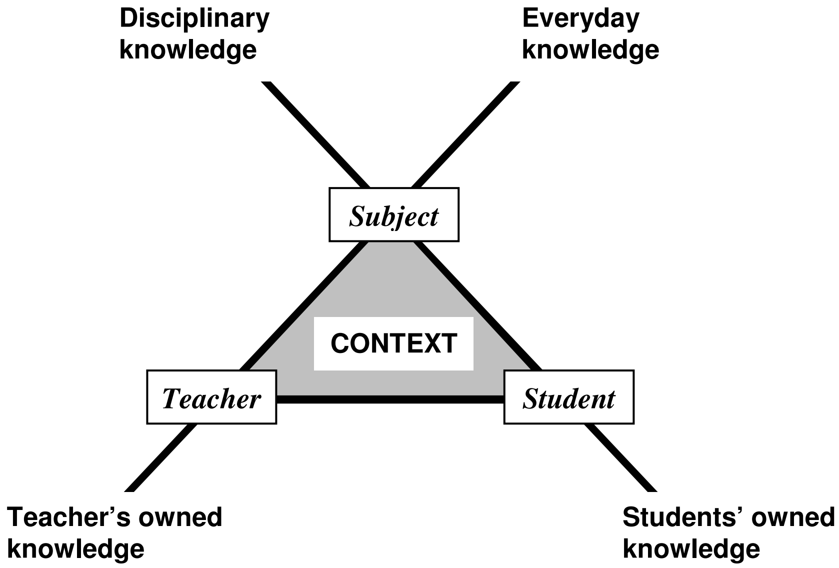

Figure 5.1. Model for forms of knowledge within an educational context (from chapter 2)

In order to view the learning context in terms of relationships with knowledge, however, the model also maps out a number of different forms of knowledge which are proposed to be relevant to the educational context. Bernsteinian and social realist theory provides some insight into the role played by forms of knowledge particularly within the top part of the model for forms of knowledge. I have also drawn upon this theory to address some of the limitations of sociocultural theory identified in chapter 2.

Bernstein's (1999) theory of knowledge discourses and knowledge structures theorises the difference between everyday and disciplinary knowledge. Bernstein's work has been extended by social realist theorists to explore implications for the curriculum of the differences between these forms of knowledge and how they articulate with each other (e.g. Ensor & Galant, 2005). This work has provided a principled account of different forms of knowledge within the curriculum and the place of disciplinary knowledge within it. This framework also provides the means by which approaches to curriculum which emphasise the inclusion of students' owned knowledge as curriculum – for example, as might be proposed in order to make the curriculum more relevant to students' interests – may be criticised.

Bernstein's (1990, 2000) theory of the pedagogic device and the arguments overviewed in chapter 4 problematise the relation between disciplinary knowledge and school subject. Chapter 4 discussed the nature of the link between disciplinary knowledge structure and curriculum structure, arguing that there must be a link between them. It was acknowledged that current theory does not provide a complete account of what the nature of this link might be. Implications for pedagogy of the importance of verticality within the curriculum were also discussed, which (only in part) addresses pedagogic issues and the central relation between subject, teacher and student within the model.

The theoretical frameworks which have been explored, therefore, provide some elaboration of the model in relation to the form and structure of the different types of knowledge. They also provide a useful means by which knowledge may be brought into the centre of discussion of an educational context. Deriving from Bernstein's (1990; 2000) imperative to explicitly focus on the voice of educational knowledge itself, social realist theory provides a realist theory of knowledge and a strong rationale for the disciplinary base of curriculum knowledge. This provides a starting point for exploring the way in which students develop relationships with disciplinary knowledge.

5.2.4 Review of the research questions

The preceding discussion has also gone some way towards addressing the research questions that I proposed in chapter 1. These research questions were as follows:

1. What is the place of disciplinary knowledge within formal educational contexts?

2. How does educational theory distinguish between disciplinary and other knowledge forms and how does it conceptualise their role within educational contexts?

3. What epistemological principles underpin the recontextualisation of disciplinary knowledge within the curriculum and how might these principles influence opportunities for the development of students' 'relationships with knowledge'?

4. Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students' relationships with knowledge in educational contexts?

5. What epistemological account can be given of the means by which students develop a relationship with disciplinary knowledge in educational contexts?
– and what are the implications for aspects of policy and practice?

Research question 1 has been partially addressed through an examination of knowledge forms and the development of a model for forms of knowledge. An answer to research question 1 is also particularly informed by the answer to research question 2. However, since research question 1 aligns with this project's aim of exploring how students develop a relationship with knowledge, it is only fully addressed once answers to all the research questions have been established.

Research question 2 has been addressed in chapter 3. It was argued that educational theory, and sociocultural theory in particular, frequently under-theorises knowledge within its conceptualisation of the educational context. Approaches to educational theory which adopt a relativist view of knowledge were contrasted with social realist theory which adopts a realist view and offers a principled account of the place of disciplinary and other knowledge forms within the curriculum.

Research question 3 has been partially addressed in chapter 4 which examined the recontextualisation of disciplinary knowledge to produce school subjects. A model for the principal modes of recontextualisation was proposed. I will return to this model later in this chapter.

Later in this chapter, an investigative strategy is proposed which aims to address the remaining research questions.

5.3 Critique: limitations of Bernsteinian and social realist theory and a return to sociocultural theory

The previous section discussed how Bernsteinian and social realist theory may provide some insight into the model for forms of knowledge and how it may be used to start to address some of the project's research questions. This section draws together some of the possible limitations of this theory and makes suggestions about how such limitations may be addressed. My purpose in this section and in the following section is to assess the extent to which the theory discussed in earlier chapters may provide a complete account in relation to my theoretical aims, to propose a strategy for exploring how this account may be made more complete and to map out a focus for future chapters.

5.3.1 Knowledge and social contexts

I will argue that the limitations of Bernsteinian and social realist theory primarily concern the account that is taken of the different communities and contexts which relate to the different forms of knowledge. All the different forms of knowledge distinguished in the model of forms of knowledge relate to different knowledge communities or communities of practice. Formal academic knowledge relates to the work of professional communities of researchers, the social practices of which, the social realists stress, are responsible for the 'powerful' nature of the knowledge that they produce. The other forms of knowledge in my model also relate to specific communities. Subject knowledge, or school knowledge, relates to the school community. Similarly, everyday knowledge is based in the wider, general community – within the horizontal discourses discussed by Bernstein (1999). Students' owned knowledge and teachers' owned knowledge may be based on communities relating to their own backgrounds and histories, local communities, social networks and personal interests. This owned knowledge, writes Paechter (1998) is "learned in a context and for a purpose" and "positions its possessor as an acting subject, able to use her or his knowledge in a dynamic way" (Paechter, 1998: 174). This form of knowledge may be distinguished from everyday knowledge since it is characterised by individual agency.

Applications of Bernsteinian and social realist theory tend to under-theorise distinctions between these communities. This neglect of the differences between communities perhaps becomes most apparent during discussions about the differences between a knowledge structure and a curriculum structure, explored in chapter 4. It will be recalled that Bernstein's initial position on the link between pedagogic and disciplinary discourse was to emphasise the differences between the school context and the context of the field of production. He referred to school subjects as 'imaginary subjects' whose logic could not be formally derived from the logic of the discipline (Bernstein, 1990: 184-185). As the previous chapter outlined, theorists such as Muller and Maton have argued that there must be link between knowledge and curriculum structure, since students' performance in the school context 'precurses' performance in other fields (Muller, 2007).

It does appear likely that there is link between knowledge and curriculum structure and it seems that Bernstein's position on this over-emphasises the discontinuity between them. As outlined in chapter 4, social realist theorists propose that the idea of 'verticality' within the curriculum is a useful one since it allows us to explore how students learn in a cumulative rather than in a segmented fashion. Such arguments aim to develop the idea that students need to be able to access knowledge in a way which is context-independent, and not bound to the context of acquisition.

I argue, however, that transporting ideas about vertical or horizontal knowledge structures into the field of reproduction may tend to flatten out aspects of what could be termed the different social and epistemic relations to knowledge in the two fields. These social and epistemic relations in the different contexts relate to the different epistemic practices, forms of meaning and agency of the participants in relation to the knowledge involved. Social realist theory emphasises the social context in relation to the field of knowledge production – the professional networks which contribute the objectivity of disciplinary knowledge. Philosophers of science such as Longino (1990; 2002) also provide strong support for such a position, clearly unpicking the assumptions behind the tendency of many writers to dichotomise rational (or cognitive) and social approaches to knowledge. Longino argues that epistemic practices are both cognitively rational and social. This social epistemological perspective, however, is limited by social realists to the field of knowledge production and a similar analysis is not extended to the fields of recontextualisation or reproduction.

Let me explain this further by referring to Wheelahan's (2007a,b) discussion of the importance of students' access to theoretical knowledge in relation to the a competence-based curriculum. Wheelahan draws extensively on the theory of critical realism in order to demonstrate how such a curriculum, in emphasising the instrumental, contextual and situated nature of knowledge, denies students' access to the underlying principles of knowledge. She suggests that such curricula lead to atomised and aggregative notions of knowledge and skill, since the conception of knowledge which underpin them omits an analysis of generative mechanisms and their emergent outcomes. This produces a 'flat ontology' which tends to reduce knowledge to experience (Wheelahan, 2007a). Wheelahan's explication of this argument, which draws upon concepts from critical realist theory, is worth quoting at length. Wheelahan proposes that:

> focusing on the knowledge and skills that people need to 'do' their job, and by insisting that assessment be *directly aligned* with these outcomes, CBT [competence based training] collapses the domain of the real (of generative mechanisms) and the domain of the actual (where events take place) into the domain of the empirical (that which is observable). It does so because CBT assumes that outcomes can be achieved by directly teaching to the outcomes, and in doing so ignores the complexity that is needed to create *capacity*, and this goes beyond the level of experience in the contextual and situated. Teaching and learning must engage the real and the actual, and not just the empirical, because this is the only way to generate a varying and contextually sensitive performance in a variety of contexts. In contrast, CBT breaks skills down into discrete components, which can be packaged as competencies, then added up, moved about and reconfigured to make different qualifications, through common core competencies (and now employability skills). That is, the total equals the sum of the parts. This is the method that *aggregates*, and is less concerned with understanding the *relationship* between elements, and how these elements are transformed in the context of such a relationship.
>
> (Wheelahan, 2007b: 648-649, emphasis in original)

In a similar way, I suggest that a 'depth ontology' is also important in terms of the social relations to knowledge. This would acknowledge the different social contexts which relate to the different forms of knowledge and recognise the different status that knowledge has in the different contexts. At first sight it could be argued that the position that I highlight here reduces to the view advanced by Wheelahan. Her emphasis, however, is on students' (who are located in a particular context) access to knowledge and its generative mechanisms. In contrast, my emphasis is upon the generative mechanisms which are located in different contexts. The two views are thus complementary.

The significance of social context – or more precisely, the significance of the social epistemic context – does not seem to be taken into account in, for example, Muller's (2007) analysis of verticality in the school curriculum in relation to mathematics. As chapter 4 pointed out, this analysis focuses on parts of the curriculum which students may need to cover – the "specifiable necessary minimum set of steps that must be pedagogically traversed" (Muller, 2007: 82). Such an analysis does not appear to account for the differences in the contexts in a number of ways. First, it does not recognise the possibility that knowledge may take on different meanings within the different contexts – such as those discussed in chapter 2. Second, it does not explore the ways in which 'we' are conscious of a vertical knowledge structure and what role this plays in knowing. Bernstein's theory of knowledge structures is a relatively easy proposition to accept in the abstract: the idea that there may be essentially two main types of knowledge structure which have the characteristics that Bernstein describes is more straightforward than delineating exactly what those knowledge structures are in relation to specific subjects. What actually *is* the knowledge structure of physics, of English, or of educational research, for example? Is the nature of this structure the same for all those who may consider these subjects or disciplines, and, more significantly how are 'we' (students, teachers, researchers, others?) aware of it?

In discussing the nature of verticality, Christie *et al*. (2007) suggest that it "may be that all knowledges are virtual, and come to light only by conscious effort on the part of pedagogic recontextualizers" (Christie *et al*., 2007: 249). This points to the possibility that the concept of verticality in relation to specific subjects or disciplines may be in part tacit, remaining in some indeterminate state, waiting to be called upon for a specific purpose in order to be realised, to be made real. Such an observation calls into question the assumption that 'structure' exists in one form and that it is equally applicable in all contexts.

Third, as I have also observed in chapter 4, some discussions of verticality and also, for example, Maton's (2004, 2006, 2007) exploration of knowledge and knower structures, does not appear to wholly account for the curriculum as a coherent and emergent level itself. This is a key consequence of the flattened ontology that I suggest underpins some of these analyses. What I attempted to show in chapter 4 was that it was possible to describe a mechanism for the emergence of curriculum structure which was neither wholly drawn from disciplinary knowledge structure nor accounted for by arbitrary social constructionist principles. I did this by exploring broad principles for the ways in which knowledge is recontextualised: as conceptually or contextually coherent. I will return to this idea later in this chapter.

The above discussion has emphasised the importance of the difference between the contexts of the fields of production, recontextualisation and reproduction, and similarly, the difference between the communities relating to the different forms of knowledge within my model. In chapter 3 I discussed sociocultural theory – specifically situated and communities of practice theory – and raised questions about how these theories address the nature of knowledge. I suggested that such theories frequently neglect the differences between forms of knowledge. Given the reservations that I have outlined in relation to Bernsteinian and social realist theory, which does acknowledge the differences between forms of knowledge, it is suggested that attention needs to be paid to the nature of different communities as *epistemic* communities. I will now examine how this notion relates to these theoretical positions and debates.

5.3.2 The significance of epistemic communities

Social realist theorists and those developing Bernstein's later work frequently refer to problems concerning the ways in which different forms of knowledge 'articulate' with each other (Ensor & Galant, 2005). As I have discussed, framing the problem in this way can tend to flatten out the different social epistemic relations within the different knowledge communities. It may be useful, therefore, to view the problem as being concerned with the way in which different *knowledge communities* or *epistemic communities* articulate with each other, rather than to focus upon how one form of knowledge articulates with another.

Such an approach recalls research carried out within a sociocultural tradition. For example, Lemke's (2001) paper *Articulating communities: sociocultural perspectives on science education* focuses upon student identities, the importance of "social, economic, historical and technological contexts" (p. 300) and the multiple discourse demands that are placed on students. However, because Lemke does not adopt a realist theory of knowledge, there is no scope for the particularly epistemic nature of the communities to be brought into focus. Lemke is in part reacting against conceptual change approaches to science education research. He characterises this research tradition as focusing upon a model of students engaged in a decontextualised process of 'rational choice'. Lemke points out the limitations of this view, emphasising the embodied and situated nature of learning, asserting that it is a:

> … falsification of science to pretend to students that anyone can or should live by extreme rationalist principles. It is often unrealistic even to pretend that classrooms themselves are closed communities which are free to change their collective minds. Students and teachers need to understand how science and science education are always a part of larger communities and their cultures, including the sense in which they take sides in social and cultural conflicts that extend far beyond the classroom.
>
> (Lemke, 2001: 310)

However, while I agree that contextual issues are important, there are conflicts between Lemke's view and a realist and social realist perspective. For example, there is little discussion in Lemke's paper about how or why science is 'falsified' in this way in relation to actual scientific discourse. Lemke suggests that school science represents a middle-class, European-dominated sub-culture; a view which recalls the 'voice discourse' approaches critiqued by Moore & Muller (1999). This view fails to recognise the status of scientific knowledge as powerful knowledge (Young, 2008a), tending to cast scientific discourse as only one discourse among many without considering the grounds upon which one discourse may be considered to be more adequate in certain circumstances than another. This is not to deny the significance of culture and class differences in students' engagement with science (Osborne *et al.*, 2003a) or with other academic disciplines; rather, I suggest that, from a social realist perspective, questions about the articulation of knowledge communities should not be reduced to only being concerned with cultural or class differences.

As I have discussed, Lemke contrasts an individual, 'rationalist' conceptual change approach with a sociocultural approach which (in terms of science education) he describes as "viewing science, science education, and research on science education as human social activities conducted within institutional and cultural frameworks" (Lemke, 2001: 296). I have already briefly referred to the distinction between conceptual change and sociocultural or participationist approaches in chapter 3. Citing Hodkinson *et al.* (2008), I pointed to problems relating to a dualist approach to such issues. The distinctions between conceptual change (or cognitive) and sociocultural approaches and the possibilities for bridging between them have been the subject of recent research (e.g. Mason, 2007; Hodkinson *et al*, 2008; Tobin, 2008). Some writers suggest that the two approaches might not represent such a duality as sometimes might be supposed and that sociocultural researchers do not necessarily hold relativist, postmodern views of knowledge, such as that which is implied by Lemke (Mercer, 2007). Some researchers also suggest that neither one nor the other conceptualisation is sufficient on its own (Sfard, 1998; Mercer, 2007).

A key challenge for sociocultural and conceptual change explanations lies in theorising the transfer of learning from one context to another. Vosniadou (2007: 55) observes that "neither the cognitive nor the situated perspectives can explain all the empirical evidence around the problem of transfer". The notion of segmented learning and issues surrounding students' acquisition of context-independent knowledge which preoccupy social realist researchers also indicates a concern which the problem of transfer. For learning to be cumulative in Maton's (2009) conceptualisation, students are able to "transfer knowledge across contexts and through time" (p. 45). Further, Maton suggests that "cumulative learning depends on weaker semantic gravity and segmented learning is characterised by stronger semantic gravity constraining the transfer of meaning between contexts" (p. 46). It appears that social realists' discussion of verticality and Maton's notion of cumulative learning align to some extent with a conceptual change approach. As such, they may be susceptible to criticisms and uncertainties similar to those which feature in the debate concerning participationist (or sociocultural) versus conceptual change approaches.

These uncertainties primarily concern the role of different contexts *as epistemic contexts* and the situated nature of meaning-making. Recall, for example, Lave & Wenger's (1991) questions relating to the communities of practice that high school physics students may be engaged in. They ask whether students are engaged in reproducing the discipline of physics or in reproducing the high school itself. This distinction and Lave & Wenger's critical question about the differences between talking *about* a practice and talking *within* it (pp. 106-107) are intimately related both to the problem of transfer and to the problem of differences between epistemic communities. Such questions appear to remain unaddressed within the conceptual change approach and within approaches such as Maton's within the social realist body of research, indicating that further attention needs to be paid to the role of different communities.

While I do not claim that it is straightforward to somehow resolve all the differences between these different research traditions, I do suggest that given the problems that have been highlighted here and elsewhere, an alternative conceptualisation which emphasises the articulation between different epistemic communities may be a useful way forward. Such an approach, unlike that of Lemke (2001) focuses upon the epistemic nature of the community. It also loosely relates to what has been termed a 'social epistemology' (e.g. Goldman, 2002) in that it emphasises the social dimensions of knowledge and knowing rather than a solely individualistic or cognitive approach.

In summary, I therefore propose to explore how a social realist theory of educational knowledge can account for the significance of different contexts, particularly the epistemic nature of those contexts. This proposal signals an intention to return to some aspects of sociocultural theory, a theory which does acknowledge the significance of context.

This theoretical agenda aligns with my fourth research question: 'Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students' relationships with knowledge in educational contexts?'. I suggest that these aims may be addressed by considering the processes by which different epistemic communities articulate with each other. I will take these questions forward in chapter 7 where I explore the significance of different epistemic contexts and discuss how such an analysis may provide a more complete account in relation to my model for forms of knowledge. Such a discussion, however, is best illuminated in relation to a specific epistemic context – as I have previously discussed in relation to Bernstein's notion of knowledge structures, there is an important difference between discussion in the abstract compared with an exploration of specific disciplines or subjects. Furthermore, Bernstein and social realist theorists tend to ignore the epistemic relation – what knowledge is about. I therefore propose to carry out a case study of the school science curriculum. In the next section, I outline a rationale for this approach in relation to existing research in the field of Bernsteinian and social realist theory.

5.4 An investigative strategy: rationale for a case study

The previous chapter explored the broad principles of recontextualisation of disciplinary knowledge. It was suggested that there are two principal modes: conceptual and contextual curriculum coherence. The next chapter examines a case study of the recontextualisation of science in the UK school curriculum which are illustrative of these modes of recontextualisation. The emergence of 'scientific literacy' approaches within the curriculum will be examined and a comparison made with traditional approaches. What are frequently referred to as 'traditional approaches' may be aligned with a model of conceptual coherence. New curriculum initiatives which aim to develop students' scientific literacy, by contrast, may be cited as a good example of the application of the principle of contextual coherence.

In the section below I outline a rationale for carrying out this case study in order to develop my theoretical argument. First, it is explored as a form of theorising in terms of the application of a 'language of description'; second, I discuss what may be gained by selecting science as the subject of the study.

The notion of the ‘language of description’ is a central aspect of Bernstein’s mode of theorising and is a key conceptual tool for those engaged in research which builds upon Bernstein’s work. Underpinning the concept of the language of description is a concern with the way in which theory (an ‘internal language of description’) relates to the empirical (which provides the basis for an ‘external language of description’). Bernstein proposed that:

> a language of description is a translation device whereby one language is transformed into another. We can distinguish between internal and external languages of description. The internal language of description refers to the syntax whereby a conceptual language is created. The external language of description refers to the syntax whereby the internal language can describe something other than itself.
>
> (Bernstein, 2000: 132)

Moore (2006) provides a useful overview of the concept and emphasises the function of the language of description as a generative theory which mediates between the theoretical and the empirical and avoids some of the problems of theoretical circularity associated with an ‘ideal types’ mode of theorising (Bernstein, 2000). A generative theory centres around the identification of certain general principles, which thus develops the “capacity to point beyond what is to what is possible, but as yet unrealized. It engages with the world by acknowledging what is absent from it through a modelling of what is present” (Moore, 2006: 35).

The approach taken in this thesis in relation to a language of description is very broad and general compared to some researchers' detailed specifications for internal and external languages of description (e.g. Morais & Neves, 2001). Rather, it aligns with approaches adopted by Young (2008b) and Muller (2009), reflecting perhaps the level of conceptual development (broad rather than detailed). The model of principles of recontextualisation (conceptual and contextual coherence, which is also in part derived from Maton and Muller's work) is proposed as a broad language of description (an internal language), which will be applied to curriculum developments in school science (an external language). This provides a generative theory which allows for an investigation of its realisation in practice.

The subject of the case study is an academic subject. This contrasts with previous research within the field of social realist theory which has, through a number of studies, concentrated for the most part upon curricula relating to vocational or craft knowledge (e.g. Gamble, 2001, 2004, 2006; Young, 2006; Wheelahan, 2007a,b). This provides a useful contrast since the natural sciences, including physics, are frequently cited as the paradigm case of hierarchical knowledge structures and are typical cases of what Bernstein termed 'singular' forms of academic knowledge: "knowledge structures whose creators have appropriated a space to give themselves a unique name, a specialised discrete discourse with its own intellectual field of texts, practices, rules of entry, examinations, licenses to practice, distribution of rewards and punishments" (Bernstein, 2000: 52). Of course, school science, however, encompasses the three main singulars: physics, chemistry and biology. Vocational subjects, by contrast, are derived from 'regions': singulars which have been recontextualised towards the field of practice. Arguably, considering singular modes rather than regions avoids the complications associated with the 'double recontextualisation' which needs to occur with regions. As Barnett (2006) points out, when vocational areas are recontextualised both disciplinary knowledge and the field of practice needs to be translated into curriculum. In this way, problems relating to the context-dependent and context-independent aspects of the curriculum are made more complicated. For example, in relation to a Health and Social Care curriculum, Barnett asks "how… in terms of pedagogic strategy, do you link the worlds of bedsores and lifting-and-turning techniques with those of Biology, Psychology and Sociology?" (Barnett, 2006: 152). Those developing such curricula must engage with problems concerning how the curriculum can 'face both ways', providing students with opportunities for both occupational and academic progression, a problem which is also explored by Wheelahan (2007a,b) and Muller (2009). Although my discussion of a subject derived from disciplinary singulars also shares some of these concerns, the recontextualising process has different work to do in relation to regional and singular fields for the reasons outlined above.

Another consideration which distinguishes science subjects from vocational subjects and subjects which derive from horizontal knowledge structures concerns the problem of verticality. In Wheelahan's (2007a,b) analysis of vocational curricula and in Christie & Macken-Horarik's (2007) discussion of English, for example, a key concern is the emphasis on developing verticality within the curriculum. Exploring the nature of verticality may be a slightly different task in relation to scientific subjects since they – arguably – already possess a strong vertical structure. In other words, it might be supposed that an analysis of how curricular verticality might be developed may not be as necessary since the vertical structure already exists – although I have already made some comments earlier in this chapter about how such a vertical structure is realised. Most of all, perhaps, this issue relates to the complexity of the process of recontextualisation. It could be the case that current social realist analyses of curriculum, because they are largely focused on vocational knowledge and skills and on originating disciplines which have a horizontal knowledge structure, tend to be most concerned with the development of vertical knowledge structures in the curriculum in order to promote the social equity agenda that they rightly support. However, if a more detailed analysis is made of an originating discipline which 'already has' a hierarchical knowledge structure, such as the sciences, more insight may be gained into the mechanism of recontextualisation from a social realist perspective.

Finally, it is also worth noting that the subject of physics is, happily, widely cited as an example by Bernstein, Lave & Wenger and others in their discussions. This is probably due to its widely acknowledged strong hierarchical structure and identity as the most 'high status' and most theoretical form of knowledge within the sciences. It is also, however, important to be aware of the limitations of such claims: as O'Halloran (2007) points out, even physics is likely to consist of some aspects of a horizontal knowledge structure. Furthermore, such accounts of the subject are significantly based around practitioners' own (possibly subjective or possibly determined by the disciplinary 'culture') beliefs about their subject – an issue that I also explore in more detail in chapter 7. An example of this may be Rutherford's famous quip that "All science is either physics or stamp collecting" (Blackett, 1962: 108) – a statement which recalls Bernstein's (1971) notion of classification and framing in more ways than one. Such beliefs may account for the enduring rivalries and claims to knowledge 'purity' and importance which exist between members of different scientific communities.

5.5 Conclusion

This chapter has reviewed progress made in the thesis so far in elaborating upon the model for forms of knowledge and in addressing the project's research questions. I have argued that Bernsteinian and social realist theory, unlike sociocultural theory, provides a theoretical place for knowledge in the educational context (and disciplinary knowledge in particular). However, I have suggested that Bernsteinian and social realist theory is limited in the extent to which it recognises the significance of the different social and epistemic contexts associated with different forms of knowledge within the model for forms of knowledge. The theory does not appear to sufficiently address the curriculum as a separate emergent level and tends to flatten out the social and epistemic relations between contexts. I therefore suggested that rather than thinking in terms of the articulation of different forms of knowledge, it may be more useful to consider the articulation of different knowledge communities, or different epistemic communities.

It was proposed that a case study of the school science curriculum as an application of the language of description of conceptual and contextual coherence may serve to explore how the limitations of Bernsteinian and social realist may be addressed. This case study will provide for a focus upon the educational context as an emergent level and will also address the question of the relation between knowledge and curriculum structures in relation to a specific area of knowledge. As I pointed out, selecting science as a case study contrasts with previous research which has primarily focused on vocational or craft knowledge. In this chapter I have again returned to consider some aspects of sociocultural theory, now suggesting that both sociocultural and social realist accounts are incomplete. In future chapters, I discuss how a social realist theory of knowledge may be located within a sociocultural theory of different epistemic contexts.

The next two chapters are broadly structured as follows. Chapter 6 examines the school science curriculum as a case study, focusing on the debates within the field concerning scientific literary and traditional approaches. I explore the nature of these debates and the basis upon which they claim that the 'rival' approach "isn't really science". This raises the important issue of the nature of authenticity. These concerns are taken forward in a more general way in chapter 7 which examines the significance of the difference between the contexts of disciplinary science and school science for discourse and practice. In focusing upon school science as a case study and in exploring the significance of different epistemic contexts, I seek to address research questions 4 and 5.

PART III – KNOWLEDGE IN CONTEXTS

Chapter 6: A case study of the debate concerning traditional and scientific literacy approaches in the school science curriculum

6.1 Introduction

This case study focuses upon a pervasive theme within the reform of the science curriculum (Donnelly, 2005: 294) which historical analyses suggest is a fundamental and enduring motif in science curriculum reform (Solomon, 1994; Laugksch, 2000; Donnelly, 2002; 2004; Turner, 2008; Jenkins, 2009; Schulz, 2009). This theme involves the principles upon which science is recontextualised within the curriculum: a 'traditional' approach which focuses on scientific knowledge itself versus a 'scientific literacy' approach which focuses on "situations in which science can legitimately be seen to play a role in other human affairs" (Roberts, 2007: 729). It will be argued that recent developments in the school science curriculum in the UK represent a clear example of the operation of these principles and provide a means to explore the theoretical language of description of curricular conceptual and contextual coherence.

The next section briefly outlines the scope of the case study examined in this chapter. The following section engages with the background of reform in terms of the perceived failures of the traditional science curriculum and other criticisms which are employed by some reformers to provide a rationale for alterative approaches. Ways in which scientific literacy has been defined are then explored, focusing on the UK context. Section five then analyses the debate concerning these curriculum models, with specific reference to recent science curriculum development in the UK. Section six explores how traditional and scientific literacy approaches align with the model of conceptual and contextual coherence. The final sections draw out what is significant about objections to traditional and scientific literacy curriculum models, focusing upon arguments concerning the nature of science and the authenticity of science in the curriculum. The concluding section summarises what can be learned from the case study which will be brought forward in future chapters.

6.2 Scope of the case study

The case study presented here refers largely to specific reforms within the UK school science curriculum. However, as many writers have remarked, the innovations within the science curriculum that I will describe are international phenomena (McEneaney, 2003; Tytler, 2007; Jenkins, 2009). Laugksch (2000: 71) observes that scientific literacy has become "an internationally well-recognized educational slogan, buzzword, catchphrase, and contemporary educational goal". So while some aspects of the reforms may be distinctive to the UK, similar initiatives may be found elsewhere (see Lynning, 2007: 481).

The focus in the case study is upon science rather than specifically being concerned with physics, chemistry or biology. Jenkins (2009) remarks upon the tendency within research and in policy documents to discuss science as a whole and not its constituent subjects. He rightly points out that there are important distinctions to be made between the sciences, in addition to their focus on different aspects of the natural world: differences in the role of observation and experiment, and linguistic differences for example. While it is important to bear such distinctions in mind, I suggest that it is sufficient for current purposes to discuss science as a unified area. This is because a section of the curriculum that I discuss is labelled as science within the curriculum and does not necessarily distinguish between them. Second, it can be argued that there is enough, particularly at school level, and arguably at pre-university level, that unifies the sciences in comparison with other subjects. In other words, in Bernstein's (1971) terms of classification and framing, the classification and framing of science is sufficiently strong in comparison with other subjects. Nevertheless, it should be recognised that this is a significant consideration for analyses of science at other, higher levels. However, physics is generally taken as the paradigm case of science and of hierarchical knowledge, and if any specific science is in mind in this case study it is this one.

The scope of this case study is therefore located within what can be argued to be a fundamental theme in science curriculum reform, which is enduring, international and also cyclical in nature. It is illustrated by recent developments in the UK context.

6.3 The traditional science curriculum: arguments for change

The rationale for the introduction of scientific literacy approaches, perhaps inevitably, centres around two key sets of arguments. One set of arguments concerns the way in which existing or traditional science curricula are seen to fail in respect of the purposes of the science curriculum. We must be cautious, however, in making assumptions about the 'purposes' of the curriculum, since this is more problematic than it might first appear – I return to this issue in a later section. The other set of arguments relates to the benefits which are provided by a curriculum based on a scientific literacy approach which seeks to address the perceived shortcomings of traditional approaches. I discuss these benefits in the following section.

6.3.1 Crisis in science education

Writers discussing the inadequacies of traditional science curricula frequently refer to the ongoing 'crisis' in science education in the UK, Australia, the United States and most other developed countries. Tytler (2007: 7) suggests that there are four main elements to this crisis in science education:

- evidence of students developing increasingly negative attitudes to science over the secondary school years;
- decreasing participation in post-compulsory science subjects, especially the 'enabling' sciences of physics and chemistry, and higher mathematics;
- a shortage of science-qualified people in the skilled workforce;
- a shortage of qualified science teachers.

I will make some comments on each of these elements in relation to the UK context.

The international comparative study, the Relevance of Science Education (ROSE) project (Sjøberg & Schreiner, 2005), highlights the low popularity of science courses amongst students compared with other school subjects. Research in the UK (Jenkins & Pell, 2006) concurs with the international ROSE study, reporting that many students think that science is 'important, but not for me' (Jenkins & Nelson, 2005). These studies also point to the marked contrast between students' attitudes in developed and developing countries, where a significantly greater number of students in developing countries do express an interest in science and scientific careers. Other studies remark upon the way in which students' attitudes vary between the different sciences, pointing out that while "biology, particularly human biology, was relevant and pertinent, addressing pupils' self-interest in their own bodies and concerns about health and disease, the relevance of the physical sciences was difficult for students to identify" (Osborne *et al.*, 2003a: 1061). Osborne *at al.*'s (2003a) study also highlights the periodic table of the elements as a particularly unpopular aspect of the chemistry curriculum since students perceived that it was not relevant to their everyday lives.

A particular concern is the way in which students' attitudes to science change upon transition from primary to secondary school, which "diminishes at secondary level to a degree which cannot wholly be accounted for by the onset of adolescence" (Millar & Osborne, 1998: 2005). Many students also perceive science to be more difficult than other subjects (Osborne & Collins, 2001; House of Lords, 2006; Jenkins & Pell, 2006) and a number of studies show that girls are more negative about the physical sciences than boys (Osborne, 2008).

Statistics relating to the participation of students in science courses in the UK do indeed appear to provide evidence of some kind of crisis, and this has been a cause for concern for some time (House of Lords, 2006). For example, the Royal Society's recent 'State of the Nation Report' (Royal Society, 2008) highlights that as a proportion of total entries, the percentage of students following A-level biology fell from 7.2% to 6.5% between 1997 and 2007. Over the same period, entries for chemistry fell from 5.5% to 4.9% and for physics it fell from 4.3% to 3.3%.

The Royal Society's report identifies that, among other things, the factors which predict whether students will study science post-16 include students' prior attainment at GCSE level and whether students have studied separate sciences, rather than a combined course. As Pring *et al*. (2009) point out, the decline in student numbers at A-level has implications for higher education, with a number of university physics and chemistry departments closing in the past few years due to lack of demand. Pring *et al*. (2009) also suggest that this situation has a negative impact on the supply of science graduates available to teach in schools. The lack of suitably qualified teachers in the sciences, and in the physical sciences in particular (Royal Society, 2007; Smithers & Robinson, 2008) has other potentially damaging effects, such as physics courses being taught by non-specialists due to a particular shortage in the number of teachers qualified to teach physics.

Each of the above factors are linked, and, some would argue, inevitably lead to a shortage of suitably trained personnel in the workforce in order to serve the needs of the economy – discussed in the UK context by the Roberts Report (Roberts, 2002). Nevertheless, it is worth noting that some commentators observe that science education appears to be a 'fairly permanent state of crisis' (The Sigma Scan/Outsights-Ipsos MORI, 2009). Shamos (1995) for example, discussing science education reform in the United States (although much of the discussion could equally apply to the UK), argues that such 'crisis-talk' (Schulz, 2009) is to a significant extent engineered by governments, professional bodies and other interested parties in order to promote their own political ends. Shamos suggests that the predicted negative consequences for the economy rarely occur and that any skill shortages within the workforce will resolve itself by the adjustment of salaries within the marketplace of supply and demand. However, Osborne *et al*. (2003a) argue that while such points may be legitimate:

> (a) they are insufficient to allay the concern, and (b) … a modern society where society and technology is a prominent and important aspect of the society can ill afford to produce nearly three times … as many arts and humanities specialists as it does science specialists.
>
> (Osborne *et al*., 2003a: 1052)

6.3.2 Criticism of traditional science curricula

I will now turn to more specific arguments which are advanced by scientific literacy proponents concerning the manner in which scientific knowledge is presented in traditional curricula. A key criticism concerns the nature of the 'content' of the traditional science curriculum. A number of observers have suggested that the curriculum contains too much content such that the emphasis is upon the acquisition of facts rather than on understanding. The result, according to the House of Lords Select Committee on Science and Technology, is "the common perception among children that science is both difficult and dull" (House of Lords, 2000: 6.14). This emphasis, argues Osborne (2007a), is based on an underlying assumption within the curriculum that it serves the needs of the future scientist, since:

> entering into the practice of science requires a long apprenticeship in which the conceptual foundations of the domain are acquired. For, as scientific knowledge is cumulative each generation builds on the discoveries of its forebears requiring each generation to learn more and more.
>
> (Osborne, 2007a: 173)

It is suggested that the outcome, therefore, is frequently a pedagogy based on transmission where teachers dispense knowledge rather that facilitate learning (Osborne, 2007b). Osborne & Dillon (2008: 8) argue that this has the effect of producing a fragmented curriculum which obscures for students a sense of overarching coherence and meaning. Within such a curriculum, therefore, students learn the products of science rather than engaging with its processes. The curriculum forms what Schwab (1962) famously termed a 'rhetoric of conclusions', which "portrays scientific knowledge as objective and true, in a positivistic sense, versus portraying that knowledge as a series of claims evaluated by interpreting data and by impeaching alternative interpretations" (Bricker & Bell, 2008: 474-475). This paints a picture of students who are compelled to engage with, and also to memorise, a series of dry facts without engaging with their meaning. In order to support this view, Osborne (2007a: 174) quotes the nineteenth century experimental biologist Claude Bernard who asserted that: "science is a 'superb and dazzling hall, but one which may be reached only by passing through a long and ghastly kitchen.'"

In addition to criticising the amount of content contained in traditional curricula, many writers draw attention to the nature of the content. This content, it is argued, is not relevant either to students' interests and concerns or to contemporary science. For example, Aikenhead proposes that:

> Most research into the science curriculum concluded that school science transmits content that is socially sterile, impersonal, frustrating, intellectually boring, and/or dismissive of students' life-worlds...
>
> (Aikenhead, 2007a: 886)

Research concerning students' attitudes to science has explored which aspects of science students *are* interested in. The outcomes of such questions are indicated by the following quotations from a study within the English strand of the ROSE project. Table 6.1 below shows the top five topics that school age children reported that they would like to learn:

Boys	**Girls**
Explosive chemicals How it feels to be weightless in space How the atom bomb functions; Biological and chemical weapons and what they do to the human body; Black holes, supernovae and other spectacular objects in outer space.	Why we dream when we are sleeping and what the dreams might mean Cancer – what we know and how we can treat it How to perform first aid and use basic medical equipment; How to exercise the body to keep fit and strong; Sexually transmitted diseases and how to be protected against them

Table 6.1 The top 5 items boys would like to learn about in science and the top 5 for girls (from Osborne & Dillon, 2008: 16)

This suggests that students' preferences are highly gendered, with female students preferring more "human related content" (Osborne & Dillon, 2008: 16) which is under-represented in traditional curricula.

It is also argued that the content of school science curricula is out of step with contemporary science, focusing rather on eighteenth, nineteenth and twentieth century achievements and technologies (Tytler, 2007). School science appears to be different to scientists' science: one of the participants in Baggott la Velle *et al*.'s (2004) study of science teachers' use of ICT asks, "why are we still boiling beakers of water with Bunsen burners?" (p. 116). Other examples of outdated curriculum content are the inclusion of the blast furnace (used for extracting metals from their ore) or the Haber process (the industrial manufacture of ammonia) in the curriculum. Osborne & Collins (2001: 449) report that students are unable to see the purpose of such topics since they are not perceived to be relevant to their lives. These industrial processes are also no longer quite so vital to the British economy. Contrasts may be drawn between those topics and the kind of science which is reported in the media - astrophysics, neuroscience or molecular genetics, for example (Osborne & Dillon, 2008: 8).

6.4 Scientific literacy approaches

The previous section outlined some of the criticisms that have been made of the traditional science curriculum. In this section I discuss the rationale for scientific literacy approaches and explore the ways in which the notion of scientific literacy is defined.

6.4.1 Defining scientific literacy

Overviews of the concept of scientific literacy and its historical development frequently draw attention to the diverse range of definitions of the term and the vague sets of meanings which have been attached to it (DeBoer, 2000; Laugksch, 2000; Dillon, 2009; Holbrook & Rannikmae, 2009). Some commentators have suggested that this has rendered the notion of scientific literacy to be meaningless and that it merely becomes a slogan for science education. The outcome is thus that "to speak of scientific literacy is simply to speak of science education itself" (DeBoer, 2000: 582) or that it becomes an aspirational statement about "what the general public ought to know about science" (Durant, 1993: 129 quoted in Millar, 2006: 1501).

Unlike the many other 'literacies' which are increasingly common within educational talk today, the term scientific literacy has a longer history. It was first employed by Hurd (1958) in a post-Sputnik American context, in relation to the questions "that satellites, rockets and missiles have focused in the American mind" (p. 14) concerning technological advancement and the availability of trained personnel. However, as Shamos (1995) observes, concerns about the public's knowledge of science can be traced back to at least the beginning of the last century.

During the 1970s and 1980s the term 'scientific literacy' became more closely associated with the social context of science – the STS (Science, Technology and Society) approach to science education. Although there are many varieties of STS course, the approach engages with the need for 'citizen science', a focus which emerged from concerns about social responsibility, environmentalism, social action and the sociology of science (Solomon & Aikenhead, 1994; Aikenhead, 2003; 2006).

The STS approach is strongly associated with what many writers refer to as 'humanistic' approaches to science curricula (e.g. Donnelly, 2004), which emphasise the role of the autonomous self, an engagement with open-ended questions and a concern with human purposes and ethical issues. STS approaches therefore are distinguished by the notion that social issues and not disciplinary content should be employed as an organising principle of science teaching. As DeBoer (2000: 588) observes, this makes such proposal for reforms based on STS principles controversial.

Other writers have proposed a definition of scientific literacy which relates more specifically to the 'fundamental' sense of literacy (Osborne, 2002; Norris & Phillips, 2003). In particular, Norris & Phillips (2003) argue that students' ability to analyse and interpret texts is a key aspect of scientific literacy since science could not exist as an oral tradition. Literacy, they argue is central to scientific literacy.

A useful contemporary definition of scientific literacy which is receiving much attention in the science education literature has been suggested by Roberts (2007) in the 2007 *Handbook of Research on Science Education*. I have already referred to this definition in chapter 4 of this thesis. Roberts suggests that there is a "continuing political and intellectual tension that has always been inherent in science education itself" which arises from the "role of two legitimate but potentially conflicting curriculum sources: science subject matter itself and situations in which science can legitimately be seen to play a role in other human affairs" (p. 729). He also notes that within the literature an increasing polarisation between the two extremes is evident. Roberts refers to these two extremes as *Vision I* and *Vision II,* where each idealised vision represents a broad analytical category. The two visions for science education are defined as follows:

> Vision I gives meaning to [scientific literacy] by looking inward at the canon of orthodox natural science, that is, the products and processes of science itself. At the extreme, this approach envisions literacy (or, perhaps, thorough knowledgeability) *within science.* … Against that, Vision II derives its meaning from the character of situations with a scientific component, situations that students are likely to encounter as citizens. At the extreme, this vision can be called *literacy* (again, read *thorough knowledgeability) about science-related situations* in which considerations other than science have an important place at the table.
>
> (Roberts, 2007: 730, emphasis in original)

The definition provided by Roberts is useful because it provides a "heuristic framework for understanding the defining ideologies of scientific literacy" (Aikenhead, 2007b: 1). Although Roberts refers to both Vision I and Vision II as models of scientific literacy, for the purpose of this thesis, Vision I is characterised as a 'traditional approach' while Vision II is referred to as a 'scientific literacy approach'.

6.4.2 Scientific literacy in the UK

The *Beyond 2000* report (Millar & Osborne, 1998) has been highly influential in writing about scientific literacy both internationally and in the UK. It embodies an originating set of ideas which have provided the background to the specific curriculum innovations in school science within the UK which will be outlined in more detail below. The *Beyond 2000* report was the outcome of a UK seminar programme held in 1997 and 1998 in which an invited group of science educators aimed to "consider and review the form of science education required to prepare young people for life in our society in the next century" (Millar & Osborne, 1998: 2001). Addressing this aim involved considering the following four principal questions:

- What are the successes and failures of science education to date?
- What science education is needed by young people today?
- What might be the content and structure of a suitable model for a science curriculum for all young people?
- What problems and issues would be raised by the implementation of such a curriculum, and how might these be addressed?

The report produced ten recommendations, the first of which was that "the science curriculum from 5 to 16 should be seen primarily as a course to enhance general 'scientific literacy'" (Millar & Osborne, 1998: 2009). Expanding on this recommendation, the authors suggested that the aim of the science curriculum should be to "produce a populace who are comfortable, competent and confident with scientific and technical matters and artefacts" (p. 2009). This should, they argued, enable students to read media reports about science with interest and to express opinions about and critically engage with current social and ethical issues which relate to science (examples given include Chernobyl, CFCs and the depletion of the ozone layer – i.e. contemporary controversial socio-scientific issues). Such an understanding is important, it was argued, in order to “sustain a healthy and vibrant democracy” (p. 2004), since:

> individuals need to be able to understand the methods by which science derives the evidence for the claims made by scientists; to appreciate the strengths and limits of scientific evidence; to be able to make a sensible assessment of risk; and to recognise the ethical and moral implications of the choices that science offers for action.
>
> (Millar & Osborne, 1998: 2004)

A distinction between the cohort of students who will progress to scientific careers and those who will not is an important theme within debates relating to scientific literacy. It reflects a critical shift in thinking about the purposes of science education: should it aim to produce suitably trained personnel or should its function be to develop overall scientific knowledge within the general population? This latter concern is frequently termed ‘scientific literacy’ or ‘citizen science’. Aikenhead (2007a) suggests that this distinction:

> reflects a competition between two ideologies: on the one hand, promoting practical utility, human values, and a connectedness with societal issues to achieve inclusiveness and a student-centered orientation, while on the other hand, promoting professional science associations, the rigors of mental training, and academic screening to achieve exclusiveness and a scientist-centered orientation.
>
> (Aikenhead, 2007a: 885)

A key argument put forward by advocates of a scientific literacy approach to curriculum concerns the extent to which traditional curricula adequately address these two aims. Writers such as Aikenhead, a key proponent of the science-technology-society (STS) approach, refer to the way in which traditional curricula represent an "elite scientist-oriented view" (Aikenhead, 2006: 4) since they privilege the needs of those students who are positioned within the 'pipeline' of pre-professional training. Miller & Osborne (1998) argue that since such students represent a minority of the student cohort as a whole, the route that such students take should not "be allowed to influence unduly the form and content of the science curriculum offered to the majority" (Millar & Osborne, 1998: 2009). The *Beyond 2000* report questions whether the same curriculum can serve the needs of both these groups of students. Osborne & Dillon (2008) suggest that:

> Asking the school science curriculum and teachers of science to achieve both of these goals simultaneously places school science in tension where neither goal is served successfully.
>
> (Osborne & Dillon, 2008: 7)

The notion of scientific literacy embodied in the *Beyond 2000* report is characterised by a focus on the general population, rather than on future scientists. Through an engagement with debates about socio-scientific issues and an understanding of some of the processes of science, it promotes what Vinen (2000: 176) terms 'scientific appreciation': "having only a feel for what science is about and of the way in which science is carried out, but without significant practical experience of it" (however see Millar & Osborne, 2000, for response to this view).

The *Beyond 2000* report has been very influential in the UK. Donnelly (2005: 295) suggests that it has become “a ‘received view’ on these matters, across much of the science education community”. The House of Lords Select Committee on Science and Technology, Third Report (1999-2000) (House of Lords, 2000) found “much in the analysis in *Beyond 2000* with which to agree”. More significantly, it became a key influence upon the development of the new national curriculum Programme of Study for Key Stage 4 Science which formed the basis for all science GCSE courses from September 2006, including the new GCSE science *Twenty First Century Science* (21st Century Science Project Team, 2003; Millar, 2006).

The *Twenty First Century Science* GCSE course was piloted by the awarding body OCR with over 12,000 students in 78 schools and colleges across England (Millar, 2006). It has provided the blueprint for the revision of all GCSE science courses (Royal Society, 2008) through the introduction of the *How Science Works* element in GCSE science specifications from September 2006 (QCA, 2005).

The *Twenty First Century Science* GCSE adopted the specific aim of developing students’ scientific literacy. The course addresses the problem of the dual purposes – students for whom the science curriculum represents pre-professional training and those for whom it does not – by separating them. The curriculum model:

> divides the curriculum time allocation for science (20% is the norm for students aged 15–16 in England) into two equal parts. All students take a Core Science course, designed explicitly to develop their scientific literacy; alongside this they may choose to take an Additional Science course, which is

> offered with either a "pure" or "applied" emphasis. Both courses are of the same size as those followed by these students in other subjects leading to the GCSE qualification. Core-plus-Additional is designed to provide a sound basis for progressing to more advanced courses in the sciences at post-16 stage. By addressing in this way the priority demand of some key stakeholders (the scientific community, employers, government) that school science should provide a sound foundation for more advanced study, it is then possible to develop a Core Science course with scientific literacy as its primary aim.
>
> (Millar, 2006: 1505)

The selection of content within *Twenty First Century Science* is based on the notion that "citizens are *consumers* of scientific knowledge rather than *producers* of it" (Millar, 2006: 1505, emphasis in original). Thus the curriculum aimed to provide a flexible structure in order to develop students' abilities to deal appropriately with scientific knowledge as they might encounter it as citizens, including in the form of media reports. This provides "students with a 'toolkit' of ideas and skills that are useful for accessing, interpreting and responding to science, as we all encounter it in everyday life" (Millar, 2008: 8). Such an approach aimed to encourage discussion rather than recall of detail or rote learning and to relate more strongly to the concerns and experience of students, in order address problems of 'lack of relevance' which is reported to be demotivating to students (Lyons, 2006).

Thus, the *Twenty First Century Science* Core employs different principles upon which the selection and organisation of knowledge is based. It therefore, for example, focuses on practical application and social concerns such as health and medicine and the environment. Ideas of risk and risk assessment are frequently associated with such issues (e.g. the correlation between specific causes and outcomes) and are therefore a key feature of this course. Drawing on the recommendations of the *Beyond 2000* report, the *Twenty First Century Science* Core employs broad explanatory accounts termed ‘science explanations’ (e.g. ‘Energy sources and use’) in order to develop the “broad, qualitative grasp of the major science explanations” (Millar, 2006: 1507) required by citizens. Roberts observes that the definition of scientific literacy within the new GCSE specifications align with his Vision II scientific literacy since “the overall learning outcomes flow from situations, not from the formal structure of science itself” (Roberts, 2007: 746).

6.5 Debating scientific literacy: criticism of Twenty First Century Science and How Science Works

The previous section outlined criticisms of traditional approaches to science curricula and arguments concerning the advantages which scientific literacy approaches are envisioned to provide for students and the wider public. This section discusses aspects of the debate about scientific literacy approaches focusing on the UK context.

In an earlier section I drew attention to the fundamental nature of the two approaches, evidenced by the fact that these competing models of curriculum occur across countries and reappear over time. It is not surprising, then, that groups of supporters of each model tend to be “exclusive and form oppositions” (Schulz, 2009: 235); the ideas that underpin them are, writes Dillon (2009: 203), “philosophically irreconcilable”. This section explores the debate, or more accurately, the counter-argument, to scientific literacy.

It is perhaps significant that the debate concerning scientific literacy in the UK has taken place both within the academic research literature and within a much wider and more public sphere. Following the introduction of the GCSE science reforms, the think tank The Institute of Ideas published a book entitled ‘What is science education for?’ (Gilland, 2006). The book suggested that the reforms acted to dilute the substantive scientific content in the curriculum, such that, warned Baroness Warnock (2006), it would become “more suitable for the pub than the school room”. Given the association with concerns about ‘dumbing down’ it is unsurprising that the book and the reforms received much media attention (e.g. BBC, 2006; Henderson & Blair, 2006; Jones, 2006; McCall, 2006; Smith, 2006)

In ‘What is science education for?’, David Perks, a physics teacher, argued that although there was a case for reforming the science curriculum given the decline in science student numbers, developing scientific literacy was the wrong solution (Perks, 2006). Perks’ argument centres around the distinction between science for citizens and science for future scientists. The scientific literacy focus, it is argued, is problematic since it may not achieve its ends of providing a knowledgeable and science-supportive public, and it also obscures the place of scientific knowledge itself within the curriculum.

Perks’ position is that science education has become politicised and, through its focus on scientific literacy and controversial socio-scientific issues, the aims of the curriculum have been displaced towards providing solutions to issues such as public distrust of science (see also Whelan, 2007). Perks suggests that:

> the new science curriculum is trying to make up for the fact that politicians and scientists don't seem able to get their message across in the public arena. Teaching 'scientific literacy' is clearly seen as a counter-balance to media panics about MMR and bird flu.
>
> (Perks, 2006: 28)

Perks argues that such an approach under-estimates the level of sophistication required to engage with such debates. He also suggests that their inclusion in the curriculum can confuse students about what is, and what is not, scientifically known. The result is that:

> Instead of empowering young people as well-informed citizens, we run the risk of setting them afloat in a sea of ethical uncertainty, with no possibility of anchoring themselves to the certainties that a scientific body of knowledge can provide.
>
> (Perks, 2006: 29)

Other writers have also pointed to the uncertain role of scientific knowledge within socio-scientific issues; Ziman (1994), for example, suggests that the treatment of such issues is less concerned with scientific understanding than it is with legal, political and moral considerations.

Perks refers to a provisional evaluation of *Twenty First Century Science* carried out by the Qualifications and Curriculum Authority (QCA) which provides weak evidence that students following the course may be more likely to continue science beyond GCSE. The final evaluation of the *Twenty First Century Science* course (with Donnelly, 2007 as evaluation co-ordinator) – which focused on the core scientific literacy element rather than the additional elements – found that teachers and students were positive about the course since it provided more relevant content but that it contained too little practical work. It also reported that it found no significant difference in students' understanding of science content within the *Twenty First Century Science* course compared with traditional courses. But Donnelly writes that students following the *Twenty First Century Science* course were:

> found to be significantly less likely to trust what a scientist said. This is perhaps unsurprising in relation to a course which, in my view, gives more attention to provisionality in scientific knowledge and to the social processes by which that knowledge is obtained, than is to be found in traditional Double Award science.
>
> (Donnelly, 2007: 27)

This finding perhaps provides some evidence that the course may not be addressing the aim of developing the public's support for science. However, the evaluation report should be interpreted with caution since the pilot group of students consisted of a greater number of 'less able' students and was therefore not representative of the student body as a whole (Royal Society, 2008: 174).

As an aside, it is interesting to note that, as the House of Lords Science and Technology Committee (House of Lords, 2006) and others have observed, changes were made to the national curriculum *before* the final evaluation of the *Twenty First Century Science* pilot course was published. The Committee stated that:

> We welcome the new science GCSE courses, although it is essential that teachers should maintain the necessary rigour in their teaching and ensure that the "hard" science is retained. However, it is unfortunate that the Government opted to roll out the new courses before the results of the Twenty First Century Science pilot could be fully evaluated, and before the other, unpiloted courses had been sufficiently scrutinised. We recommend that, in future, the Government should allow more time between piloting new courses and rolling them out across the country.
>
> (House of Lords, 2006: 54-55)

More recently, a number of issues have emerged concerning the *How Science Works* strand of GCSE science (the core scientific literacy element of the *Twenty First Century Science* course which now forms a part of all science GCSEs) relating to the '"hard" science' that the Committee suggested should be retained. A report in March 2009 by Ofqual, the examinations and qualifications regulator in England, (Ofqual, 2009) recommended that the GCSE science specification should be revised following its findings that there were differing standards across exam boards, that some papers provided a lack of challenge for students and that assessment validity could be improved. Following Ofqual's criticisms, Science Community Representing Education (SCORE) reported that:

> There were a few instances where neither knowledge of science nor of How Science Works was needed to answer some parts of some questions. Of particular concern were questions which appeared to be general knowledge. However it was noted that there can be a 'grey area' between what is considered to be general knowledge and what is considered to be scientific knowledge or understanding. In some cases, to candidates of differing abilities, the same question could be interpreted as being either general knowledge or as one that requires some scientific knowledge.
>
> (SCORE, 2009: 5)

In relation to the Ofqual report, former Schools Minister Jim Knight suggested that the problem was with the process of assessment rather than with the content of GCSE science courses, asserting that "it does not mean the knowledge is not there" (BBC, 2009). Perks, however, in his earlier essay, identifies the problem of the need to make content relevant to students, an argument which he suggests is based on the belief that students "cannot be expected to engage with concepts and ideas beyond their immediate frame of reference: educationalists, therefore, should relate the subjects they teach directly to the language and ideas with which pupils are familiar in their everyday lives" (Perks, 2006: 15). He proposes that such developments act to sideline the role of the teacher as a subject expert and that the educational value of featuring controversial socio-scientific issues in the curriculum is unclear, since:

> in the absence of a thorough grasp of science and a clear understanding of its importance in the context of a particular debate, any discussion will quickly

> boil down to rhetorical posturing or simply confusion. Asking teenagers to make up their minds about anything is pretty daunting. But if you try to ask them to decide if we need to replace the UK's nuclear power stations, you are far more likely to get the question: 'Sir, what is nuclear power?'.
>
> (Perks, 2006: 17-18)

What these arguments indicate is that, among other things, science teachers and others who have similar interests within the field of recontextualisation, are significant stakeholders within the implementation of new approaches – although they may have little influence at national policy level. Holbrook & Rannikmae (2009: 278) point out that it appears that adherence to traditional approaches is prevalent among today's science teachers. Tytler suggests that the persistence of 'status quo science' amongst teachers may be accounted for by the:

> strong discursive traditions subscribed to by teachers of science resulting from their enculturation during their own schooling and undergraduate studies … This culture is strongly represented in school science discursive practices, supported by resources such as textbooks, laboratories and their associated equipment, timetabling arrangements and by assessment and reporting traditions. Another aspect is the force of long habit of teachers who have developed effective ways of delivering canonical content, who may lack the knowledge, skills and perspectives required for the effective teaching of a different version of school science.
>
> (Tytler, 2007: 18)

However, while it may be true that many teachers are unwilling to abandon their traditional approaches, it does not necessarily follow that force of habit wholly accounts for their resistance to mandated curriculum change.[7]

Donnelly (2005; 2006) provides a critique of the notion of scientific literacy within the educational research literature, providing some support for the practitioner view advanced by Perks. Donnelly draws attention to policy's focus upon the instrumental purposes of science education: the creation of a scientifically trained workforce or a scientifically literate public who is able to understand socio-scientific issues and who is supportive of science. He argues that such purposes are instrumental since "their principal focus is not the promotion of the informed autonomy of the student" (Donnelly, 2006: 636). He also suggests that if instrumental purposes take undue priority, education then "begins to serve whoever can gain control of the curriculum, whether they be politicians or 'science educators', and not the student as a growing human being" (p. 636).

Writing in the UK context, Donnelly (2005) offers a critical examination of the *Beyond 2000* report and developments such as *Twenty First Century Science* which have arisen from it. Donnelly rejects the view that the same curriculum cannot serve the needs of future scientists and the general population, arguing that such a

[7] Ratcliffe & Millar (2009) report on teachers' implementation of the *Twenty First Century Science* pilot course. They also point to the persistence of habitual practices and the difficulty of implementing change. While they suggest that teachers in their study "may have sympathy with the course aims" (p. 957), teachers' views on this matter appear to be unexplored. Rather, the focus is upon implementation of pre-determined course aims. This again points to a possible over-emphasis by researchers upon explanations concerning teachers' inertia and does not acknowledge that teachers' professional views about education and their subjects are also likely to influence their interpretation and implementation of mandated change.

distinction is not adequately justified within *Beyond 2000*. He also questions the rationale for reform, particularly in terms of the amount and nature of content in the curriculum. He suggests that characterising traditional curricula as a "succession of 'facts' to be learnt" (Millar & Osborne, 1998: 2004) attenuates a key justification for the place of science in the curriculum: namely, the aim to introduce "children to science as our best available account of the world, understood materialistically" (Donnelly, 2005: 296). In other words, the place of scientific knowledge itself – knowledge which possesses certain essential characteristics – has become ambiguous in the curriculum. Donnelly proposes that:

> the central distinctive characteristic of natural science is its physicalist world view, and its success in understanding, predicting and controlling the world when it is understood in this way. Accordingly, science's distinctive educational *justification* is in making available to children so much as is appropriate of the knowledge which science has produced, and giving some realistic insight into its general characteristics and boundaries. The study of science should lead to an understanding of the intellectual coherence of that knowledge, and its instrumental power, that is its power to predict and control.
>
> (Donnelly, 2005: 298, emphasis in original)

Attempts to make science 'relevant' in terms of engaging students interests and opinions is problematic, argues Donnelly, since:

> Science, as a distinctive body of knowledge and as a mode of engaging the world has intellectual qualities which present significant challenges. These

> include, in my view, a divorce from direct engagement with human concerns in its *construal* of the world …, and an authority, as a result of its scale, power and success, which renders problematic the expression of children's individuality.
>
> (Donnelly, 2005: 304-305, emphasis in original)

Donnelly suggests that *Beyond 2000* and 'successor documents' such as the *Twenty First Century Science* curriculum, do not engage with or recognise the distinctive nature of scientific knowledge. It is on this basis that Donnelly argues that the aims of the science curriculum for future scientists and the general population are not fundamentally different: both groups should have the opportunity to explore this "key mode of construing the world" (p. 304).

Aims such as those expressed within the *How Science Works* strand of GCSE science which emphasise issues and arguments which involve scientific knowledge (the nature of risk, the validity of conclusions drawn from data or engaging with complex socio-scientific issues, for example) are, in Donnelly's view, in the way they are presented in the curriculum, either not specific to science itself or, since they are divorced from their disciplinary foundations, tend to be reduced to trivial content. Such concerns are:

> only indirectly, and not exclusively, related to either the practices of science, or the body of scientific knowledge. They draw their main conceptual framing from such fields as politics, sociology, philosophy, history and perhaps

> economics and media studies. These fields … possess their own intellectual apparatus.
>
> (Donnelly, 2005: 301)

To deal with such issues in a *science* context, he argues, is beyond the reach of school science.

Interestingly, Donnelly also suggests that reducing science to become another literacy among many 'literacies' (social, political, financial, emotional etc.) undermines the place of science in the curriculum. Since the notion of 'literacy' emphasises relevance to everyday life and the needs of citizens as its justification, the importance of science in the guise of scientific literacy is threatened in comparison with the other literacies which arguably *are* more important in everyday life. Donnelly argues that:

> in the notion of scientific literacy that we are offered, 'science' has been retained as a distinct curriculum area, but the thrust of the ideas from which the notion of scientific literacy derives appears to undermine the notion of academic disciplines as the foundation of the curriculum.
>
> (Donnelly, 2005: 306)

Although Donnelly agrees that some criticisms of the traditional science curriculum may be legitimate, and although he accepts that there is some role for the inclusion of some aspects of the content advocated in the reforms, he argues that the "legitimacy of the former group of arguments does not necessarily imply that of the latter" (p. 306) since they tend to lose sight of the distinctive nature of scientific knowledge. In a later paper Donnelly argues that:

> Claims that science education is not ‘relevant’, that it is too full of ‘content’ (i.e. scientific knowledge), that it is insufficiently motivating, that it is dominated by professional science, and so on, seem to me to be essentially superficial arguments. They derive their underlying intellectual impetus from more deep-rooted doubts about the educational legitimacy of science.
>
> (Donnelly, 2006: 635)

6.6 Implications of the case study

This section draws out the implications of the case study in relation to the theoretical goals outlined in the previous chapter. First, the alignment between traditional science curricula and scientific literacy approaches and the model of conceptual and contextual coherence is examined. Second, an assessment is made of the insights provided into the link between knowledge structure and curriculum structure. Third, I explore what insights are afforded by the case study as an external language of description of the principles of recontextualisation, conceptual and contextual coherence.

6.6.1 Alignment with conceptual and contextual coherence

In chapter 4 I suggested that two broad principles of recontextualisation of disciplinary knowledge structures could be identified:

- Conceptual coherence - which emphasises an abstract and internally coherent structure. This principle of recontextualisation emphasises a knowledge code in Maton's terms and may align with a traditional curriculum or 'canonical' content.

- Contextual coherence - which aligns with specific contexts of application *or* the characteristics of knowers (a knower code) and which contains segmentally organised knowledge. Contextual coherence may also be said to draw upon characteristics of everyday knowledge to provide the basis of recontextualisation.

The previous section indicated that traditional and scientific literacy models of curriculum are fundamental modes of recontextualisation of science at the broad level of the curriculum. They endure over time, are cyclical in nature, are exclusive and form oppositions (Schulz, 2009: 235). I have outlined the principles upon which these opposing modes operate: traditional (Vision I) curricula tend to look inwards towards the canon of orthodox science, while scientific literacy (Vision II) curricula look to contexts (Roberts, 2007: 730).

There is a clear alignment between traditional or Vision I curriculum models and conceptual coherence and between scientific literacy of Vision II curriculum models and contextual coherence. Many of the criticisms of traditional curricula point to hierarchical, cumulative, 'overloaded' and 'irrelevant' content. They also refer to the recontextualising principle within these curricula as being centred around a canon, around scientific knowledge itself. This clearly indicates conceptual coherence. The scientific literacy model, derived from *Beyond 2000*, by contrast, largely employs contextual coherence. In this model, knowledge is "segmentally connected, where each segment is adequate to a context, sufficient to a purpose" (Muller, 2009: 216). The contexts in question in the *Twenty First Century Science* curriculum relate to socio-scientific issues and to the science that is encountered in everyday life (Millar, 2008: 8). The purpose is to enable the curriculum to be made more relevant to students by enhancing its relation to the everyday and by allowing students to engage in debate about scientific ideas, and to express their own opinions. As such, some elements align with a 'knower' code in Maton's (2007) terms. As scientific literacy advocates argue, this contextual coherence provides the means by which the shortcomings of traditional curricula – characterised as dull, irrelevant, difficult, content-heavy and concerned with the transmission of facts – may be addressed.

6.6.2 Knowledge structure and curriculum structure

I will now turn to the process of recontextualisation. As I remarked in chapter 5, Muller (2009) suggests that a particular curricular form may be more compatible with specific disciplinary structures. This case study provides evidence for the link between disciplinary and curriculum structures.

A key feature of arguments against scientific literacy approaches concerns the marginalisation of scientific knowledge as a distinct form of knowledge within the curriculum (Donnelly, 2005: 296; Perks, 2006). Scientific literacy approaches, it is argued, either displace scientific knowledge for other forms (e.g. politics, sociology, philosophy, history, economics and media studies) or, as the SCORE report (SCORE, 2009: 5) suggested, confuses it with general knowledge. Such a marginalisation implies that applying a principle of contextual coherence may not be appropriate for scientific knowledge if the arguments about its displacement within scientific literacy approaches are accepted. If this is the case, then in terms of the control of the epistemic device within the recontextualised field (Moore & Maton, 2001) – which presumably would determine whether a scientific literacy approach or a traditional approach is adopted – this does appear to be an arbitrary and political process, but one which is limited by the distinctive form of scientific knowledge itself which, under instrumentally biased drivers for reform "will appear mainly as obstacles or affordances, to be defeated or exploited as necessary" (Donnelly, 2006: 636).

6.6.3 Wider implications of the external language of description

This case study of scientific literacy approaches and the debate surrounding it provides further support for conceptual and contextual coherence as fundamental modes of recontextualisation. However, the key implication of the case study and the finding of this chapter relates to more significant conclusions regarding the place and nature of scientific knowledge in the curriculum.

I have referred to Donnelly's (2005) arguments about the distinctive nature of scientific knowledge, but I have said little about what these distinctive characteristics are. In a later paper Donnelly (2006) does make a case for the distinctive intellectual characteristics of science which he describes in terms of the ontic (forms of being under which the world is construed), the epistemic (the basis and authority of scientific knowledge claims) and that of value (the ways in which science relates to key modes of human valuing) (p. 634). He suggests that reforms tend to act to reposition these characteristics in the following ways:

- marginalizing, and sometimes problematizing, the place of science's substantive account of the world;
- emphasizing, and sometimes problematizing, the epistemic characteristics of science so as to promote the direct engagement of students with processes of knowledge creation, justification, evaluation, and use (increasingly this element is taken to involve sociological understandings of these matters); and
- redefining the subject matter of the curriculum so as to include socially and politically significant issues at the core of which are ethical questions.

(Donnelly, 2006: 635)

It is possible to interpret Donnelly's complaints about 'repositioning' as being concerned with what science is, or the nature of science.

In addition to the range of instrumental concerns which are associated with the rationale for scientific literacy – increasing participation, generating public support and knowledge of science and so on – there is, then, a more fundamental side to this debate. This is eloquently summed up by Rudolph when he observes that:

> The school curriculum is no less a site where negotiation of the scientific image occurs... the curriculum is the one place that society has set aside specifically for the purpose of systematically conveying to the public just what science is.

(Rudolph, 2003: 67)

The nature of science is an important aspect of this negotiation of the scientific image. The question 'What is science?' is therefore a key question at the broad level of curriculum, and is addressed not only in terms of instrumental reasons, but also at this more fundamental level.

One example of this is the public and academic debate about the status and authority of scientific knowledge which has taken place in the 'science wars' (an engagement with the postmodernist critique of science which attacks its claim to high-status, realist, objective and universal knowledge, see e.g. Brown, 2001)[8]. I do not wish to engage with these debates here, particularly since I have addressed similar issues in chapter 3 (when, for example, I referred to standpoint epistemology), but rather aim to draw attention to their importance at the broad level of the curriculum. This is

[8] In terms of science education such concerns are bound up with what some researchers term the importation of elitist 'Western science' into certain contexts such that the perspectives of 'indigenous peoples' is under-valued (e.g. Aikenhead & Ogawa, 2007). This can signal a tendency towards relativist approaches to knowledge and an emphasis upon the status of knowers. While not all scientific literacy advocates necessarily adopt a postmodern approach, some science educators do (Schulz, 2009) and explicitly refute the kind of arguments that were outlined in chapter 3 which suggest that such approaches only act to further marginalise disadvantaged students (e.g. see Roth & Lee, 2004: 279 for such an argument). However, while most science educators implicitly adopt a realist approach – Cobern & Loving (2008) argue that realism within science education is just 'common sense' – supporters of scientific literacy do tend to focus upon the tentative nature of scientific knowledge and its fallibility. This is certainly the case in *Beyond 2000* and *Twenty First Century Science*, where Donnelly (2005: 303) suggests that the provisional nature of scientific ideas is over-emphasised. A similar example is the recent debate about the place of creationism and intelligent design in the curriculum. The 'science wars' debates are also reflected in differing interpretations of the term 'constructivism' which has a long history in the field of science education research (e.g. see Jenkins, 2009) and which is very influential within the UK school science curriculum (Taber, 2010), but I will not consider these debates in detail here.

because it is possible to view the debate between traditional approaches to curriculum and scientific literacy approaches as being concerned with the nature of science.

Reviewing the arguments advanced by each side of the debate, it is possible to make the following observations. Scientific literacy proponents argue that traditional approaches to curriculum do not represent science as it really is: they argue that it does not reflect science as it is done today, that it relies on rote learning, that it disconnects from real world concerns and that it does not attend to the realities of how science is done, presenting a distorted image of 'the scientific method'. Furthermore, it "persists with presenting an idealized view of science as objective, detached and value free" (Osborne, 2007a: 175). On the other hand, those who criticise scientific literacy approaches suggest that such approaches treat science education instrumentally and ignore science's distinctive intellectual characteristics, such that scientific knowledge itself is marginalised within the curriculum. Put in these terms, it is not difficult to see why the views of each of these 'two major camps' (Holbrook & Rannikmae, 2009) are, as Schulz (2009) observes, oppositional and exclusive. Aikenhead appears to be making a similar point when he observes that:

> One of the cultural myths associated with a Vision I ideology of Eurocentric SL is the story line that school science accurately reflects professional (academic) science. Many science education researchers, however, lament the misrepresentation of professional science found in Vision I types of school science ... "Is it really science?" they ask, which is the same scrutinizing question that advocates of Vision I tend to pose about Vision II …
>
> (Aikenhead, 2007b)

The question about whether each model of the science curriculum (and by extension, each principle of recontextualisation – conceptual or contextual) accurately represents science is the key outcome of this case study. It draws attention to significance of the notion of 'authenticity'.

The literature concerning authenticity reveals overlaps between two key models of authenticity and the models of conceptual and contextual coherence. Hutchison writes that:

> There are essentially two conceptualizations of authenticity in the literature. The first focuses on the activities planned within a curriculum, which are authentic insofar as they resemble the activities of professional scientists …The second focuses on the students' sense of what they are doing, and activities are authentic to the extent that students find them personally meaningful.
>
> (Hutchison, 2008: 16)

The first conceptualisation, which Hutchison terms 'disciplinary authenticity', appears to align with the notion of conceptual coherence. The second conceptualisation (termed 'personal authenticity') aligns with contextual coherence. Each of these models of authenticity has clear educational benefits, but is also associated with significant educational failures: even though students may engage with authentic practices, they may not understand the nature of their engagement; and, while students may be personally engaged they may not achieve valid educational outcomes. Hutchison proposes that a solution is found by combining aspects of these forms of engagement, providing what he terms “epistemological authenticity”.

The notion of authenticity provides a theoretical bridge, both to re-engage with sociocultural theory – which, it will be recalled, frequently theorises the educational implications of practices in their authentic communities of practice contexts – and also with a more specific theoretical project. Let me explain this as follows. Perks (2006), Donnelly (2005; 2006) and those debating the scientific literacy versus traditional approach engage with the question, ‘What is science education for?’, and with the more fundamental question, ‘what is the science in science education?’. Schulz, however, suggests that:

> … it is time to ask the essential questions once again: ‘‘what does it mean to be educated?’’ … This … crucial question should be kept distinct from – though it often tends to be subsumed to – the question harbouring a social utilitarian criterion: ‘‘what do we educate people in science for?’’
>
> (Schulz, 2009: 228)

This focus on “what does it mean to be educated” is distinct from either ‘what is science education for?’ and even ‘what is science?’. What it means to be educated, in my interpretation, aligns closely with my research questions which concern the development of ‘relationships with knowledge’. These ideas will be brought forward in the following chapters.

6.7 Conclusion

This chapter has presented a case study of the school science curriculum, focusing upon the distinction between traditional and scientific literacy approaches. It has been shown that these approaches align with conceptual and contextual modes of curricular coherence. Support has also been provided for the link between disciplinary and curriculum structure in the context of science.

The case study has been concerned with specific innovations in the UK school science curriculum and chapters which follow stay with the subject of science, although discussion will be much broader compared with the case study. Although I will generalise about my conclusions in relation to other subjects, retaining the focus on science as one example assists in engaging with the 'aboutness' of knowledge: the epistemic relation, or how truth claims can be made (Wheelahan, 2007a: 25) which features to a lesser extent in Bernstein's work compared with his focus on the social relations (Beck & Young, 2005). Continuing to focus on the specific subject of science also allows for engagement with the specifics of disciplinary discourse and practices. A rationale for such an approach, which aims to explore ways in which epistemic practices within disciplinary and educational communities articulate with each other, was given in chapter 5.

The important outcome of this chapter concerns the identification of the key issue of authenticity. The fact that traditional and scientific literacy approaches align with conceptual and contextual coherence is not surprising. What is more significant within the external language of description is the nature of the debate about the competing approaches. The key issue of authenticity identified in this chapter provides a focus for an exploration of the articulation of disciplinary and educational communities. The next chapter draws upon the idea of 'authentic' science to explore the nature of the articulation between these two communities as epistemic communities. The next chapter will also focus on the nature of an *educational context*, which aims to address Schulz's (2009: 228) key question that I referred to in the previous section: 'what does it mean to be educated in science?'. Earlier in this thesis I have also discussed Lave & Wenger's (1991) sociocultural approach and their exploration of learning in authentic contexts. Chapter 7 draws these themes together, with the intention of exploring the epistemological implications of a realist model of knowledge within a sociocultural perspective on formal educational contexts.

Chapter 7: The significance of contexts

7.1 Introduction

This chapter explores the articulation of scientific disciplinary and educational contexts as epistemic communities. The approach adopted is thus a socio-epistemic one, although not in the historical sense described by Muller (2009). Rather, the chapter examines how authentic disciplinary discourse and practices are recontextualised in the educational context and assesses the impact on the authenticity of those practices and discourse in relation to the disciplinary context. It will be shown that the process of recontextualisation imposes significant limits upon the possibilities for authenticity. It is argued that this is a fundamental aspect of recontextualised discourse and practice.

This chapter also starts to address research question 4: 'Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students' relationships with knowledge in educational contexts?'.

I have referred to 'the disciplinary epistemic community' of science which in some respects over-simplifies matters. Disciplinary communities are heterogeneous: they focus on different aspects of the natural world, employ different methods and adopt different perspectives (Wong & Hodson, 2008). In addition, communities within 'the educational context' are hardly homogenous. However, following Sharma & Anderson (2009) I argue that it is possible to discern broad distinguishing features of the disciplinary discourses and practices of science, as Wittgensteinian 'family resemblances'. The educational context is similarly treated broadly. Without such an assumption, an analysis such as this could not take place.

This chapter is organised in the following way. The next section reviews, in general terms, the problem of context and authenticity from a sociocultural perspective. This reiterates some of the problems referred to earlier in this thesis, but it is worthwhile to draw these observations together in the current chapter which seeks to address them more explicitly. Section three outlines the approach that I adopt in exploring the nature of the disciplinary and educational context: first by examining contexts from the perspective of practice (and purposes) and second by examining contexts from the perspective of discourse. The following two sections then proceed to explore how the process of recontextualisation impacts upon disciplinary practices and discourse. Section six explores the implications for the way in which the educational context may be framed, arguing for a specific model of the educational context such that it neither constitutes a microcosm of disciplinary practice, nor does it necessarily represent a wholly disconnected community.

7.2 Sociocultural theory and the problem of context and authenticity

Sociocultural theory, under the broad interpretation outlined in chapter 2, emphasises the contextual contingency of knowledge. Brown *et al.* (1989), for example, argue that there is an enduring connection between knowing and doing, and between what is learned and how it is learned. They suggest that:

> Situations might be said to co-produce knowledge through activity. Learning and cognition, it is now possible to argue, are fundamentally situated.
>
> (Brown *et al.,* 1989: 32)

Communities of practice theory also emphasises the situated nature of learning, focusing on participation within a practice (Lave & Wenger, 1991). Wenger (1998: 72) describes “three dimensions of the relation by which practice is the source of coherence of a community”. These are by mutual engagement (the negotiation between participants of meaning in relation to specific community practices), a joint enterprise (the focus of the activity) and a shared repertoire (common resources such as tools, routines or concepts).

As I have already argued, there are compelling reasons to agree with sociocultural theory’s emphasis upon the significance of context. However, chapter 3 identified the problems that can arise when we consider formal educational contexts rather than the informal or out-of-school learning communities discussed, for example, by Lave & Wenger (1991). Sociocultural writers do point out the problems associated with formal educational contexts concerning the alignment between an ‘ambient community’ (an educational context) and a target community of practice (a disciplinary community). In the case of formal educational contexts the purposes of the participants and the purposes of the community do not align quite as neatly as they do for learners in an apprenticeship mode – Lave & Wenger’s (1991) Yucatec Mayan midwives, for example. In the case of ‘students’, then, who are located in a formal educational context, the three dimensions of community suggested by Wenger (1998) – mutual engagement, joint enterprise and a shared repertoire – are more problematic than is the case for ‘learners’ or apprentices in the kind of out-of-school contexts described by Lave & Wenger (1991). A number of theoretical implications of such a situation have been highlighted in chapter 3.

Frequently, the outcome for sociocultural theorists is that the school activity becomes a routine or ritualised activity which bears no relation to authentic activities or to students’ interests. For example, Brown *et al.* (1989) suggest that school activity:

> too often tends to be hybrid, implicitly framed by one culture, but explicitly attributed to another. Classroom activity very much takes place within the culture of schools, although it is attributed to the culture of readers, writers, mathematicians, historians, economists, geographers, and so forth. Many of the activities students undertake are simply not the activities of practitioners and would not make sense or be endorsed by the cultures to which they are attributed. This hybrid activity, furthermore, limits students’ access to the important structuring and supporting cues that arise from the context. What students do tends to be ersatz activity.
>
> (Brown *et al.,* 1989: 34)

Lave & Wenger (1991) make a similar point – cited earlier – in relation to school physics students. They suggest that these students do not participate in the reproduction of the community of practice of physicists, rather that they “participate only in the reproduction of the high school itself” (Lave & Wenger, 1991: 99) since the meanings of the activities involved in the two contexts are very different. Wenger (1998: 267) sums this up quite eloquently when he observes that if “school practices become self-contained then they cease to point anywhere beyond themselves. School learning is just learning school". In other words, as Jimenez-Aleixandre *et al*. (2000) point out, there is a significant difference between students 'doing science' and the procedural displays of 'doing the lesson' or 'doing school' (Bloome *et al.*, 1989). It is apparent that such observations about the 'ersatz' nature of the school context relate very closely to the criticisms of traditional school science curricula outlined in chapter 6.

Sociocultural theorists propose a number of solutions to the problem of the ersatz nature of school activities. Lave & Wenger (1991) in their discussion of communities of practice argue that:

> rather than learning by replicating the performances of others or by acquiring knowledge transmitted in instruction, we suggest that learning occurs through centripetal participation in the learning curriculum of the ambient community. Because the place of knowledge is within a community of practice, questions of learning must be addressed within the developmental cycles of that community, a recommendation which creates a diagnostic tool for distinguishing among communities of practice.
>
> (Lave & Wenger, 1991: 100)

However, while such a proposal sounds like it might be the basis of a reasonable mechanism to develop students' participation in disciplinary communities, it does not specifically address how this might occur in relation to the knowledge involved. For example, what are the 'developmental cycles of the community' and how do they relate to disciplinary knowledge? The answers to these questions in relation to specific disciplines remain uncertain. Nevertheless, Lave & Wenger (1991: 104) do make a useful distinction between talking *about* a practice and talking *within* it and they also point to the role played by personal stories:

> Talking within itself includes both talking within (e.g., exchanging information necessary to the progress of ongoing activities) and talking about (e.g., stories, community lore). Inside the shared practice, both forms of talk fulfill specific functions: engaging, focusing, and shifting attention, bringing about coordination, etc., on the one hand; and supporting communal forms of memory and reflection, as well as signaling membership, on the other. … For newcomers then the purpose is not to learn *from* talk as a substitute for legitimate peripheral participation; it is to learn *to* talk as a key to legitimate peripheral participation.
>
> (Lave & Wenger, 1991: 109, emphasis in original)

While this is a useful idea, and one that I will return to later, it still does not address the missing element of the *disciplinary* nature of such stories, since this discussion focuses upon communities such as recovering alcoholics or midwives and is subject to the problems outlined above.

Brown *et al*. (1989) appear to suggest that a solution to the ersatz nature of school may lie in developing activities for students which are more authentic – defined as the "coherent, meaningful and purposeful … ordinary practices of the culture" (p. 34). They argue that teachers should employ "authentic domain activity" (p. 40).

However, there may be a tension within this account since Brown *et al.* (1989) themselves also claim that:

> When authentic activities are transferred to the classroom, their context is inevitably transmuted; they become classroom tasks and part of the school culture. Classroom procedures, as a result, are then applied to what have become classroom tasks. The system of learning and using (and, of course, testing) thereafter remains hermetically sealed within the self-confirming culture of the school. Consequently, contrary to the aim of schooling, success within this culture often has little bearing on performance elsewhere.
>
> (Brown *et al.,* 1989: 34)

As Hutchison (2008) points out, Brown *et al.*'s (1989) position is ambiguous since the question of how student activities which are "coherent, meaningful and purposeful" relates to what counts as 'authentic' in a disciplinary sense remains unresolved.

The significance of authenticity was a key outcome of the debate about scientific literacy approaches discussed in the previous chapter. Hutchison (2008: 16) proposes that there are two models of authenticity in the literature and I suggested that these two models align with the two modes of curriculum coherence. A curriculum may be considered authentic if it either engages with students' interests and real life concerns, or if it mirrors the authentic practices of disciplinary practitioners. I argued that a curriculum which adopts the former model of authenticity, such as might be found in the scientific literacy model previously described, or which is argued for by Lemke (2001), tends to marginalise the place of disciplinary knowledge. Given that my aim is to maintain a focus on knowledge, I therefore focus now on the latter notion of authenticity, i.e. the relation between students' activities and those of disciplinary practitioners.

The movement of knowledge from one context to another (or from a sociocultural perspective, the limits of its ability to be moved between contexts due to its situated nature) is primarily a problem of recontextualisation. Earlier in this thesis I discussed Bernstein's position on the recontextualisation of knowledge from one context to another. Bernstein (1990; 2000) emphasised the distinction between disciplinary knowledge and curriculum, referring to knowledge in the school context as 'imaginary subjects'. In relation to school physics, Bernstein suggested that:

> such physics is a recontextualized discourse. It is the result of recontextualizing principles which have selected and declocated what counts as physics from what we could call the primary context of the production of discourse and relocated, refocused physics in the secondary context of the reproduction of discourse. In this process physics undergoes a complex transformation from an original to a virtual/imaginary discourse.
>
> (Bernstein, 1990: 184-185)

Characterising school subjects as 'imaginary' appears to concur with the conclusions of the sociocultural researchers who describe it as ersatz. Dowling (2009: 83) also makes this connection, observing that in Lave & Wenger's (1991) account the decoupling between school and discipline may be even greater than that implied by Bernstein.

I have, following Maton & Muller (2007) and Muller (2007), suggested that there must be a link between discipline and curriculum – and I have argued for the existence of such a link in relation to science. However, social realists' emphasis on the location of this link within the idea of *structure*, does, as I have argued, tend to flatten the social relations to knowledge. The focus within this chapter on authenticity and the use of a socio-epistemic theoretical lens, then, aims to address the limitations of sociocultural and Bernsteinian and social realist theory outlined above.

7.3 Recontextualisation as articulation of communities: practice and discourse

This chapter considers the articulation of different communities of practice, or the way in which different epistemic communities (which are aligned with different contexts) align with each other. Such an approach relates to a view of disciplinary and school contexts derived from social epistemology (Goldman, 2002; Longino, 2002). In this view, communities of practice are epistemic communities which engage in epistemic practices and epistemic discourse. This approach seeks to frame *knowers* within the relevant community, rather than to consider the knowledge of individuals (Kelly, 2007). In the following sections I consider the way in which two aspects of a disciplinary epistemic community (specifically of science) are recontextualised. These aspects are: first, *practices* (which are aligned with purposes) and second, disciplinary *discourse*.

It may be suggested that such a distinction between practices and discourse is artificial since the two constitute each other: practices are a form of discourse, and discourse is practised. Lea & Street (1998), for example, view literacy (a form of discourse) as a social practice. However, I argue that maintaining a separation between the two enables us to focus on the disciplinary nature of practice and discourse. Gee (1996) makes a distinction between 'discourse' (lower case d) and Discourse ("big 'D' Discourses"). Here, discourse refers to a community of practice's spoken and written dialogue or language, whereas Discourse refers to a combination of language and practice:

> Discourses … are ways of behaving, interacting, valuing, thinking, believing, speaking, and often reading and writing that are accepted as instantiations of particular roles (or 'types of people') by specific *groups of people* …They are 'ways of being in the world'; they are 'forms of life'. They are, thus, always and everywhere *social* and products of social histories.
>
> (Gee, 1996: viii, emphasis in original)

The term 'Discourse' is therefore a broader construct which subsumes the notion of discourse since "language makes no sense outside of Discourses" (Gee, 1996: viii) However, as Airey & Linder (2008) argue, it is important to distinguish between Gee's Discourse and disciplinary discourse: in their terms disciplinary discourse has a meaning which is more focused and is defined as "the complex of representations, tools and activities *of a discipline*" (Airey & Linder, 2008: 29; emphasis added). This is because, as they argue, "Gee's Discourse is a much wider concept which also includes all the attributes of the learners themselves" (p. 30). Although this is important to the process of learning, it contrasts with a view of disciplinary discourse which represents a particular way of knowing and which centres upon a discipline's characteristic semiotic resources. Gee's very broad interpretation of Discourse which subsumes discourse, then, is too general a tool within a socio-epistemic analysis: as Airey & Linder (2008) argue, it is necessary to maintain the distinction in order to be able to access the disciplinary nature of 'discourse'. For the present, then, while these wider aspects of Discourse are acknowledged as important, they are bracketed out from the analysis.

There is another reason to maintain a distinction between practice and discourse which is perhaps particularly relevant to the school science curriculum. This is because in most countries, and unlike most other school subjects, science education involves practical work: "activities in which the students manipulate and observe real objects and materials" (Abrahams & Millar, 2008: 1945). Indeed, if some icon of school science were to be chosen it would surely correspond to some aspect of the practical. Delamont *et al.* (1988, cited in Wellington, 1998: 3-4) for example, point to the 'fetishistic' way in which the Bunsen burner has become such an icon. In school contexts such practical activities are frequently referred to as 'experiments'. However, as I will discuss in the next section, for much practical work this is a misnomer since the activities do not necessarily include the generation and testing of hypotheses (Hodson, 1998). Nevertheless, students' engagement in practical work is a significant element of school science and relates to a crucial aspect of the corresponding discipline.

7.4 The recontextualisation of practices

7.4.1 Practising science

In the previous section, I referred to Brown *et al.*'s (1989) suggestion that school activities should be more closely aligned with the authentic activities of practitioners within the disciplines. In this section I examine how far this is possible and what is entailed by the epistemic nature of the different contexts.

A significant body of work in the science education literature has considered the possibilities for developing authentic learning in school science, although this does not necessarily align itself with research which is located within the field of 'authentic learning' more generally (e.g. Tochon, 2000; Stein *et al*., 2004). A common theme within the literature is the identification of the initial task of first establishing what the nature of authentic practices are in the disciplinary context; it is necessary to know "(i) what constitutes an authentic view of scientific practice, and (ii) how that understanding can be conveyed to students in an effective and an efficient way" (Wong & Hodson, 2008: 110). There are a number of difficulties associated with determining a straightforward account of authentic practice as it relates to the nature of science. Osborne *et al*. (2003b: 695-696) for example, suggest that, "it is hard to argue that there is an established consensus about the nature of science, let alone agreement about a version that might be communicated to students."

There appears to be two key mechanisms by which researchers attempt to determine the nature of authentic practice. The first is to examine the nature of scientific practice as it is reported by scientists themselves (e.g. Osborne *et al.*, 2003b; Wong & Hodson, 2008; Park *et al.*, 2009). Such accounts frequently point to an array of practices which are highly context- and field-dependent, and which can contradict classical accounts of the nature of science. For example, Wong & Hodson (2008) report that:

> inductivist approaches, for so long derided by philosophers of science as logically invalid and impractical (see Chalmers, 1999), are alive and well in contemporary science. Indeed, they are considered essential in some fields as a means of building up a large database from which speculation can begin.
>
> (Wong & Hodson, 2008: 125)

Other attempts to determine the nature of authentic practice draw upon the science studies literature, or the sociology of scientific knowledge: ethnographic and sociological studies of groups of scientists (e.g. Latour & Woolgar, 1986; Latour, 1987; Knorr-Cetina, 1999). Such studies explore the work of those who are engaged in 'science in the making' as opposed to science which is 'ready made' (Latour, 1987) – the "after-the-fact renarration of scientific process" (Weinstein, 2008: 391) which is traditionally learned in a school context. However, while there is increasing interest amongst researchers in exploring the links between science studies and science education (e.g. see Duschl *et al.*, 2008), some writers suggest that such accounts should be interpreted with caution. A relativist view of knowledge can be said to underpin much of the science studies literature. Ford (2008: 407), for example, argues that the sociology of scientific knowledge literature "grew primarily in reaction to the hegemony of the positivist vision [of science]" and does not provide an epistemological account of how the authority of new knowledge is decided within the community. In addition, as Wong & Hodson (2008) suggest, such accounts should be tempered by reference to comments from practising scientists themselves, since scientists frequently do not recognise themselves in these ethnographic accounts.

Bearing in mind that determining the nature of authentic scientific practice is not without difficulty, let us explore the curriculum models which aim to enhance students' exposure to authentic practice. Some researchers advocate the development of apprenticeship approaches where students work in contact with practising scientists in authentic settings (e.g. Barab & Hay, 2001; Schwartz *et al.,* 2004). Another approach is to simulate the activities of scientists in the school context, for example the Nuffield curriculum's discovery approach to science ('being scientists for a day') or the 'process approach' which focuses on the techniques of science. However, both the apprenticeship and simulated approaches are associated with a range of problems when we consider the broad aims of the science curriculum, particularly in relation to practical work.

For example, in addition to the practical difficulties in providing school students with opportunities to work with and be mentored by scientists – in terms of feasibility, cost and safety for example – students are likely to play very limited roles in an authentic context. Hay & Barab (2001), for example, compare the outcomes for students of an apprenticeship and a simulated environment. They observe that in the apprenticeship environment, students lack opportunities to exercise what they term an 'executive role' in setting goals, identifying tasks and monitoring progress in less narrowly defined projects. Therefore, they are likely to be less able to access an understanding of the purposes and meaning of the practices. Schwartz *et al.* (2004) suggest that students' *reflection* upon the experience of authentic practice – rather than merely participating in it – is a critical element of learning the nature of science. For such reflection to be meaningful requires "a cognitive disengagement from the authentic context of scientific identity", or in other words "to consider the nature of authentic practice, one must mentally step out of that context" (Schwartz *et al.,* 2004: 638). In relation to the 'process approach' which focuses on the authentic practices of scientists in a simulated environment, Wellington (1998: 5;) argues that it was "based on the myth that the skills and processes of science (observing, inferring, predicting and so on) could be divorced from the knowledge base; namely the laws and theories of science". Authentic practice in an apprenticeship or simulated mode, then, may be limited in its ability to expose students to what Hodson (1998) terms the three key justifications for science learning: to *learn* science, *learn to do* science and to *learn about* science.

7.4.2 The significance of contexts for practices

This sub-section considers how the process of recontextualisation impacts upon disciplinary science by exploring the epistemic contingencies of the different contexts. The range of activities considered here relate to what we could term traditional school science, and may be distinguished from the purposefully 'authentic' curriculum models referred to above, although a traditional curriculum could also incorporate some aspects of those models.

A useful analysis of the impact of different contexts upon science 'inquiry' practices is provided by Chinn & Malhotra (2002). A framework derived from studies of the history, philosophy and psychology of science was used to analyse and compare simple inquiry tasks (practical experimental activities) as they are presented in science textbooks and authentic science as it is carried out by practising scientists. Chinn & Malhotra (2002) report a number of differences between the school tasks and the authentic tasks, which includes the following:

- Scientists generate their own research questions whereas research questions are provided to students;
- Scientists select or invent their own variables from many possibilities, but students are usually provided with one or two variables to measure or observe;
- Scientists build and revise theoretical models, whereas students uncover surface-level regularity;
- Scientists coordinate theoretical models with multiple sets of conflicting data in order and seek global consistency, while students usually work with one set of results in order to achieve local consistency;
- Scientists' reasoning is uncertain, employing non-algorithmic and heuristic methods, while students use algorithmic reasoning in order to derive the conclusion from an experiment;
- Scientists refer to the published results and arguments of others and work within institutional norms, while students, although also possibly working in collaborative groups, do not refer to earlier research or work within institutional norms.

What these differences between the school context and the disciplinary context mean for Chinn & Malhotra (2002) is that:

> many scientific inquiry tasks given to students in schools do not reflect the core attributes of authentic scientific reasoning. The cognitive processes needed to succeed at many school tasks are often qualitatively different from the cognitive processes needed to engage in real scientific research. Indeed, the epistemology of many school inquiry tasks is *antithetical* to the epistemology of authentic science.
>
> (Chinn & Malhotra, 2002: 175, emphasis in original)

These observations resonate with the view of the school context as ersatz discussed earlier in this chapter. However, we can, through this analysis, gain a clearer view about the nature of the effects of recontextualisation. For example, Hodson (1998) suggests that embedded in the activities within school practical work are a number of *myths* about science, which he lists as shown below:

1. Observation provides direct and reliable access to secure knowledge.
2. Science starts with observation.
3. Science proceeds via induction.
4. Experiments are decisive.
5. Science comprises discrete, generic processes.
6. Scientific inquiry is a simple, algorithmic procedure.
7. Science is a value-free activity.
8. The so-called 'scientific attitudes' are essential to the effective practice of science.
9. All scientists possess these attitudes.

(Hodson, 1998: 95)

This suggests that the effects of recontextualisation may be to not only create a *discontinuity* between the disciplinary and school context, such as that described by Brown *et al.* (1989) and Lave & Wenger (1991), but it may also bring about something new and qualitatively different; namely, a mythical understanding. This mythical understanding is, as Chinn & Malhotra (2002: 175) argue, antithetical to the epistemology of authentic science: it presents science "as a fixed, algorithmic process" where "scientists are portrayed as possessed of a superior rationality and an all-purpose method for arriving at the truth" (Hodson, 1998: 93). Clearly, such a mythical understanding appears to be the likely source of criticisms of the traditional school science curriculum as being inauthentic.

Practices are associated with specific purposes. When discussing authentic science in the apprenticeship mode, I previously referred to Hay & Barab's (2001) assertion that students working in authentic contexts are unable to participate in the executive functions associated with scientific practice, i.e. activities involving planning and identifying tasks and goals. In this way, they do not gain an insight into the purposes of the (authentic) practices. The existence of a mythical form of understanding which is suggested by Chinn & Malhotra's (2002) analysis of simulated scientific practices also indicates the importance of purposes which relate to activities in different contexts. After all, the school context and the disciplinary context are underpinned by quite different purposes.

These differences in purposes are highlighted by Greiffenhagen & Sherman (2008) when they consider in detail the difference in contexts and practices between science practice and classroom practice. This particular focus centres upon the notion of conceptual change in science education and how this is theorised by Piaget and Kuhn. Both Piaget and Kuhn theorise the nature of scientific progress. Science education and other literature frequently compare individual students' conceptual change to Kuhn's notion of the 'paradigm shift'. However, Kuhn's analysis is based on the community of scientists rather than on individuals. Greiffenhagen & Sherman, (2008: 12) suggest that "Kuhn would object to [conceptual change]'s 'psychologising' or 'individualising' of his history of science". It is suggested that there is an erroneous model in the literature, the conceptual change literature in particular, of both school science and of common sense:

> In order to be able to apply Kuhn's notions of 'conceptual change' and 'scientific revolution' to what happens in schools, [conceptual change] needs to treat what children already know about the natural world as something akin to a scientific theory, since for Kuhn the change is between two *comparable* things. That is to say, in Kuhn's version of paradigm shifts within science, both the new and the old paradigm serve a similar purpose or aim (although the new paradigm may be more successful at certain aspects).
>
> (Greiffenhagen & Sherman, 2008: 14-15, emphasis in original)

This is contrary to certain models of science education which aim to treat children as scientists. What is argued here is that children are not scientists in the sense of discovering something new, rather they learn what others have discovered: "[children] might learn something new for themselves (‘personal discovery’), but what they learn has been known for a long time (i.e., is not a ‘scientific discovery’)”. We need to recognise, it is argued, that “pupils and scientists are just not doing the same thing. No curriculum or pedagogy can change this (logical) observation” (Greiffenhagen & Sherman, 2008: 22). This is self-evident, although some models of science education may attempt to devise student activities which are premised on the idea that children *can* act like scientists.

Much conceptual change and constructivist science education literature refers to students’ misconceptions about science and their naive theories (e.g. Driver *et al.*, 1994). However, if we take seriously the observation that children are not engaged in the same practices as scientists, we can point to another interpretation of the difference in common sense knowledge and scientific knowledge which is not based on immature or incorrect thinking. Greiffenhagen & Sherman (2008: 22) observe that “what pupils learn in school science does not address ‘inadequacies’ in common sense” in the sense that it helps them to resolve anomalies in their observations of the world:

> Pupils do not participate in school science lessons with the anticipation that what they will learn might help them to solve problems that they have been struggling with for some time. Their life outside school is ‘in order’ before and after instruction in school science—although they may as a result be able to do new things.
>
> (Greiffenhagen & Sherman, 2008: 22)

Science knowledge, then, is an expansion and specialisation of students' everyday knowledge rather than a replacement of it. The writers conclude that:

> [conceptual change] mystifies what goes on in school science classrooms to the extent that it treats what pupils know as a set of proto-scientific, ontological beliefs. What pupils have to learn in school science is difficult and it is worthwhile finding ways of helping pupils with acquiring this new and difficult material. However, this is a pedagogical, not an ontological, problem.
>
> (Greiffenhagen & Sherman, 2008: 23)

The important point to draw out from these discussions of Kuhn and Piaget relates to the differences in the epistemological practices in school, in everyday and in professional scientists' communities of practice.

7.4.3 Summary: the recontextualisation of practice

The first and perhaps most significant conclusion concerns the relation between meaning and practices which are intimately related to the purposes of the practices in the different contexts. In short, even though practices may be 'authentic', it does not necessarily follow that those carrying out those practices will experience a meaning which is authentic. Osborne (2009: 400) citing Sartre (1969) summarises this point very effectively when he asserts that "authenticity is not a given but has to be earned and results from a commitment by the individual to seek understanding and purpose in any activity". In other words, if authenticity is defined as a surface level phenomenon which can be discerned from inspection of the activities in which participants are engaged, then it neglects to recognise the significance of meaning and purpose. From an *educational* perspective, what matters is what students learn from the activity. As Ford & Forman (2006: 11) point out, if "students are merely engaged in trivial aspects of science (e.g., holding a test tube), then it is unlikely that they are "taking away" what is deemed important in that discipline".

Secondly, and following from this first point, it is important to recognise that students are engaged in very different contexts which relate to different purposes. These purposes may impact upon the experience of meaning such that it is difficult to disentangle it from the context. This has two consequences in relation to promoting authenticity in a school context. First, it is difficult to take from the authentic context that which is at the core of the authentic practice in order to transplant it elsewhere. Brown *et al.* (1989: 34) express this problem as follows:

> apparently peripheral features of authentic tasks—like the extralinguistic supports involved in the interpretation of communication—are often dismissed as "noise" from which salient features can be abstracted for the purpose of teaching. But the context of activity is an extraordinarily complex network from which practitioners draw essential support. The source of such support is often only tacitly recognized by practitioners, or even by teachers or designers of simulations. Classroom tasks, therefore, can completely fail to provide the contextual features that allow authentic activity.
>
> (Brown *et al.,* 1989: 34)

Similarly, it is difficult to identify how those aspects of routine classroom practice – which are learned by teachers and students over years of experience – will impact upon recontextualised practices in such a way as to render that practice inauthentic (Brown *et al.,* 1989: 34; Ford & Wargo, 2007).

Thirdly, the role played by scientific knowledge is different within the different contexts. Practising scientists are primarily engaged in applying and creating new knowledge, whereas the role of students is to learn existing, canonical scientific knowledge. The function of experiments in 'real' science is such that they provide the basis of an argument for individual (or more usually groups) of scientists to advance the knowledge within a particular field. This knowledge is validated according to established norms, which are partly social but are also supported by material reality (Longino, 2002). For students, by contrast, the primary aim is to advance their own knowledge of established science. As Greiffenhagen & Sherman (2008: 14-15) point out, this knowledge is related to, but is not in the same category as, their own, everyday knowledge of the world. For students to genuinely act as scientists, the place of established science is compromised since students generally do not posses sufficient knowledge to design suitable experiments or to interpret them.

On the basis of these observations, then, I suggest that disciplinary scientific practice inevitably changes upon recontextualisation, fundamentally altering the epistemology of practice (Chinn & Malhotra, 2002: 175). What emerges is not only an 'ersatz' version of authentic activity, but a mythical version of science. This is not an arbitrary collection of beliefs, however, but a version of science underpinned disciplinary science.

7.5 The recontextualisation of discourse

7.5.1 Talking/writing/reading science

In this section, I turn to the recontextualisation of scientific discourse. As outlined in an earlier section, my approach here is to retain a distinction between practice and language. This is contrary to sociocultural perspectives which "situate language centrally with respect to science practice" (Sadler, 2007: 2). Although it is true that language and practice are mutually constitutive within an overall Discourse (Gee, 1996) as I discussed earlier, such an approach can tend to obscure the place of disciplinary knowledge. Therefore, for the purposes of this section, the definition of scientific discourse I employ is similar to that provided by Brandt (2008: 828): "a formal discussion of the sciences in either speech or writing in an academic context, using highly technical terminology to describe or explain the natural and physical world".

The role of language in learning science has been of interest to researchers for some time (Duschl & Osborne, 2002). Recently, such discussions have also taken place within the field of scientific literacy research. Writers such as Norris & Phillips (2003) argue for consideration of the fundamental sense of literacy within scientific literacy since the existence of disciplinary science and students' access to it is intrinsically dependent upon writing and the interpretation of texts. While science has traditionally been viewed as a 'hands-on' activity, Phillips & Norris, (2009) suggest that its primary characteristic is as a 'minds-on' process since, for example, practising scientists spend up to two-thirds of their working time engaged in reading, writing and speaking.

Many researchers, particularly those working within systemic functional linguistics (SFL), have explored the distinctive features of the language, grammar and genres of scientific discourse. Halliday & Martin (1993) argue that scientific writing is significantly different from everyday language such that students should be specifically taught the grammar of scientific genres and its appropriate usage within scientific discourse. Halliday claims that scientific knowledge cannot be represented in everyday language because “the conceptual structures and reasoning processes of physics and biology are highly complex and often far removed, by many levels of abstraction, from everyday experience” (Halliday, 1993: 70). Everyday language and scientific language are therefore incommensurable. Several writers have suggested that this is the biggest barrier for students in learning science itself (e.g. Lemke, 1990; Wellington & Osborne, 2001). Thus, researchers in the sociocultural tradition suggest that students need to be engaged in a ‘border crossing’ between everyday language and scientific language (Aikenhead, 2006). Other researchers, notably Lemke (1998), also highlight the multi-semiotic nature of scientific language, including words, graphs, diagrams, images, gestures and mathematical signs.

7.5.2 The recontextualisation of scientific discourse

In examining the recontextualisation of scientific discourse I will focus primarily upon the science textbook. Although there are many linguistic resources within science classrooms that could be explored, the science textbook is perhaps the primary example of recontextualisation of scientific discourse. A number of writers have noted the significance of the role of the textbook in the careers of science students, particularly in the field of physics (Kuhn, 1963; Traweek, 1988; Nespor, 1994) and other researchers highlight the enduring influence of textbooks in shaping science classroom activities and discourse, even within the networked age (Dimopoulos *et al.*, 2005; Abd-El-Khalick *et al.*, 2008; van Eijck & Roth, 2008).

Bernstein (2000: 34) suggested that physics textbooks are rarely written by practising physicists – they are written by authors working in the field of recontextualisation. Dowling (2009: 83), however, counters that such an observation misses the point, since those who write university level textbooks (which are significantly different from research papers) generally are practising physicists. In other words, textbooks serve particular purposes within the field of recontextualisation, whether written by practitioners or not.

Myers (1992) carried out a textual analysis of the differences between a science research text and a science textbook and points out a number of differences which relate to the accreditation of 'facts', or how 'facts' are established. He observes that textbook authors "try to arrange currently accepted knowledge into a coherent whole, whereas authors of journal articles try to make the strongest possible claim for which they think they can get agreement" (p. 4). His comparison of research and pedagogic texts across a checklist of linguistic features highlights a number of differences which I summarise here:

- Both texts are found to contain both personal and impersonal subjects, although impersonal subjects dominate in both. However, the use of the personal subject plays a different role. In the research text, the use of the impersonal subject indicates an action for the author(s) (e.g. ‘we now show’) whereas in the textbook it serves to mark out a specific section for the reader (e.g. ‘we will consider’). The use of personal pronouns therefore takes on quite different meaning within the two texts.

- Textbooks and research texts show differences in their use of tense. In the research text the past tense generally refers to methods used in relation to existing knowledge (an account of an experimental procedure for example), whereas the use of the present tense refers to established facts. In the textbook, examples of the use of the past tense are rare; they are “bits of human interest that keep leading back to the facts in present tense” (p.4).
- While ‘polite statements’ of new claims within the research text are frequently hedged, such claims are presented as accredited facts in the textbook. Fewer hedges are used in the textbook and where they are used, they refer to areas of knowledge where there is no established consensus.
- The research article is held together by noun phrases which require much disciplinary knowledge in order to infer meaning as a whole, while relations between nouns are more explicit in textbooks.
- Textbooks generally refer to a narrow range of literature, and articles cited are generally reviews rather than papers advancing the original claim. However, textbooks do refer to other parts of the textbook, reinforcing the “self-contained nature of the text” (p. 5). Research texts, by contrast, refer to a wide network of other texts which are themselves cited in other papers in order to provide support for an argument and to make claims more difficult to

challenge.

- Illustrations such as photographs, diagrams and graphs are used as a part of evidence in research texts; their function is to persuade the reader. In textbooks they are used in a more supplementary way in order to enhance the text: illustrations are used pedagogically in textbooks, while they are used rhetorically in research texts.

This analysis shows that the textbook genre recontextualises disciplinary texts in such a way as to strengthen the status of claims as facts. Myers (1992: 7) observes that "fewer and fewer claims remain, but the claims that do remain become more established as facts". Furthermore, differences such as the use of personal and impersonal subjects, the use of tense and textbooks' lack of references to original research papers decontextualises knowledge, moving it from the specific to the general or to the abstract.

This emphasises the recontextualisation process as a process of translation. This translation perhaps has a particular form within science as a result of its cumulative nature (or, perhaps, it is what makes the knowledge within the subject cumulative). For example, Barnett (2006) observes that:

> Newton's ideas are central to classical mechanics teaching in physics and engineering, but no one would dream of serving up raw chunks of the *Principia* (even when translated from Latin into English) in school or university courses.
>
> (Barnett, 2006: 145-146)

This can be contrasted with social science or humanities subjects where original sources are more likely to be used in an educational context. On the other hand, science research papers are unlikely to cite the *Principia* either, since "the truly established fact does not need to be stated at all" (Myers, 1992: 4) [9]. Scientific knowledge, then, must move on in a cumulative way – as Whitehead observes, "A science that hesitates to forget its founders is lost" (cited in Kuhn, 1963: 350).

Another more recent study by Sharma & Anderson (2009) considers the way in which scientific discourse is recontextualised 'from lab to school'. In their analysis Sharma & Anderson (2009) propose that four main distinguishing features of scientific discourse may be identified: the concealment of rhetoric, use of grammatical metaphors, empirical evidence as a rhetorical tool, and double-edged addressivity. I will give a brief outline of these features and how they are recontextualised below.

Concealment of rhetoric is the appearance of objectivity within scientific texts which obscures their social construction and makes them appear "hard, solid and hence objective and true", presenting an "edited, even distorted, image of scientific inquiry" (Sharma & Anderson, 2009: 1255). What might appear to be a neutral report on scientific work is in fact a rhetorical device to convince colleagues. They suggest that "what gets reported is a highly sanitized image of how science is done" (Sharma & Anderson, 2009: 1255). This is also what is reported by sociologists of science and even, as Sharma & Anderson also observe, by some scientists themselves (Medawar's, 1963, *Is the scientific paper a fraud?* is one well-known example). The process of recontextualisation, argue Sharma & Anderson, maintains this denial of rhetoric and

[9] Although, strictly speaking, Newton's theory has been superseded by Einstein's work.

thus “presents and perpetuates a simplistic and incorrect picture of science and scientific inquiry among students” (Sharma & Anderson, 2009: 1266).

The use of grammatical metaphors is an important feature of the language used by scientists within the rhetoric communicating their experiences. Citing Halliday (2004), Sharma & Anderson (2009) observe that grammatical metaphor is the prime linguistic device in the construal of meaning in scientific discourse. This concerns the distinct scientific meanings which are allocated to specific word groupings and allows for the precise communication of *scientific* meaning and its persistence over time. Examples of scientific grammatical metaphors include: ‘plant growth’, ‘crop failure’ or ‘particle spin’. Sharma & Anderson (2009: 1257) observe that a consequence for the learner is the “creeping in of semantic ambiguity in texts”, the increasing abstraction from everyday meaning and the development of an image of science which is anti-democratic and elitist to outsiders. This feature of scientific discourse is also retained under recontextualisation; grammatical metaphors, particularly in the form of nominalization, characterise school textbooks (although as Myers (1992) writes, textbooks may aim to make their meaning more explicit). Thus nominalization both abstracts from experience and that which is observable, compacting meaning to the extent that for students the knowledge that it represents becomes abstruse and ambiguous.

The role of empirical evidence as a rhetorical tool concerns the relationship between rhetoric and the way in which consensus is achieved about the meaning of sets of experiences, patterns and models. As I have outlined in the previous section, practical work takes on a different meaning for students compared with practising scientists. In addition, Sharma & Anderson (2009) argue that empirical evidence has a different role in illustrating scientific concepts rather providing the basis for arguments. This appears to be similar to Wong & Hodson's (2008) observation about the role of some school laboratory activities as *theatre*: providing evidence for established knowledge, or demonstrating an idea. Unlike in research where few models or theories arise from a wide base of empirical experience, the reverse is the case in textbook science where a broad range of theories need to be discussed in relation to a narrow base of empirical examples. It is suggested that:

> scientific knowledge as a loosely related package of facts, definitions, sequences of events and problem-solving descriptions would, perhaps, be a fair description of school science. The organization of these elements in textbooks tends to be that of a linear narrative. Thus the ongoing, contested dialogues of scientific communities are transformed into ''canonical stories'' that provide authoritative accounts of the world as science has discovered it to be.
>
> (Sharma & Anderson, 2009: 1264)

The addressivity of scientific texts refers to its orientation in relation to other texts and audiences. In scientific discourse this is achieved such that it seeks to engage others in a dialogue, but also assumes a large amount of shared knowledge. Thus, as Sharma & Anderson observe, this addressivity is "double-edged – it includes (insiders) and excludes (others) at the same time" (Sharma & Anderson, 2009: 1260). Under recontextualisation, Sharma & Anderson argue that addressivity undergoes the most profound change of each of the characteristic features of scientific discourse. They argue that:

> The heteroglossic discourse wherein the multiplicity of voices that contest, respond, commingle and build upon each other in a commonly shared space, gets transformed into a relative monoglossic, unitary school science discourse on its journey from lab to classroom. Within a classroom, one voice and discourse, that of the science textbooks, dominates over that of the students.
>
> (Sharma & Anderson, 2009: 1266)

The result is that science becomes a discourse which is primarily authoritative rather than internally persuasive: science texts are not "addressed to an equal, but to someone considered inferior in knowledge, status and power relations" (Sharma & Anderson, 2009: 1266). This invites a monologic transmission of information from the teacher than dialogic exchange with students. The implications in terms of the school context, then, include the emergence of an authoritative discourse which can only be transmitted to students but not appropriated by them.

7.5.3 Summary: the recontextualisation of discourse

In the account that I have given of the recontextualisation of scientific discourse, the principal differences between discourse in the disciplinary and school context concern the decontextualisation of discourse from its original purposes, context and from other texts. Myers (1992) refers to development of factual statements in textbooks and Sharma & Anderson (2009) highlight the authoritative nature of recontextualised scientific discourse. I would argue, however, that all scientific discourse, whether in a school or research context, is or aims to be authoritative. Perhaps a stronger term would be more appropriate: school science becomes *authoritarian* since it loses what

Sharma & Anderson (2009) term its internally persuasive nature and its link to empirical evidence.

Alongside other features of scientific discourse which distinguish it from everyday language (Halliday & Martin, 1993) – which are not much changed under recontextualisation – through this analysis we can gain more insight into the possible origin of the criticisms of traditional school science. Lemke (1990) for example, points to a number of 'stylistic norms' which characterise traditional school science discourse. These norms include the avoidance of: colloquialisms, personification, metaphoric and figurative language, human experience, reference to fiction or fantasy and to narrative and dramatic accounts (Lemke, 1990: 133-134). For Lemke these norms "are a recipe for dull, alienating language" (p. 134) and perpetuate the "mystique" and mystification of science – the myth of science's infallibility and its opposition to common sense.

7.6 The educational context

The previous section has argued that recontextualisation changes disciplinary practices and discourse in the following ways:

In relation to scientific practices in the educational context:

- Authentic disciplinary practices may not necessarily be experienced in such a way as to retain their authentic meaning and purposes
- The range of practices in the educational context may interact with authentic

disciplinary practices in ways which are difficult to determine

- The role played by scientific knowledge is different compared with its role in the disciplinary context
- The epistemology of practice is fundamentally changed

In relation to scientific discourse in the educational context:

- Discourse strengthens the status of claims as facts and abstracts it from original research texts
- Discourse tends to become not only authoritative, but authoritarian

This section explores how we might respond to these observations and discusses how the educational context can be viewed from a socio-epistemic perspective. There are two broad approaches to addressing the problems concerning disciplinary authenticity within the educational context. These are, first, to seek to establish an approximate form of local authentic epistemology within the school context. The second approach focuses upon the culture of the school context itself and emphasises the participation of students within its discursive practices. In this section I argue that both of these approaches fail to adequately address the difference between contexts from a socio-epistemic perspective and propose an alternative view which draws upon aspects of both these approaches.

7.6.1 Responses to the problem of authenticity

Some writers suggest that it is possible to develop classroom activities which are locally epistemologically authentic with respect to disciplinary knowledge (e.g. Hutchison, 2008; Steinbring, 2008). Such approaches attempt to avoid the problems of transporting disciplinary authenticity into the school context which were described earlier. For example, Ford & Forman (2006: 3) suggest that classroom activities could be designed around the way in which the discipline decides upon knowledge claims, a process which they term a 'grasp of practice'. Such an approach is mindful of the need for disciplinary authenticity, but also seeks to emphasise what students learn from the activities. Ford & Forman (2006) draw upon the science studies literature in order to define the roles that students should play such that they engage with the discipline in an authentic way. They identify two distinct roles – constructor of claims (about facts, method and values) and corresponding critiquers of these claims. Students must therefore learn to play both of these roles in a way which is appropriate to the function of the practice. Such a model therefore simulates both the social aspects of science and its material aspects (through the use of data, observation and so on). It allows students, argues Ford & Forman (2006: 27) to "position or author themselves in that practice".

The second approach – what Cobb & Bauersfeld (1995) refer to as a 'collectivist' viewpoint – emphasises the distinction between school and disciplinary contexts. Here, the role of the microculture of the school is foregrounded. An example is Solomon's (2008) research which focuses upon students' participation in a social or discursive practice defined within the school. Students are initiated into – in this case – mathematics as a social practice. Solomon (2008: 163) writes that "the practices of mathematics are part of an established community: this means that mathematics is not therefore negotiable without participation in that community". Problems of ritual behaviour, such as those identified by Edwards & Mercer (1987), are thus dealt with as an inevitable part of participation in collective practice. Students' early participation may consist of "a certain amount of "joining-in" behavior which, although it may be at another's bidding and in that sense not autonomous, is nevertheless situated within the discourse" (Solomon, 2008: 182). Critical issues within such a framing of the educational context include the role of teacher authority and the distinction between epistemic and social authority (Solomon, 2008).

Neither of these approaches, however, fully address two concerns: the socio-epistemic differences between contexts and the particular focus within this thesis to explore how students develop a relationship with disciplinary knowledge.

In terms of epistemological authenticity, while there may be elements of this approach which might be workable in the classroom, it appears unlikely that it would be possible to overcome all the differences between contexts described earlier. This is particularly true if students are to engage with the full range of scientific 'content' which comprises typical school curricula. Rather, it is more likely that epistemological authenticity could only be achieved on a dynamic, moment-to-moment basis, and for a limited range of topics. Such 'productive moments' are heavily contingent on the specifics of a situation and the experiences of participants; upon a "present–moment relationship to knowledge" (Tochon, 2000: 333) and would be difficult to plan in advance (Steinbring, 2008). From the broad perspective adopted here, it is argued that epistemological authenticity, which is derived from disciplinary authenticity transferred to a school context, may only be achieved in a dynamic and emergent fashion. This is one implication of the fact that school and disciplinary contexts have different purposes and knowledge has a different status in each context.

This situation is recognised in the collectivist view: in privileging the local context, the approach acknowledges that students are learning what is essentially, and by definition, an alien discourse which originates from another context. However, what this perspective does not address is the link between school discourse and practices and those of the corresponding discipline. In other words, it does not recognise the disciplinary origins of the discursive practices in school which relate to a 'subject', and also – crucially – does not theorise the means by which students may progress from a school to disciplinary context.

7.6.2 The role of myths about knowledge

I have argued that neither a collectivist view (which privileges the local context as a discourse community) nor a locally authentic perspective adequately accounts for the socio-epistemic differences between disciplinary and school contexts. In order to focus on the epistemic nature of the school context – to recognise that which distinguishes it as an *educational* context (Schulz, 2009), I argue that it is necessary to consider the role played by scientific knowledge within the context and the nature of students' 'participation' in relation to it.

Since there is a disconnection between meaning and practices in disciplinary and educational contexts, it is likely that students need to participate in one epistemic community in order to eventually participate in another. Lemke (1997) also makes this point when he highlights the possibility that students (and others engaged in learning) need to participate in different communities of practice in order to master the practices which are integral to some other community. This is distinct from other cases in which "participation in the same activity in which the form is learned is sufficient to also learn its meaning" (Lemke, 1997: 43). This is not the case for all communities, as I have also argued. This is because, schools do not "preach what they practice … they teach about practices of other communities" (p. 52) and these practices can only be fully understood in relation to the purposes embedded within their authentic settings. Lemke expresses this very well when he observes that:

> It is not enough to hang around with lawyers or doctors or scientists, to assist them, to learn to speak part of their lingo, even to become very good at some of their visible practices to begin to be counted as one of them. You also have to have been schooled in their mysteries, taken certain (even functionally irrelevant) courses, bear certain credentials, have passed certain rituals. The CoP [communities of practice] of schools and the CoP of practitioners are linked, but they are not identically the same CoP.
>
> (Lemke, 1997: 43)

This participation in another practice forms a bridge between, in this case, the disciplinary and school contexts. Lemke proposes a link between communities of practice, but does not explicitly explore the nature of that link. What Lemke does not seem to do is to relate his observations about participation in different communities of practice to his (and others') analysis of myths about knowledge and the 'mystique of science' (Lemke, 1990). For Lemke, these myths still appear to only have the status of incorrect assumptions or exclusionary attitudes or practices.

I argue that these myths are not just an inevitable consequence of the differences in context, but rather that they are part of a necessary link between the contexts. Lemke (1997: 43) himself alludes to this when he refers to the significance of mysteries and rituals. Lave & Wenger (1991) also point to the significance of the role of stories in talking about a practice. I will pursue these questions in the next chapter when I suggest that rather than obscuring students' insight into disciplinary practice, myths and stories about knowledge constitute an important element of a disciplinary narrative which acts as a carrier for the culture of the discipline. However, as I will argue, these stories are epistemological in nature and are not only linked to the customs and practices of schooling.

The proposal that is made here about the significance of myths about knowledge therefore adopts some of the insights of both collectivist and locally authentic approaches. It recognises that in an educational context students are engaging in a specific social practice, but does not disconnect this practice from the disciplinary context. As will be argued in the next chapter, mythical accounts are also integral to authentic disciplinary practice.

7.7 Conclusion

This chapter has demonstrated how a socio-epistemic theoretical lens sees the recontextualisation of scientific knowledge within the school context. It has revisited some of the problems highlighted within sociocultural theory about the nature of formal educational contexts, but which are not addressed by that theory.

In my analysis of the epistemic differences between contexts, I have pointed to possible explanations for the ersatz nature of the school context, as it is characterised by Brown *et al.* (1989) and Lave & Wenger (1991). By showing how and why the nature of the practices or discourse changes, a greater insight into what makes the school context 'inauthentic' is provided. This chapter has suggested that efforts to promote 'authenticity' are limited for reasons which are fundamental to the nature of the school context. Such an insight is difficult to conceive of within sociocultural theory. This is because sociocultural theory tends to neglect the place of disciplinary knowledge and fails to consider what students "take away" from the educational context, preferring to focus on what students do in the context (Ford & Forman, 2006). Consequently, perhaps, sociocultural theory can tend to slide towards relativism, although this is not necessarily the case. This chapter, by focusing on the epistemic nature of communities and how they articulate with each other, maintains a realist view of knowledge, in contrast to some sociocultural approaches which might focus on disciplinary discourse as exclusionary or elitist. The conclusions of this chapter concerning the role of myths about knowledge also provide a new perspective on the positive function of 'ersatz' practice.

In setting out the means by which I intended to explore the recontextualisation of science, I argued that practice and discourse should be considered separately in order to maintain a focus upon disciplinary knowledge. This is not to deny, however, that practices and discourse also constitute each other as Gee (1996) describes within the notion of 'big D' Discourse. The analysis in this chapter found that comparing disciplinary and school contexts shows that the epistemology of practices changes: practices take on different meanings as they serve different purposes in the contexts and scientific knowledge takes on a different role. Scientific discourse was shown to become decontextualised and authoritarian. Both analyses also indicate the development of mythical understandings. But given that practice and discourse do constitute each other, the two analyses are also complementary in some respects. To some extent the findings can be generalised across practices and discourse. For example, it is likely that scientific knowledge also plays a different role within discourse, as it does for practice. In relation to practice in the school context, it has been argued that scientific knowledge is a product of the community of scientists, not the community of students. This is why practice has a different purpose for students. By extension, it is possible to suggest that scientific knowledge has a different role within classroom discourse.

I have pointed to the possible role played by myths and stories about knowledge which may serve as a disciplinary narrative linking the two contexts. These myths appear as the dogmatic, authoritarian school science discourse criticised by researchers such as Osborne *et al*. (2003a) when writing about the traditional school science curriculum. The next chapter will explore this further and suggest that such a mythical disciplinary narrative plays an important role in developing students' relationships with knowledge.

By highlighting how practices and discourse change upon recontextualisation this chapter has started to address research question 4: 'Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students' relationships with knowledge in educational contexts?'. By expanding upon the role played by myth, chapter 8 will address the latter part of this question.

Chapter 8: The role of disciplinary narratives within the educational context

8.1 Introduction

This chapter develops the idea that myths about knowledge play a role in bridging between school and disciplinary contexts. It focuses on the notion that myths about knowledge – and specifically about scientific knowledge – are not only the inevitable products of recontextualisation, but are also fundamental to developing students' relationships with knowledge. This chapter argues that such myths constitute a particular type of narrative about knowledge which is disciplinary in nature. It is suggested that this disciplinary narrative has a relation to, but is not the same as, other forms of narrative use which are currently advocated by some science education researchers in order to enhance student engagement.

Scientific knowledge and school science have been the focus of the previous two chapters. This focus has enabled a discussion about specific knowledge and its epistemic relation and has served to mitigate the problems associated with only speaking about knowledge in general terms. My concern in this thesis, however, is not with science or science education *per se*; rather it is about how students develop relationships with disciplinary knowledge. Therefore, this chapter starts to address how the conclusions of the thesis may be abstracted and generalised from the specific case of science to other subjects and disciplinary areas.

The next section explores the role of myths *as* narratives of and about disciplinary science in the school context. Implications of these ideas are then drawn out in the following two sections. Section three assesses the extent to which this chapter's conclusions about the role of disciplinary narratives elaborates upon the model for forms of knowledge. Section four examines how the notion of disciplinary narratives may serve to reconcile the seemingly incommensurable aspects of sociocultural and Bernsteinian/social realist theory. Section five discusses the generalisation of the conclusions in terms of the variation in knowledge structure between disciplines and considers factors which may need to be considered in applying the conclusions to vocational knowledge. The penultimate section explores the implications for teaching and learning from a theoretical perspective – implications in terms of application in the field are considered in the concluding chapter. The conclusion to this chapter summarises how research questions 4 and 5 have been addressed – the research questions as a whole are considered in chapter 9.

8.2 The role of myths and narratives

This section builds upon the previous chapter's analysis of epistemic practices and discourse in disciplinary and educational contexts. Chapter 7 examined science and science education as a specific case and explored how the disciplinary community's epistemic resources in terms of practices and discourse are recontextualised in the school context. The separation of practices and discourse allowed the influence of the different socio-epistemic contexts to be clearly identified while also recognising that other contingencies of context also exist. This analysis provided useful insights into issues such as the limitations upon authentic disciplinary practice in the school context, how disciplinary epistemology changes and how the process of recontextualisation gives rise to mythical understandings. It also pointed to the possibility that students may need to participate in separate practices – and also perhaps in a separate discourse – in order to join the disciplinary community (Lemke, 1997).

This chapter acknowledges, however, that the analysis is incomplete for two reasons. First, because practices and discourse do constitute each other; and second, because the analysis is limited in the extent to which it acknowledges the school context as a socio-epistemic context itself. This section explores the implications of this wider perspective and develops the arguments that were suggested at the end of the previous chapter about the role of myths and narratives in developing students' relationships with knowledge.

8.2.1 Practice and discourse

The previous chapter referred to Gee's (1996: viii) notion of Discourse: "ways of being in the world", where, language is seen as being "fully attached to 'other stuff': to social relations, cultural models, power and politics, perspectives on experience, values and attitudes, as well as things and places in the world" (p. vii). These connections to 'other stuff' were bracketed out in the previous chapter – since otherwise all of these factors would surely eclipse the focus on the discipline. I will now consider this wider perspective in the light of the previous analysis. What does it mean to consider scientific practices and discourse as Discourse in this wider sense? In order to explore this point, I will again focus on science textbooks, since, as has previously been noted, they not only provide stable representations of recontextualised discourse but also have a significant influence on teaching and learning practices in the science classroom (Dimopoulos *et al*., 2005; Abd-El-Khalick *et al*., 2008; van Eijck & Roth, 2008).

It is suggested that there are two ways in which textbooks may be viewed from this Discourse perspective. First, textbooks may be conceptualised as not only the source of recontextualised scientific language or representations of scientific practice; they are part of the overall practice of science education as contextually-bound artefacts. In this interpretation, they are as important for the 'knowledge' they 'contain' or represent as they are for the role they play in shaping what could be termed the 'life-world' of students and teachers. Perhaps it is unsurprising that good examples of analyses which illustrate something of this come from non-specialists or 'outsiders' reporting on ethnographic studies of physics students (e.g. Traweek, 1988; Nespor, 1994). Nespor (1994) for example, rejects ideas about learning physics as the transmission of facts towards a view of physics students moving within spatialised and temporalised activities which connect them to the discipline. Nespor explores the:

> pathways and trajectories that entangled [physics students] in the discipline's representational productions of space-time. Although this entanglement didn't make students practicing physicists in any sense, it did crucially connect them to the discipline. The media of this connection were the textbooks, notetaking, and problem-solving practices that involved the students in the use of equations and mathematized representations and mobilizations of the world.
>
> (Nespor, 1994: 53)

It is also worth noting that these ideas provide a means of moving beyond sociocultural theory's emphasis upon individuals participating in "pristine or local small-scale" (Nespor, 1994: 9) communities of practice; rather, in Nespor's words, it allows students to be viewed as being "defined, enrolled and mobilized along particular trajectories that move them across places in a network and allow them to move other parts of the world into that network" (p. 9).

While these ideas are compelling, they are also – rather like communities of practice theory – hazy in their conceptualisation of knowledge itself and unclear about the role of the meanings experienced by participants and how this shapes the field of practice. Therefore, while Nespor can be vague about what his conclusions imply in terms of actually learning physics, he does provide an insight into the effect of the stabilisation of knowledge that is achieved within textbooks and the function of this in students' learning trajectories.

For the moment, then, what I suggest can be taken from this is a wider sense of connection between school and discipline. Importantly, as Malcolm & Zukas (2005: 8) observe, Nespor's approach recognises that students are not only "being prepared to participate at a later stage in professional fields of practice – they are participating in those fields already". Therefore, these ideas also resonate with the separate yet bridging form of school practice which is implied by Lemke (1997: 43).

The second way in which textbooks may be conceptualised within a Discourse perspective is to speculate about their role in transmitting what we could refer to as a ‘scientific culture’[10]. Gee suggests that a Discourse also incorporates “the ‘right’ ways to think, feel, and behave” (Gee, 1996: ix) and that it can “be used to identify oneself as a member of a socially meaningful group or ‘social network’” (Gee, 1996: 131). In other words, while it is clear that textbooks do transmit scientific knowledge, what role do they play in transmitting a ‘culture’ in the sense that Gee describes? Gee writes that “all Discourses are the products of history” (Gee, 1996: 132) and that Discourses speak through individuals, but how is this Discourse spoken through the textbook?

It is suggested that viewing practices and discourse from a Discourse perspective opens out the kinds of possibilities and questions that have been outlined above. However, it is important to maintain an epistemic focus – to discuss these issues in terms of the knowledge involved. In the light of the observations made above, I therefore turn to my second assertion about how chapter 7’s analysis was limited. It was suggested that this analysis under-emphasises the school context as a distinct socio-epistemic context itself. It primarily viewed the school context as a boundary or

[10] Trowler (2008: 1) notes that “‘Culture’ is an extremely slippery word” and that some approaches lack precision in the way they use the term. ‘Scientific culture’ is placed in scare quotes here to indicate the possibility of a culture-like understanding which aligns with Gee’s concept of Discourse. It is, therefore, not an ‘organisational’ culture, which would refer to a more detailed level of analysis. Nor does it attempt to identify any variation in the way culture is experienced. In that it calls upon the notion of ‘culture’ it aligns to some extent with the TLC project’s notion of a cultural approach to learning, but does not relate to a specific ‘learning culture’. Rather, it loosely calls attention to the idea of a ‘knowledge-related culture’ employed by Knorr-Cetina (1999: 2), although perhaps not strictly speaking an ‘epistemic culture’ which relates more closely to epistemic practices. It should be noted, however, that Knorr-Cetina highlights both the diversity of epistemic cultures within the sciences and deviation from its idealised characterisation. Snow (1993) proposed the existence of a scientific culture and highlighted the ‘mutual incomprehension’ between the ‘two cultures’ of science and the humanities. Snow’s vision of a scientific culture centres on notions of progress and optimism and an appreciation of scientific ways of knowing. In the sense that it is concerned with the nature of belonging and affiliation, it aligns with the meaning of ‘culture’ alluded to here.

container for disciplinary science's discourse and practices, rather than recognising the school context's own history and purposes[11]. While this analysis provided an insight into the possibilities for disciplinary authenticity, it did not address the school context's own epistemic practice. The sub-section below now draws together how the wider Discourse perspective on practices and discourse may be reconciled with a socio-epistemic view of the school context and disciplinary knowledge by drawing on Kuhn's observations about the role of science textbooks.

8.2.2 Textbooks within a Discourse perspective

Although talking about education at university level, Kuhn observed that science education is "conducted entirely through textbooks" (Kuhn, 1977: 228). It is possible to extend this observation to science education at lower levels, and as previously noted, textbooks continue to be highly significant in science education today. Kuhn's observation that textbooks provide a Whig history of science is well known: textbooks tend to present scientific knowledge only in terms of its development to produce the currently accepted version of knowledge, bracketing out details such as the blind alleys of scientific investigation or other more factual contingencies of scientific progress. In *The Structure of Scientific Revolutions* Kuhn suggests that:

> Textbooks thus begin by truncating the scientist's sense of his discipline's history and then proceed to supply a substitute for what they have eliminated. Characteristically, textbooks of science contain just a bit of history, either in an

[11] Edwards (2009) and other contributors to Edwards *et al.* (2009) also discuss the notion of learning context as container, however their focus is largely upon exploring relational understandings of learning contexts rather than on educational contexts as containers of disciplinary discourse and practices.

> introductory chapter or, more often, in scattered references to the great lessons of an earlier age … science textbooks (and too many of the older histories of science) refer only to that part of the work of past scientists that can easily be viewed as contributions to the statement and solution of the text's paradigm problems. Partly by selection and partly by distortion, the scientists of earlier ages are implicitly represented as having worked upon the same set of fixed problems and in accordance with the same set of fixed canons that the most recent revolution in scientific theory and method has made seem scientific. No wonder that textbooks and the historical tradition they imply have to be rewritten after each scientific revolution. And no wonder that, as they are rewritten, science once again comes to seem largely cumulative.
>
> (Kuhn, 1996: 137-138)

In addition, these observations apply not only to scientific knowledge itself, but also to scientific method (Bauer, 1992: 113-114).

In terms of the disciplinary field of production, textbooks reflect the stabilisation of knowledge – they reflect the operation of 'normal science' through their depiction of the accepted paradigms within the field (Myers, 1992; Bertomeu-sánchez *et al*., 2006). As Kuhn observes, a consequence of this is a strengthening of the cumulative nature – or the cumulative structure – of the knowledge involved, as it is represented in the textbook. In terms of textbooks as didactic texts, the process thus demands students' commitment to the dogma of established knowledge and techniques, such that science education "remains a relatively dogmatic initiation into a pre-established problem-solving tradition that the student is neither invited nor equipped to evaluate" (Kuhn, 1963: 351). Such a situation results in a tension between tradition and innovation (Kuhn, 1977), since “scientists are *trained* to operate as puzzle-solvers from established rules, but they are also *taught* to regard themselves as explorers and inventors who know no rules except those dictated by nature itself” (Kuhn, 1963: 368, emphasis in original).

Where Kuhn recognises the function of dogma, writers such as Lemke (e.g. 1990) do not appear to do so, since they prefer to focus upon the emergence of a mythical and inaccurate scientific history. Like Lemke, Kuhn also acknowledges that scientific knowledge is distorted through this process, but significantly, he asserts that there are “good reasons why, in these matters, [textbooks] should be systematically misleading” (Kuhn, 1996: 137). This distortion has a purpose – the result is that:

> both students and professionals come to feel like participants in a long-standing historical tradition. Yet, the textbook derived tradition in which scientists come to sense their participation is one that, in fact, never existed.
>
> (Kuhn, 1996: 138)

In relation to the moral implications of misleading students, Kindi writes that:

> Kuhn does not recommend abusing the trust that students bestow upon teachers and the educational process. He is laying bare how the practice of science develops. He describes the conditions that make it possible. The authors of textbooks, who are usually themselves accomplished scientists, do

> not set out to deceive their readers. They tell them what they themselves believe.
>
> (Kindi, 2005: 724)

It is important to recognise the precise form of the 'distortions' in recontextualised science, and what Lemke refers to as 'myths' about science that are advocated by Kuhn as being both inevitable and beneficial. Some writers point to Kuhn's role in the development of postmodern ideas about knowledge – although they are mainly referring to his wider analysis of the role of social factors in the development of scientific knowledge rather than specifically to his views about textbooks (e.g. Latour & Woolgar, 1986). But Kuhn strongly rejected the association of his work with postmodernism or with the 'Strong Programme' within the sociology of scientific knowledge (Nola, 2000; Matthews, 2004). Importantly, Kuhn is not suggesting that *any* myth will suffice as scientific knowledge for students; rather, he is proposing that intrinsic to the process of the communication of science and to the function of the community of scientists, is the mythical version of scientific ideas and the role of dogma within those myths.

Furthermore, Kuhn's observations do not only refer to science students but also to scientists themselves. Rather than engaging in purposeful fabrication, textbook writers give an account based on their own beliefs (Kindi, 2005: 724), such that both students and pedagogic recontextualisers "come to feel like participants in a long-standing historical tradition" (Kuhn, 1996: 138). Scientists themselves also provide accounts of their *own* research in order to "make the history of science look linear or cumulative" (Kuhn, 1996: 139).

It appears that Kuhn's account of the Whig history of distorted science is reflected in many of the criticisms of the traditional science curriculum discussed in chapter 6. However, as Kuhn observes, these myths are not just a by-product – they have a role in science education and in science. They assist in creating what Medawar, writing about the scientific method, refers to as "a dialogue between fact and fancy, the actual and the possible; between what could be true and what is in fact the case" (Medawar, 1982: 110). In particular, they are strongly linked with the epistemological structure of science as it is understood or narrated in a recontextualised setting: this is the cumulative and hierarchical structure. The observations of sociologists of science, then, who have pointed to the difference between science as it is practised and science as it is represented (e.g. Latour & Woolgar, 1986, Latour, 1987; Knorr-Cetina, 1999) may furnish us with a more accurate account of science practices, but, according the argument outlined above, it is not an account which is integral to science practice.

As discussed in chapter 6, advocates of scientific literacy approaches emphasise that their curriculum model is aimed towards *consumers* of scientific knowledge rather than *producers* of it" (Millar, 2006: 1505, emphasis in original). From Kuhn's perspective, however, students following traditional curricula are also consumers of scientific knowledge in a fundamental sense.

8.2.3 Disciplinary narratives and other narrative forms

According to Kuhn, a distorted history or account of science plays an important role in science and in science education. Although Kuhn does not explicitly discuss Whig histories in these terms, it is clear that these kinds of accounts are ways in which the discipline as a whole is narrated in the school context through the textbook.

In a slightly different way, Allchin (2003) explores the role of narrative in science education. He focuses upon the historical stories employed in textbooks to portray the processes of science – for example, Mendel's research on inheritance in pea plants or Fleming's discovery of penicillin. Allchin's argument is that, due to the narrative form employed in their communication, the result again is mythical understandings. These are not just misconceptions of science, but what he terms *myth*-conceptions, which are characterised as follows:

- monumentality – scientists are portrayed as larger-than-life, heroic characters;
- idealisation – narratives incorporate a streamlined plotline which Allchin relates to Kuhn's Whig history of science;
- affective drama – narratives employ rhetorical devices to enhance the story's persuasive or entertainment value;
- Explanation and justification – narratives seek to persuasively explain and justify the authority of science. Allchin writes that these narratives are not 'just' science stories; they are 'just-so' stories which are underpinned by a specific lesson or moral.

Although Allchin restricts his discussion to historical stories or anecdotes, it is possible to relate these observations to the narrative of science as a whole. Allchin (2003: 341) suggests that "all narratives of science and of scientists risk drifting into myth". If we accept the conclusion that science in the school context is a narrative in the way that Kuhn describes, then Allchin's observations point to more detailed characteristics of narratives, particularly those which relate to historical accounts.

Nevertheless, the subject of Allchin's analysis is historical stories, while Kuhn's substantive focus is on the Whig history of the discipline as a whole. In the previous chapter I referred to Kuhn's (1963: 350) quotation of Whitehead's observation that "A science that hesitates to forget its founders is lost". However, Kuhn later suggests that:

> [Whitehead] was not quite right, for the sciences, like other professional enterprises, do need their heroes and do preserve their names. Fortunately, instead of forgetting these heroes, scientists have been able to forget or revise their works.
>
> (Kuhn, 1996: 138-139)

This suggests that there is a relation between historical narratives and Whig history narratives. In some cases, they may essentially amount to the same thing, but at other times historical narratives may provide for additional interpretations or 'companion meanings' (Östman, 1998) that are implicit in mythical accounts, particularly heroic stories of science. Milne (1998: 184), for example, observes that some heroic stories imply that only "male scientists have the courage and self-determination to stand against forces outside science, while female scientists are drudges who study minute things in great and uninspiring detail". It is important, therefore, to be aware of ways in which some of the perhaps more peripheral details of these mythical narratives might convey unintended messages to some social groups.

The function of narratives in science education has been discussed by researchers over the years and is also the focus of current interest. Research has considered the role of narratives in different ways, including, like Allchin, historical narratives (e.g. Solomon, 2002; Metz *et al*., 2007), contextual narratives (Stinner, 1995), personal narratives (Boström, 2008; Levinson, 2008) and fictional narratives (Avraamidou & Osborne, 2009). Many of these analyses are in fact concerned with different ways in which science may be recontextualised – in a similar sense to my discussion of conceptual and contextual coherence in chapters 5 and 6. But a number of these other narrative types appear to play a role similar to that of the historical narratives discussed above.

For the purposes of this thesis, my emphasis is upon recontextualised science as a narrative, rather than on the use of particular narratives for pedagogical purposes. In some cases, however, these two ideas converge, since a particular narrative may be composed of a number of elements including a narrative *of* science and its methods and a narrative *about* science or scientists, which may refer to history, context, or personal experience. The primary point I wish to make is that recontextualised science is a narrative whether it is explicitly recognised as such or not.

Researchers who advocate the use of narratives frequently refer to the difference between a narrative mode of communication and other modes which are found within the school context and beyond (e.g. Bruner, 1986; Egan, 1997). Before concluding this section, I will briefly consider this distinction but will also return to it in section four.

In their discussion of the use of fictional narratives in science education, Avraamidou & Osborne (2009) refer to the work of Klein (2006) who, drawing upon research in second generation cognitive science, highlights the fuzzy and contextual nature of individuals' knowledge and the largely metaphorical and narrative characteristics of everyday language. Klein suggests a model for science education that "mediates between everyday, narrative speech and scientific explanation and argumentation by combining talk and writing; having students write informal, speech-like texts and narrative-argument blends" (Klein, 2006: 171). The argument is thus for the use of narrative modes since they match more closely to everyday language and speech when compared with the denotative nature of the language within science textbooks.

To some extent, the conclusions of this chapter support this, but with some important caveats: namely, that within this we also need to recognise the significance of literacy in its fundamental sense and the importance of the fixities of scientific texts for science (Norris & Phillips, 2003). In other words, science could not be represented by an entirely oral, or oral-like narrative. So, it is suggested that other narratives have a function around these texts, complementing but not replacing logico-mathematical thinking (Hadzigeorgiou, 2005). Additionally, in my interpretation, the fixity of the scientific texts in science education contexts represents another kind of narrative – the narrative of the discipline.

8.2.4 Conclusion: disciplinary narratives

This chapter has suggested that the narration of science produces a disciplinary narrative which is intrinsic to the socio-epistemic nature of the school context. It is argued that the school context does not only *contain* disciplinary science's practices and discourse, providing a boundary around them and limiting the possibilities for authenticity, it also constitutes a socio-epistemic context itself. This socio-epistemic context is primarily concerned with the narration of the discipline which rests upon mythical understandings. In relation to Gee's Discourse perspective, it can be suggested that these myths then constitute a link between the school context and the disciplinary context: they are an important element – if not *the* important element of 'scientific culture'. This is what links the two communities but also transcends and underpins them both.

This provides the analogue of the separate context of practice that was proposed by Lemke (1997). Lemke suggests that students may need to participate "in some other [community of practice] or engage in some other practices in order to master or be counted as having mastered the practices of the first [community of practice] (Lemke, 1997:43). The narratives of disciplinary science and their associated myths appear to fulfil this role. They represent a separate discourse from what is, strictly speaking, disciplinary discourse, but this separate discourse underpins both contexts. As Lemke also says of the practices he discusses, some of them may be irrelevant or based upon ritual and the same could be said of mythical narratives since they also allow those who engage with them to "travel along the connections between the networks of school and professional practices" (Lemke, 1997:53).

In chapter 6, I referred to Schulz's (2009) distinction between the utilitarian question 'what do we educate people in science for?' and the more fundamental question 'what does it mean to be educated?'. The notion of the disciplinary narrative provides the means to address this second question. Instead of focusing on students as more or less competent authentic practitioners, or as more or less knowledgeable persons, the previous chapters have investigated the socio-epistemic process of science learning. The notion of the disciplinary narrative is an outcome of that exploration and provides a greater insight into the nature of *education* in contrast to considerations of how much students know or what they might do with their knowledge.

In conclusion, it is suggested that myths about science inevitably result from the process of recontextualisation and they also have a function in wider scientific practice and communication. This process of recontextualisation has also been characterised as a process of narration. While I have emphasised the place of the disciplinary narrative, other types of narrative (e.g. historical, personal or fictional) may also fulfil this role – or they may be employed to enhance the disciplinary narrative. In these cases, attention needs to be given to other unintended messages (e.g. in relation to gender). The notion of a disciplinary narrative, then, connects the school context with the disciplinary context and provides us with a means by which the school context as a distinct socio-epistemic context may be conceptualised.

8.3 Disciplinary narratives and the scientific literacy debate

To some extent, the notion of disciplinary narratives reconciles some aspects of traditional approaches to the science curriculum and scientific literacy approaches. Scientific literacy approaches also advocate the use of media stories about science and certain forms of narratives about science. But within scientific literacy approaches such resources are employed to enhance 'relevance' and application to 'real life' in order to promote student engagement. In contrast, within the framework suggested here, the focus is upon enhancing an exploration of the disciplinary narrative.

It has been argued that many aspects of the traditional curriculum which are criticised by scientific literacy proponents are an inevitable aspect of recontextualisation, for example the cumulative nature of knowledge and a content-heavy curriculum. A focus on the disciplinary narrative and the role of other stories in relation to it, are therefore suggested as the basis upon which issues relating to student motivation and disengagement could be addressed.

A much broader point can also be made in relation to how scientific literacy itself may be conceptualised. As I have outlined, many aspects of this debate are concerned with whether science education should aim to produce a trained workforce, an informed citizenry, or simply to achieve the purpose of making science more popular. I have already noted that the notion of disciplinary narratives provides an alternative view which centres around the question of what it means to be educated. But there is another sense in which we can consider the instrumental purposes of education. Earlier, I quoted Wheelahan's assertion (in relation to competence based training [CBT]) that:

> CBT assumes that outcomes can be achieved by directly teaching to the outcomes, and in doing so ignores the complexity that is needed to create *capacity*, and this goes beyond the level of experience in the contextual and situated.
>
> (Wheelahan, 2007b: 648-649, emphasis in original)

In other words, it appears that scientific literacy approaches attempt to flatten out social and epistemic relations as I discussed in chapter 5. In order to retain a depth ontology, it may be that this requires us to view scientific literacy as an *emergent* property of society rather than as a characteristic (or set of skills, or knowledge) held by an individual. Such a conceptualisation would recognise that while everyone may engage with the disciplinary narrative to some extent, only a minority would actually practise science in a disciplinary context. As I have suggested, the disciplinary narrative underpins the knowledge of both citizens and practitioners.

8.4 Elaboration upon the model for forms of knowledge

This section returns to the model for forms of knowledge and explores the insights into the model that may be provided by the notion of disciplinary narratives. The model is shown again in Figure 8.1 below:

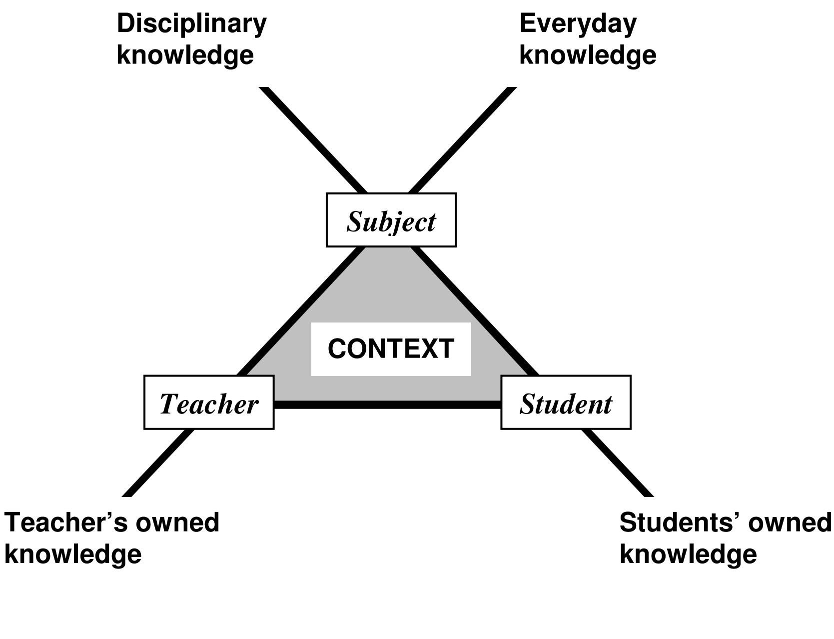

Figure 8.1 Model for forms of knowledge within an educational context (from chapter 2)

Koulaidis & Tsatsaroni (1996) point out that the process of recontextualisation of disciplinary knowledge to the educational context is not only one of simplification of knowledge. Rather, this knowledge is reproduced, or reconstructed within the school setting. This is undoubtedly the case, but still such a conceptualisation implies, at least, a process in which knowledge is cascaded from the field of production down into the field of reproduction: knowledge moves from the discipline into the subject. The analysis in this thesis, however, suggests a more complex process which disrupts this uni-directional model in a number of ways. As has been shown, scientific knowledge plays a different role in the recontextualised setting – students are primarily concerned with learning established scientific knowledge rather than generating new knowledge. Disciplines, on the other hand, as epistemic communities, are essentially concerned with the production of new knowledge. This process relies upon the established knowledge acquired by practitioners through the process of schooling; through the long apprenticeship into scientific dogma they undertake as science students. In this sense, then, rather than only viewing disciplines as underpinning school subjects, we can also view subjects as underpinning disciplines.

New scientific knowledge inevitably becomes part of the school curriculum, and while this new knowledge must displace some aspects of existing content, this process is slow and new knowledge remains a small proportion of the curriculum as a whole. It is true that the older 'traditional' curriculum looks different from a newer 'traditional' curriculum, but these differences are less to do with the inclusion of new 'canonical' knowledge, than they are to do with new contexts of application, different practices in schooling (less challenging mathematics, fewer requirements to recall information, more inclusive language, and so on) than with new scientific knowledge.

These ideas, then, bring the discipline and subject together and indicate a relationship between them in which knowledge can be thought of as not only moving from discipline to school subject. It has been argued that disciplinary and school contexts are linked by means of myths about knowledge which arise from the narration of the discipline. These disciplinary narratives, it is suggested, not only link the two contexts, but provide a shared culture between them. Within this conceptualisation, students are not thought of as pre-professional initiates who may join a disciplinary community at some future time: they are already part of the culture, although they may not yet practise in the disciplinary epistemic community. It has been argued that disciplinary narratives are crucial in understanding the relationships with knowledge which are instrumental in facilitating students' learning of 'scientific content' in the more conventional sense.

The educational context, viewed from a socio-epistemic perspective, can be understood as one in which disciplinary knowledge is narrated. It is suggested that this is the primary purpose of the educational context. Strictly speaking, these narratives do distort disciplinary knowledge, but this distortion is not only inevitable due to the contingencies of the context, but is intrinsic to the disciplinary 'culture'. These mythical disciplinary narratives link to aspects of the teacher's and students' owned knowledge, but do not allow for owned knowledge to *replace* disciplinary knowledge: the myths are not arbitrary since they are bound up with the narrative of the discipline.

I previously drew upon Paechter's definition of owned knowledge as knowledge which "positions its possessor as an acting subject, able to use her or his knowledge in a dynamic way" (Paechter, 1998: 174). Disciplinary narratives are suggested to link to students' and teachers' owned knowledge because the narrative form is a fundamental mode of understanding (Bruner, 1986) in everyday life. Furthermore, it is suggested that wider narratives in the form of science stories may also play a role in this mechanism. These stories, although tending to promote stereotypes, are widespread in popular culture and aspects of these are familiar to students (van Eijck & Roth, 2008: 1060). They provide another resource for exploring disciplinary narratives, though they must be used with caution.

Although it is not suggested that this accounts for the *whole* of the teacher's or students' owned knowledge, it does point to a means by which aspects of those forms of knowledge may be engaged within the educational context, either as a native form of meaning-making, or by drawing upon, but not wholly adopting, familiar cultural references. It is this mode of communication and of understanding that is suggested to provide a link between the forms of knowledge in the model, to provide a basis for conceptualising the nature of the educational context and to provide a foundation for the way in which relationships with disciplinary knowledge are developed.

8.5 Reconciling Bernsteinian/social realist and sociocultural theory

The relative insights and limitations of Bernsteinian/social realist theory and sociocultural theory have been highlighted at different points within the preceding chapters. This section highlights the key ways in which the notion of disciplinary narratives and their associated mythical understandings serve to address some of these limitations and to reconcile the insights of one theoretical area with the other.

In essence, it has been argued that while sociocultural theory acknowledges the significance of context for the experience of meaning, it does not attend to the experience of meaning which is *disciplinary*. But while sociocultural theory in a sense tends to be blinded to epistemological concerns by the context, Bernsteinian and social realist theories, it was argued, tend to under-theorise the socio-epistemic nature of contexts. As has been described, the proposed solution to this problem was to explore the socio-epistemic nature of contexts, and to frame the problem as being concerned with the articulation of epistemic communities rather than being about the articulation of forms of knowledge. In other words, the thesis has explored the social epistemology of the interface between disciplinary and educational contexts.

It was suggested that the 'articulation of knowledge' approach can tend to impose a 'conceptual change' model of knowledge acquisition which ignores the different purposes and meaning of knowledge in different contexts. The strategy of framing the problem as one of articulation of different epistemic communities, therefore, has the effect of imposing a realist view of knowledge into sociocultural theory, since when sociocultural theorists do attend to the issue of knowledge, they can be drawn towards a relativist view of knowledge, treating everyday knowledge and teacher' and students' owned knowledge as being in the same category as disciplinary knowledge.

Both sociocultural theory and Bernsteinian/social realist theory are concerned in different ways with the authenticity of the school context: sociocultural theorists refer to school practice as 'ersatz' (e.g. Brown *et al.,* 1989; Lave & Wenger, 1991) while

Bernstein (1990) refers to school subjects as ‘imaginary’. The model for forms of knowledge and how it has been elaborated through the current conceptual analysis views the educational context as an epistemic context itself. Although in some respects the educational context is ‘ersatz’ or ‘imaginary’ in relation to the disciplinary context, under this theorisation it is not seen as a poor reflection of some remote or ideal disciplinary context. Rather it views it as being part of the culture of the discipline which is maintained through a narrative. This, therefore, not only provides a connection, but establishes subject and discipline within the same epistemic network which is also constitutive of each other. This provides more substance than, for example, Wenger’s (1998) or Lemke’s (1997) claims that students should have ‘connections’ to the discipline in some unspecified way and addresses the limitations upon disciplinary authenticity in educational contexts. A greater insight is thus provided into the processes by which students may acquire the powerful knowledge that social realist researchers advocate. It establishes a new perspective into the nature of disciplinary recontextualisation and into the nature of the connections with the disciplinary community.

Lave & Wenger (1991) point to the role of stories in fashioning the identities of participants in communities of practice. The notion of disciplinary narratives suggested here is both a story *about* a practice, in the sense that Lave & Wenger (1991) intend, but is also a narrative *of* a practice: it is what is necessary to speak the discipline in these contexts. Lave & Wenger (1991: 109, emphasis in original) suggest that it is “necessary to refine our distinction between *talking about* and *talking within* a practice”. Under the conceptualisation offered here, another mode of talking is suggested: one which might be described as talking *within a practice within a* *context*, a context which has specific socio-epistemic characteristics.

This is direct consequence of the contrast between Lave & Wenger's (1991) focus upon informal, apprenticeship modes of learning and the focus in this project upon formal educational contexts. As Greiffenhagen & Sharrock (2010, in preparation) observe, the purposes of, for example, Lave & Wenger's apprentice Liberian tailors and school students are much different: the tailors learn a restricted range of skills while they are located within the practice. Formal educational contexts, particularly at school level, have different purposes: students engage with a wider range of knowledge, which – crucially – develops their *capacity* to eventually participate in any one of a number of professional practices. The socio-epistemic purposes of the contexts, therefore, are different.

The notion of the disciplinary narrative is not so distant from Bernsteinian and social realist theory. Chapter 3 introduced Bernstein's model of knowledge discourses and structures. Knowledge discourses, Bernstein (1999) argues, in the form of vertical and horizontal discourses, provide a language of description for disciplinary or theoretical knowledge and everyday knowledge. Furthermore, within vertical knowledge discourse two main forms of knowledge structure were suggested: horizontal knowledge structures and hierarchical structures. There are two ways in which the notion of disciplinary narratives relates to Bernstein's notion of knowledge discourses and structures.

First, disciplinary narratives in a sense bridge between the form of meaning-making between horizontal and vertical discourse, but without resorting to 'pedagogic populism' (Bernstein, 1999: 161): avoiding the consequences for knowledge of 'relevant' approaches that Bernstein and others highlight (Muller, 2000; Moore, 2004; Wheelahan, 2007b; Young, 2008b). Bernstein (1999: 159) argues that horizontal discourse "is likely to be oral, local, context dependent and specific, tacit, multi-layered, and contradictory across but not within contexts". Although Bernstein does not refer to narratives, this model of segmental pedagogy and its relation to horizontal discourse surely relates to a narrative mode of communication. And, although I do not suggest that all science can be learned in this way, or that all science can be represented in a form which takes on these characteristics, it is possible to view this, more native form of meaning-making as playing a role alongside other more denotative language forms, as has been suggested in section 8.2. Exploiting these aspects of horizontal discourse characteristics within disciplinary narratives, then, avoids the problems which have been described earlier in relation to the pedagogic use of everyday knowledge or horizontal discourse, usually for less able students (e.g. Dowling, 1998).

Second, the notion of disciplinary narratives points to a different interpretation of the notion of knowledge structures. Although, as writers such as Young (2008a) and O'Halloran (2007) have pointed out, Bernstein's models of knowledge structures may be idealised, or too clear-cut, they are nevertheless compelling ideas and appear to capture the essential characteristics of the nature of disciplines. But perhaps we should be more cautious about this, since as Muller (in Christie *et al*., 2007: 249) suggests, it "may be that all knowledges are virtual, and come to light only by conscious effort on the part of pedagogic recontextualizers". I pointed out in chapter 5 that "the concept of verticality in relation to specific subjects or disciplines may be in part tacit, remaining in some indeterminate state, waiting to be called upon for a specific purpose in order to be realised, to be made real". In other words, it is suggested here that the very idea of a knowledge structure is itself a narration of the discipline, although it might not be a *narrative* of it – although in some ways it is this too since the notion of the cumulative nature of knowledge is such an intrinsic aspect of science. The key point is that in the discipline being 'realised, being made real': the disciplinary narrative comes into play as soon as this starts to occur.

This also points to a different interpretation of the social construction of knowledge. Constructivism, however, is a notoriously slippery term. Young (2008b) suggests that there are two broad interpretations of social constructivism, the first, 'interest-based' which emphasises power relations, and the second, 'process-based' which focuses upon the contextual nature of knowledge – a sociocultural approach. An over-emphasis on either of these forms of constructivism, argues Young, leads to the equation of knowledge with knowers, making knowledge arbitrary. In order to reconcile a realist account of knowledge with the reality of social processes, social realism emphasises that disciplinary knowledge depends in part for its objectivity upon the social networks of practitioners. In a sense this observation brings social construction into a realist framework within the field of production. In a similar way, the current analysis has carried out an analogous task but for the field of reproduction. It allows for knowledge to be socially constructed through disciplinary narratives (socially constructed since it is dependent upon the socio-epistemic characterises of the context), but *not* for it to be arbitrary. This is because mythical accounts are intrinsic to the narration of the discipline within a context.

The conclusions of this thesis, then, provide some ways in which Bernsteinian/social realist theory and sociocultural theory may be reconciled and also suggests ways in which some of their insights may be reinterpreted. This thesis does not propose that the notion of disciplinary narratives replaces either theory, rather it argues that such an idea, by encompassing the insights of both sets of theories, provides a different view of the formal educational context from a socio-epistemic perspective.

To conclude this section, I will briefly consider the problem of the 'transfer of learning'. As has previously been noted, transfer is not addressed satisfactorily by either theoretical framework. Although it is not claimed in this thesis that a solution is found for the all the problems of knowledge transfer, it is suggested that the notion of disciplinary narratives and their associated mythical understandings provide a new way of thinking about how transfer takes place. In relation to the problem of transfer, sociocultural researchers might emphasise the limits upon the decontextualisation of knowledge (knowledge is situated) without really recognising that nevertheless transfer does take place or that it is an important function of education. Hodkinson *et al.*'s (2008) solution to the problem of transfer, for example, that "There is no learning to transfer. There are people who have learned, who learn as they move and learn after they have moved" (Hodkinson *et al.*, 2008: 43), essentially dodges rather than addresses the problem. We rely on the fact that learning and knowledge must transfer. Social realist researchers, meanwhile, might wish to promote cumulative rather than segmented learning (Maton, 2009), but not sufficiently acknowledge that knowledge has different meanings in different contexts, or that knowledge might play a different role. Recognising how knowledge is narrated within the socio-epistemic confines *and* purposive framework of the educational context, however, allows us to view transfer differently. In this interpretation, knowledge is transferred culturally, but it is not only dropped into an existing ‘learning culture’ (Hodkinson *et al*., 2008: 34), although this also occurs as well. The difference lies in understanding the educational context also as an epistemic context which is already connected to the disciplinary context.

8.6 Generalising to other subject areas

This section considers what factors may need to be taken into account when generalising the conclusions of this chapter to subjects and disciplines other than science. The specific context of science has been important in generating these conclusions, and so in some respects the implications for practice which are discussed in the next section and in the concluding chapter are most closely bound to that disciplinary area. However, it is suggested that the method of analysis and the pedagogic implications in terms of the relevance of disciplinary narratives and the role played by myths about knowledge may be generalised to other subject areas.

In terms of Bernsteinian and social realist theory, what distinguishes science from other disciplines is its hierarchical knowledge structure. In the previous section it was suggested that in one sense this hierarchical structure is a function of the manner in which the discipline is narrated. However, this does not make this ‘structure as narrative’ unimportant, as there are, as my socio-epistemic analysis has suggested, good reasons why the narrative should be of this form: it is not ‘only a narrative’ after all.

There are a number of ways, however, that the exclusivity of the description of science as hierarchical (i.e. possessing a strong vertical structure) may be moderated. First, because – as previously mentioned – science may not be quite as hierarchical as supposed; and, second, because other disciplines – even ones with stereotypically horizontal knowledge structures – also consist of some elements of verticality. Furthermore, in the way discussed by Christie & Macken-Horarik (2007), curriculum designers may endeavour to enhance the degree of verticality within their subjects. This points to the possibility that the conclusions of this chapter may directly transfer to other disciplinary areas. In other words, other disciplines consist of elements of a hierarchical structure too: they also have their mythical understandings, Whig histories and debates about authenticity.

Earlier in this thesis, I discussed the relation between knowledge structures and curriculum structures. Like other theorists who have considered this question (e.g. Maton & Muller, 2007; Luckett, 2009), I have suggested that there is likely to be a link between them: this is shown through the case study of school science. In chapter 6 it was suggested that the model of contextual coherence tends to marginalise the place of disciplinary knowledge in the science curriculum which indicates the unsuitability of this form of curriculum coherence to science. This also supports the notion that disciplinary narratives are instrumental in communicating disciplinary culture; and, in a sense too, this could be interpreted as placing limits on the way in which verticality may be imposed upon the horizontal disciplines, although it appears to be more likely that this process is more selection than imposition.

It may also be useful to consider how the analysis which has been presented in chapters 6 and 7 may apply to other disciplinary areas. Do other disciplines, for example, behave in a similar way when different models of curriculum coherence are applied to them? Do other disciplines experience the same constraints upon authenticity within the educational context? It seems likely that disciplines other than science do behave slightly differently: they are probably more amenable to different models of curriculum coherence, and it is possible that there is more scope for authentic performances in the educational context because of the horizontal disciplines' 'knower code' (Maton, 2007). In arts subjects this is most likely to be true, but for the humanities and social sciences I suspect it is less so. Therefore, the conclusion suggested here is that, since these disciplines are not in a pure horizontal form, disciplinary narratives and myths about knowledge also apply, but that this is mediated – and perhaps obscured to a greater extent – within these subject areas.

However, an important proviso needs to be attached to these observations, namely that it is necessary, as I have argued, to attend to the epistemic relation – what knowledge is about. This is particularly crucial when considering the idea that if a cumulative structure is part of the way in which science is narrated, then perhaps a horizontal structure is part of the way in which horizontal knowledge structure disciplines are narrated. At first sight it is difficult to imagine how this might constitute a disciplinary narrative, but as Maton's (2007) analysis of the 'Two Cultures' debate (Snow, 1993) shows, the disciplinary narrative of the humanities, for example, may be centred around the dispositions or 'gaze' of knowers. A more detailed analysis might reveal aspects of mythical understandings around this form of structure. The existence of a 'cultivated appreciation' within the arts and humanities may, like the myths about science that have been discussed, constitute a significant aspect of these disciplines' narratives.

The discussion above has been restricted to academic knowledge: to Bernstein's singular knowledge structures (Bernstein, 2000). I will now consider how these observations may apply to regions, or to vocational and occupational subject areas. As has previously been suggested, this case is more complex since it involves the recontextualisation of both disciplinary knowledge and fields of practice (Barnett, 2006: 152; Wheelahan, 2007a). In relation to this, it may be important to consider ways in which the disciplinary narrative occupies the same context as other narratives central to the practice. In particular, since disciplinary narratives also relate to aspects of identity, for vocational areas, it would be necessary to explore how these identity concerns relate to other identity issues within vocational socialisation. For example, Colley *et al*. (2003) drawing on the work of Bourdieu, propose the notion of 'vocational habitus' which dictates "how one should properly feel, look and act, as well as the values, attitudes and beliefs that one should espouse" (p. 488). Depending on the vocational area involved, then, there may be a number of ways in which the disciplinary and vocational habitus or narrative may interact in constructive or destructive ways.

8.7 Theoretical implications for practice

As a number of writers have pointed out, different perspectives on the process of learning may readily be described in terms of a range of metaphors. Sfard (1998) for example, describes two competing metaphors for learning as participation or as acquisition. Such metaphors are important since they act as an unconscious guide for thinking and practice, and surfacing teachers' tacit metaphors about knowledge can be illuminative (Martnez *et al*., 2001). Other writers focus upon how metaphors might be applied to the role of the teacher. The self-images that teachers have – described in terms of role metaphors – have an important impact upon their pedagogical thinking, their selection of teaching strategies and how they conceptualise their function in society (Ben-Peretz *et al.*, 2003). Metaphors for the teacher's role which may be suggested to correspond to Sfard's (1998) acquisition and participation metaphors may include teachers as dispensers of knowledge (the acquisition metaphor) or teachers as facilitators, co-participants or guides (the participation metaphor). These two metaphors represent a dominant duality in educational thinking. Acquisition appears to align with 'knowing that' while participation aligns with 'knowing how'; acquisition tends to correspond to conceptual change, while participation corresponds to sociocultural approaches (McGuinness, 2005).

The conclusions of this chapter suggest another metaphor, however – that of the teacher role as narrator of knowledge. Many writers have pointed to the role of stories and storytelling in teaching, and to teachers as storytellers (e.g. Egan, 1986; Stinner, 1995; Hadzigeorgiou, 2006; Boström, 2008). However my emphasis is more concerned with an orientation to knowledge which is implied within the overarching metaphor of narrator, rather than storytelling as a pedagogical strategy itself. This does not, however, exclude the use of storytelling strategies, and indeed such ideas are also encompassed within the overall metaphor of narrator. Within the narrator metaphor, storytelling may or may not be used since the concern is with an orientation towards an engagement with the overall disciplinary narrative. The conclusions of this chapter indicate a number of considerations for pedagogic practice which follow from the significance of teachers' awareness of their disciplinary knowledge as a narrative of the discipline.

First, it requires that teachers have a clear grounding in what that narrative is. This observation aligns with Muller's assertion that the "condition for a teacher being an authoritative pedagogical agent is, at the minimum, an internalized map of the conceptual structure of the subject, acquired through disciplinary training" (Muller, 2007: 82). This idea points to the importance of not only adequate subject knowledge, but that this subject knowledge needs to be located within the overall narrative of the discipline. It also suggests that current resource issues within science education such as, for example, physics being taught by non-specialists (Royal Society, 2007; Smithers & Robinson, 2008) is problematic since these teachers may not possess such a map of the conceptual structure, although they might, strictly speaking, be knowledgeable about the specific content they are teaching. In other words, teachers need a wider understanding of their discipline's knowledge than that which relates to a particular lesson or course's learning outcomes.

Second, teachers need to be able to recognise the ways in which particular narratives are narratives of the discipline and they must be able to distinguish these from other peripheral narratives. Earlier in this chapter I drew attention to some of the less desirable aspects of heroic accounts of science, particularly in relation to communicating messages about gender. It is therefore important to be able to identify what other meanings may be associated with such stories, and, importantly, how they relate to social justice issues and the other narratives which are present within the educational context. So, more broadly, this indicates a concern with the different identities of the participants involved and how these are recognised, marginalised or celebrated within narratives associated with the subject. Writers within the field of science education such as Lemke (2001), Roth & Lee (2004) and Aikenhead (2006) have also explored these types of interaction between students' self-identities and the identities which traditional science classrooms appear to impose upon them. Aikenhead (2006: 108) for example, suggests that when "students' cultural self-identities do not harmonize with the cultures of scientific disciplines, many students enter a science classroom feeling as if they have crossed a type of cultural border". The pedagogic strategies that these writers suggest to address these issues, however, are counter to the conclusions of this thesis. Rather, it is suggested that teachers should seek positive identities for students grounded within the disciplinary narrative and other positive models derived from stories about the discipline and perhaps other fictional and cultural accounts (e.g. in the media). This is not to say that these ideas should be central to science or other subject classrooms, but rather that teachers should be aware of their peripheral role in enhancing student engagement, or in mitigating disengagement. Essentially, while these other stories and narratives (e.g. heroic stories) may well be usefully employed alongside and as a part of the disciplinary narrative, the main focus advocated here is for the disciplinary narrative and the role of myths as aspects of disciplinary 'culture'. It is suggested that this is the key resource for developing the kinds of identities which Ecclestone (2007b) alludes to when she suggests that it is important to conceptualise identity in relation to subject knowledge.

Third, teachers not only need to explore their own role in narrating the discipline, but also think about how they might engage students in a dialogue about that narrative, and to engage in that narrative themselves. In other words, students need to be able to appropriate (Bakhtin, 1981) those narratives in a way which aligns with their own intentions. To some extent this requires that disciplinary narratives as a Discourse

(Gee, 1996) are made explicit – although this is attached to other problems concerning how this is done – but also means that narratives are introduced or called upon in ways which are appropriate to students' needs. This not only refers to the sets of issues involved in my second point, but also requires that narratives are employed at the appropriate level and at the appropriate stage. For example, a number of writers have pointed to the different ways in which students engage with disciplines. In relation to science education, examples of this include Aikenhead's (2006) categorisation (based on Costa, 1995) of student orientations to science education as a function of their ease of transition into that world from the world of family and friends. The analytical categories suggested are fairly self-explanatory: potential scientists, "I want to know" students, other smart kids, "I don't know" students, outsiders and insider outsiders. In a similar way, Venturini (2007) delineated a number of different categories of students' 'relation to knowledge', or the nature of their engagement with the discipline. What is suggested here is that the challenge for teachers is not only to recognise such differences in engagement – and to understand the processes which surround them – but also to make judgments about the kinds of narratives which could be employed to promote students' *progressive* engagement with the discipline. This means that appropriate disciplinary narratives may be selected which not only match with students' academic level and their stage in learning the discipline – rather like Bruner's (1960) spiral curriculum – but also with their degree of engagement.

Science stories do have the ability to engage (Allchin, 2003; Hadzigeorgiou, 2005) although as has been emphasised previously, these stories need to be employed within the wider disciplinary narrative. In order to promote students' progressive engagement – perhaps to move them from one of Aikenhead's or Venturini's categories to another – disciplinary narratives and their associated myths may be useful resources for teachers. Although it is beyond the scope of this chapter, it may also be fruitful to consider what aspects of myths and narratives may be used and the extent to which some of these may be temporary in nature, serving as the means by which progressive engagement may occur.

Finally, it is important to note – although these points will not expanded upon here – that teachers also need to attend to the language used and emphasis employed in relation to myth and how that relates to 'truth'. The thesis has argued that mythical accounts are inevitable and that they play an important role in scientific communication and in education. But truth still matters[12]. It is also important to attend to the objections raised by those who point to the inevitable distortion in truth and the misrepresentation of scientific practice. It is therefore part of the teacher's role as narrator to sensitively negotiate between these debates or tensions. As Scott *et al.* (2006) and also Solomon (2008) point out, this requires teachers to be mindful of the issue of teacher authority and its relation to knowledge i.e. their epistemic authority. A delicate balance needs to be maintained between authoritative and dialogic discourse, and similarly between mythical accounts and more accurate accounts – rather like the 'essential tension' that Kuhn (1977) describes in relation to innovation and tradition.

[12] Although establishing what the truth actually is may be a complex matter, particularly in non-scientific disciplines.

8.8 Conclusion

Einstein (2009) famously stated that "imagination is more important than knowledge"[13]. The conclusion of this chapter and of this thesis supports this claim, but, like Einstein, it does not suggest that knowledge is *not* important. Indeed, the key aim of this project has been to place knowledge at the centre of the educational context. The notion of disciplinary narratives, encompassing myths about knowledge and a possible role for other kinds of historical, fictional or personal stories, aligns with a range of imaginative possibilities. It has been argued in this chapter that these have an important function in communicating science and are intrinsic to the socio-epistemic purposes of the educational context.

This chapter has argued that disciplinary narratives play a key role in developing

[13] Quoting Einstein in this way also illustrates something of the nature of the points raised in this chapter. Scientific quotations are frequently used aphoristically in a way which relies upon scientists such as Einstein's status as popular cultural icons and heroes of science. Such popular images are frequently encountered both in the wider public culture and in science textbooks. Although quoting necessarily involves the accurate reproduction of words, it is also a recontextualisation because it removes words from one context of meaning to another. It can take them *out of context*. After all, Einstein was not necessarily talking about education (he was actually talking about the role of intuition in scientific research). For example, Osborne's quote from Claude Bernard about the 'long and ghastly kitchen' of scientific initiation (Osborne *et al*., 2003a: 1074; Osborne, 2007a: 174) – which I quoted in chapter 6 – is taken out of context and misinterpreted. Osborne relates this 'kitchen' to students' experience of tiresome and authoritarian scientific knowledge, but Bernard was more likely referring to his distaste for the gruesome experiments involving animals which he felt were necessary to develop knowledge within his field (Richards, 1990: 140). Meanings as they are experienced are variable – as was illustrated in chapter 2 – and they might be 'wrong' or even *wrong* (without the scare quotes). However, as argued in this chapter, mythical understandings have a role in bridging between contexts, communicating 'culture' and in exciting imagination. As has been argued, in science education these myths need to be employed alongside other accounts and mediated by the teacher who can distinguish between the 'scientific moral' as a disciplinary narrative and other 'companion meanings'.

students' relationships with knowledge. Disciplinary narratives provide a bridge between the different forms of knowledge in the model for forms of knowledge that was introduced in chapter 2. They provide a means of conceptualising how the disciplinary context links with the educational context, and how students' and teachers' owned knowledge may function in the model. The model for forms of knowledge that has been proposed, then, provides a conceptual framework for teachers to explore how their own teaching and their own subject areas can employ these disciplinary narratives to enhance student engagement.

This thesis has drawn upon Bernsteinian/social realist theory and sociocultural theory and has acknowledged the insights into the educational context afforded by both theoretical frameworks. It has been argued that both theories are limited, however, in the extent to which they recognise the socio-epistemic relation between educational and disciplinary contexts. The notion of disciplinary narratives provides a link between the top part of the model for forms of knowledge which is illuminated by Bernsteinian and social realist theory and the bottom part which is primarily the province of sociocultural theory. The two theories are thus shown to be complementary from a socio-epistemic perspective. In addition, the notion of disciplinary narratives provides some different ways in which the insights of Bernsteinian and social realist theories may be re-interpreted.

Chapter 9: Conclusion

9.1 Introduction

This thesis has given an account of an ambitious project which aimed to explore the role of knowledge in the educational context and how students may develop a 'relationship' with knowledge. The project's starting point was the context of practice in FE and a set of concerns relating to reforms in teacher education programmes which called for a focus upon subject-specific pedagogy. But the 'practitioner research' outlined in this thesis – perhaps because of its focus on knowledge itself – goes beyond the concerns of one specific context.

Although it could be argued that all research must be open-ended to some extent, this research has been especially so. It would have been very difficult at the start of this research process to speculate about its end point. Nevertheless, an end point has been reached – for the present at least. This concluding chapter draws together the outcomes of the project, evaluates the approaches which were adopted and makes proposals for further research.

9.2 How the thesis addresses the project's research aim and research questions

This section gives an account of the key insights of the project in relation to its aims and research questions. The first part summarises how the thesis has addressed its research questions. The second part focuses on the model of forms of knowledge, outlining how the nature and relation between forms of knowledge have been elaborated. A summary is also given of the argument advanced in the thesis about the function of the model in relation to thinking about the educational context.

9.2.1 Research questions

The project's research questions have been addressed in the following ways:

Research Question 1. What is the place of disciplinary knowledge within formal educational contexts?

This thesis has highlighted the uncertain place of disciplinary knowledge within aspects of policy and practice, and has outlined a number of problems which make a focus upon knowledge problematic in practice. It has been argued that if insufficient attention is paid to the central place of knowledge in formal educational contexts, undesirable consequences may follow in relation to students' acquisition of knowledge and the possibilities for equitable access to knowledge. The thesis proposed the notion of 'relationships with knowledge' in preference to considerations of 'learning' and 'teaching'. It has argued for a mode of educational research theorising which places knowledge at its centre and which emphasises the function of education as being concerned with students' acquisition of knowledge.

A framework for knowledge forms in terms of a model of forms of knowledge in the educational context has been proposed. This model provides a place for disciplinary knowledge and explicates the relation between disciplinary knowledge and other forms of knowledge. This thesis has argued that within a formal educational context, the place of disciplinary knowledge needs to be foregrounded within policy and practice. It has suggested that the place of disciplinary knowledge within the educational context is realised through disciplinary narratives which are contingent upon the socio-epistemic characteristics of the educational context. Teachers' and students' roles are thus positioned in relation to those disciplinary narratives.

Research Question 2. How does educational theory distinguish between disciplinary and other knowledge forms and how does it conceptualise their role within educational contexts?

This thesis has engaged with theoretical models of the educational context which encompass the relation between teachers, students, subject knowledge and other forms of knowledge. Its focus has not been restricted to, for example, teacher knowledge, or students' personal epistemologies. Therefore, the project has concentrated upon a broad interpretation of situated or sociocultural theory and Bernsteinian/social realist theory. This thesis has argued that the way in which meanings of knowledge are contextually contingent and are co-constructed play a significant role in how knowledge is experienced by teachers and students in the educational context. Sociocultural theory acknowledges the complex and co-constructed nature of the educational context, but it under-theorises the place of knowledge in that context. An example was given of communities of practice theory which, although recognising some of the theoretical challenges associated with considering a formal educational context, does not explicitly theorise the context. The Transforming Learning Cultures project's notion of the 'learning culture' is closer to theorising a formal educational context, but yet also does not theorise the place of knowledge. It was argued that such theories, due to their focus on learning, fail to recognise the place of knowledge, which is intrinsic to the formal educational context. The project explored the insights of Bernsteinian theory and recent advances in social realist theory, which seek to conceptualise the place of knowledge in the educational context, to distinguish between different forms of knowledge and to advance a realist rather than relativist view of disciplinary knowledge. These theories provide a principled account of the place of disciplinary and other knowledge forms within the curriculum. This thesis, however, pointed to a number of limitations of social realist theory, particularly in relation to how it conceptualises a depth ontology of social relations to knowledge and the socio-epistemic nature of the educational context.

Research Question 3. What epistemological principles underpin the recontextualisation of disciplinary knowledge within the curriculum and how might these principles influence opportunities for the development of students' 'relationships with knowledge'?

The thesis has argued for an approach which considers school subjects as emergent wholes, in preference to other approaches which focus upon particular elements of the curriculum. Two principal modes of recontextualisation of disciplinary knowledge to produce school subjects were explored: conceptual coherence which aligns with a 'knowledge code' and emphasises an abstract and internally coherent structure; and contextual coherence which aligns with a ‘knower code’ and emphasises the specific contexts of application of the characteristics of knowers. Drawing on a range of research, it was argued that these modes of recontextualisation form an ‘internal language of description’, or generative conceptual model of curriculum forms. An external language of description was realised by applying this model to recent curriculum developments in the UK school science curriculum. The case study provided support for social realists theorists’ argument for the link between disciplinary and curriculum structures, since, in the case of science, applying a contextual coherent mode of recontextualisation tends to marginalise the place of scientific knowledge within the curriculum. It was argued that the mode of recontextualisation needs to align with the knowledge structure of the corresponding discipline. Nevertheless, it was also recognised that school subjects are also social constructions and are shaped by other non-epistemological political and social forces. Thus, it was suggested that inappropriate applications of recontextualising modes may limit the extent to which students may develop a relationship with the disciplinary knowledge to which the subject nominally corresponds.

Research Question 4. Taking science as a case, what impact does the recontextualisation of disciplinary discourse and practices have on the development of students’ relationships with knowledge in educational contexts?

A key outcome of the case study of the recontextualisation of science was the significance of the notion of authenticity. Critics of both models of curriculum (traditional approaches which align with conceptual coherence, and scientific literacy approaches which align with contextual coherence) suggest that the opposing model gives rise to curriculum content which 'isn't really science'. An analysis was carried out of the impact of recontextualisation on disciplinary scientific discourse and practice. It was shown that in the school context the epistemology of practice changes significantly, that practices take on different meanings and that knowledge plays a different role compared with the disciplinary context. Analysis of scientific discourse showed that in the school context, scientific discourse becomes decontextualised and authoritarian. It was concluded that, in the case of science, the educational context inevitably limits disciplinary authenticity and gives rise to mythical understandings which are intrinsic to the nature of the school context. Students' relationships with knowledge, therefore, are inevitably shaped by the epistemology of practice in the school context and the mythical understandings which are intrinsic to that context.

Research Question 5. What epistemological account can be given of the means by which students develop a relationship with disciplinary knowledge in educational contexts?

– and what are the implications for aspects of policy and practice?

The educational context is not only a container for disciplinary practices and discourse, it is a distinct socio-epistemic context itself. It has been argued that a fundamental function of the educational context is the narration of the discipline and that these 'disciplinary narratives' play a key role in bridging between school and disciplinary contexts. Disciplinary narratives are the way in which the discipline is mediated by the distinct socio-epistemic nature of the educational context. They serve to connect and underpin both disciplinary and educational contexts. Disciplinary narratives consist of aspects of 'culture' and myths and stories about knowledge, and while strictly speaking, they might give rise to inaccurate understandings, these inaccuracies and myths are not arbitrary; they are intrinsic to the discipline's epistemology and its narration in the educational context. It has been argued that students' relationships with knowledge are developed both within and through these disciplinary narratives. Under this conceptualisation, teachers are narrators of the discipline, and they need to engage students with and within that narrative.

A number of implications for practice have been outlined. It has been suggested that it may be useful for teachers to reflect on their own practice as narrators of their disciplines. This thesis has argued that in order for teachers to effectively narrate their disciplines, they need to: have a good and broad knowledge of their own discipline; to explore the ways in which that disciplinary knowledge is narrated in the educational context; and, to interrogate how disciplinary narratives relate to their students' current understandings. It has also been suggested that teachers need to explore ways in which they can draw upon popular stories about knowledge, but that attention needs to be paid to the extent to which these stories are narratives of the discipline or narratives about them. Teachers should also account for the less desirable messages and stereotypes that such stories might communicate to students. Further implications for aspects of educational policy and practice are outlined in the following section.

9.2.2 Model for forms of knowledge

The model for forms of knowledge has provided an organising idea throughout this project. It served to express the initial problem as it was posed in earlier chapters by clearly placing the triangle of teacher, student and subject at the centre and emphasising that understandings are co-constructed within a triangle of relations between them. The central label CONTEXT acknowledges these understandings and the insights provided by situated and sociocultural theories. However, the model also provides a place for disciplinary, everyday and owned knowledge and it thus set out a framework to explore the place of these forms of knowledge and the relations between them in the educational context. The model was therefore used as a guide for the direction of the theoretical path that has been taken.

The model for forms of knowledge is shown again in Figure 9.1 below.

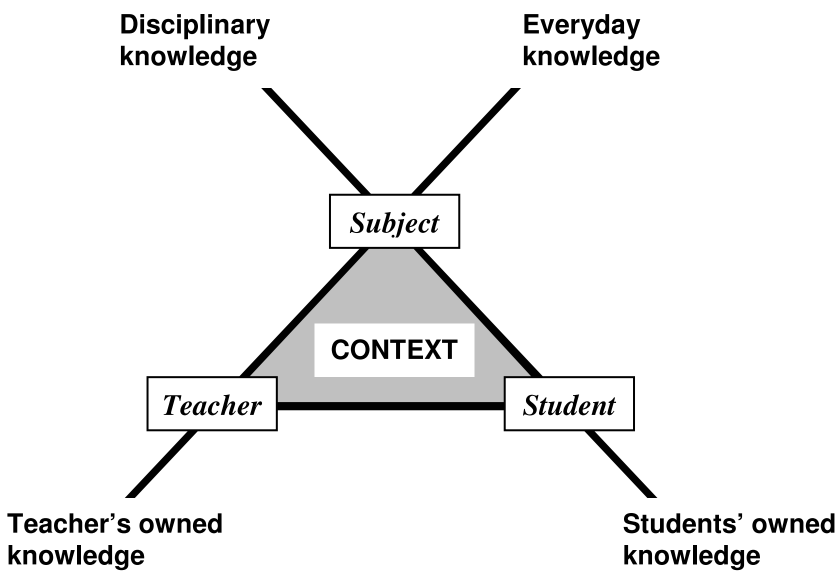

Figure 9.1 Model for forms of knowledge within an educational context (from chapter 2)

This thesis has drawn upon Bernsteinian and social realist theory to provide the means by which the characteristics of forms of knowledge within the model may be distinguished and how they relate to each other. Disciplinary knowledge is distinguished from everyday and owned knowledge since it constitutes 'powerful knowledge' (Young, 2008a). This provides the basis upon which to discriminate between forms of knowledge in the curriculum and addresses policy and practice agendas in relation to 'relevant' and 'real life' knowledge. The relation between subject and discipline has also been addressed: subjects may be recontextualised in different ways and according to different principles, but, as has been argued, certain forms of recontextualisation may be more appropriate than others. These observations themselves provide significant insights into how one might approach the curriculum, but they have less to say about pedagogy.

Part III of the thesis focused to a greater extent on pedagogic issues. The notion of disciplinary narratives provides a conceptual link within the model between the different forms of knowledge and provides a framework for teacher and student roles in relation to them. Disciplinary narratives provide a connection between all forms of knowledge within the model: they underpin disciplines, they may draw upon aspects of everyday knowledge, they link to the socio-epistemic nature of the context and the understanding of the subject within that context and also draw upon aspects of teachers' and students' owned knowledge.

It was argued that there is a dual aspect to the disciplinary narrative: while it is primarily defined by the socio-epistemic nature of the educational context, it is also related to stories about knowledge in addition to narratives of them. In this way, teachers may also draw upon popular or media accounts of disciplinary knowledge, and also employ aspects of the narrative form as a more native form of meaning-making. However, it should be noted that the previous chapter emphasised a number of limitations in relation to this: the need to attend to 'companion meanings' and to recognise that science, for example, could not be communicated in an entirely oral form.

The model, then, provides a framework for conceptualising relationships with knowledge within the educational context. It has also been suggested that the framework provides flexibility for teachers to address differences in students' academic levels and level of engagement. A model of progressive engagement was proposed, in which teachers can, instead of thinking about students' progressive acquisition of knowledge, consider how students' engagement with disciplinary narratives develop.

9.3 Application of the findings

9.3.1 Policy and curriculum design

The outcomes of this thesis suggest that methods of recontextualisation of disciplinary knowledge need to be appropriate to the corresponding disciplinary structure. Therefore, curriculum models which seek to promote 'relevance' and 'real life' contexts as a method of student engagement need to attend to the consequences for knowledge within the curriculum and the impact on access to 'powerful' knowledge by particular groups of students. In addition, bearing in mind a model of forms of knowledge can assist in promoting clearer conceptualisations of what it is that particular curriculum models or new innovations in teaching and learning expect students to learn: what knowledge they are expected to acquire.

Early chapters of this thesis discussed examples of practice and policy relating to ‘non-academic’ or ‘disaffected’ students, and explored, in a limited way, aspects of problems which are frequently associated with the experience of younger students in FE colleges. Many of these students follow courses which feature generic skills and ‘relevant’ knowledge. Teachers working in this area face a range of complex challenges and it is not my intention to offer simplistic solutions. However, I do suggest a different conceptualisation of the problem. Disciplinary narratives appear to be marginalised within such curricula, mainly due to their emphasis upon relevance, but such a situation also results from perceptions – which may or may not be justified – of students’ abilities, interests and motivations. I do not suggest that all forms of specialist provision should be abandoned, or that courses should not be practical or applied. I do propose, however, that it might be useful to reconsider the place of disciplinary narratives within such provision and to question some of the fundamental assumptions which underpin it. Such a recommendation is not solely motivated by a concern with social justice and differential access to knowledge, but also by the apparent uncertainties among educationalists about the value of disciplines themselves and their faith in disciplines as intrinsically interesting and worthwhile (Pring, 2005). Within my vignettes, what appear to be missing are disciplinary narratives. It is suggested that, instead of marginalising disciplines, more could be done in curriculum development to explore how disciplines can and do engage, rather than assuming that they necessarily do not.

9.3.2 Teachers

The model for forms of knowledge and the conceptual development in this thesis in relation to the significance of disciplinary narratives provides an insight into the means by which teachers and students connect with the disciplinary community (Wenger, 1998). This thesis has suggested a new way for teachers to think about their role – not as a facilitator, and not as a dispenser of knowledge, but rather as a narrator of disciplinary knowledge who seeks to engage students with the story of the discipline and to help them to tell that story for themselves. In this way, the thesis puts forward a particular view of the teacher's unique pedagogical role in relation to disciplinary knowledge and their knowledge of their students.

The particular form of the disciplinary narrative and its relation to other stories about knowledge has been explored in this thesis. It has been argued that such an approach provides room for flexibility to account for differences in subject and level and to address motivational issues. As will be discussed later in this chapter, the interface between educational theory and practice and the way in which research relates to practice is highly complex. But this thesis does not offer prescriptive instructions about what will work in all contexts. Rather, it makes suggestions about how teachers could conceptualise their own practice and apply their own knowledge of their discipline and context in order to explore how they and their students engage with disciplinary narratives.

9.3.3 Teacher education

The context of practice and the introduction of subject-specific pedagogy in teacher education programmes formed the starting point for the questions within this thesis. The outcomes of this project can also speak back to this context. Even though teacher education now does include this subject-specific focus, as was mentioned in chapter 1, the place of the subject within subject-specific mentoring is uncertain. The outcomes of this thesis provide a framework to explore the role of the subject within teacher education.

It is suggested that teacher educators and mentors should assist teachers to: seek to enhance and maintain their interest in their own disciplinary knowledge; explore ways in which their own disciplines are recontextualised; surface the myths and beliefs about knowledge and particular disciplinary narratives which are relevant to their own subjects; and, to explore with others how these disciplinary narratives are employed in the classroom. The outcomes of this thesis also suggest that teachers should be encouraged to draw on wider resources which reflect disciplinary narratives, including use of media and other stories about knowledge or authentic practitioners' accounts of work in their field. These ideas provide a framework for disciplinary engagement which would need to be developed in relation to specific disciplines.

As I have observed, teacher training in FE now consists of some aspect of subject-specific pedagogy in a limited sense. For the most part, however, these programmes are still generic in practice. It is recommended that in spite of this focus on generic principles of teaching and learning there is still a place for a subject focus in that teachers can be generically encouraged to explore the nature of own subjects and disciplines.

In the field of academic development in the HE sector, writers such as Healy & Jenkins (2003) argue for discipline-based rather than generic educational or academic development (or in FE terms, teacher training). Teacher training programmes are frequently criticised as being irrelevant or ineffective (e.g. see the recent article and reader comments about teaching courses in HE in the *Times Higher Education*, Magueijo, 2009). It is not possible to engage with all of these debates here, but it is my view that teacher training programmes should emphasise, or even start with, the subject or discipline. This is because while (arguably) the principles of teaching and learning are largely generic, the manner in which teachers engage most effectively with these principles may not be generic. Disciplinary narratives play an important role, not only in communicating disciplinary knowledge, but in underpinning teacher identities, affiliations and habitual practices (Trowler, 2009; Wareing, 2009).

9.4 Contribution of the research

This thesis is relevant to a range of key contemporary issues within FE and in other education sectors. Student engagement is an enduring concern both for teachers and policy-makers. Teachers' primary focus in the educational context is generally concerned with student engagement in terms of student motivation and achievement. Policy-makers frequently focus upon student engagement for the needs of the knowledge economy. All of these framings of student engagement are underpinned by a number of sometimes tacit assumptions about the 'relevance' of knowledge and the utility of 'real life' experience.

This thesis has explored the nature of student engagement and distinguishes between engagement which is primarily concerned with the processes of education and engagement with disciplinary knowledge. It proposes a model for thinking about the different forms of knowledge within an educational context and explores the means by which students' relationships with disciplinary knowledge may be developed from an epistemological perspective. It highlights the key role played by disciplinary narratives in this process. A framework for thinking about these issues, particularly in the context of teacher education is thus provided. The main thrust of the thesis is theoretical and conceptual, but issues concerning students' relationships with knowledge are nevertheless practical concerns and the model that is proposed provides a tool for exploring the nature of practice.

A contribution is also made in the area of educational theory. This thesis has explored a range of theoretical approaches to thinking about knowledge in education. The limitations of sociocultural and situated learning theories in approaching issues relating to knowledge and the formal educational context have been highlighted. I have elaborated upon research within Bernsteinian and the emerging social realist school of educational theorists and applied insights gained from this work to the area of the school science curriculum. The thesis questions the adequacy of the consideration of social relations to knowledge within social realist theory and suggested the need for a 'depth ontology' of social relations to knowledge.

This thesis has adopted a socio-epistemic perspective: it has considered the social epistemology of teaching and learning. This perspective has provided a means by which aspects of sociocultural and social realist theory may be reconciled with each other. Instead of focusing on social realists' emphasis upon ways in which forms of knowledge articulate with each other, this thesis has concentrated upon the means by which epistemic communities articulate with each other. This provides a new way of thinking about the social aspects of knowledge, other than only as a process of social construction. Sociocultural theory tends to focus upon processes in relation to learning and the situated nature of knowledge, but not on social practices in relation to knowledge. It was argued that while social realist theory recognises the social epistemology of knowledge production, it does not consider the social epistemology of recontextualisation or the epistemic nature of the school context. Therefore, this thesis has drawn on aspects of both broad groups of theories and shown how they may illuminate each other: by bringing a realist theory of knowledge into sociocultural theory, and by emphasising socio-epistemic relations to knowledge in social realist theory.

This thesis has also considered the problem of the transfer of learning. It has been suggested that neither sociocultural, conceptual change nor social realist theory adequately address the issue of transfer. While transfer of learning has not been a substantial focus in the thesis, is has been suggested that the notion of disciplinary narratives provides a new way in which the problem of transfer may be conceptualised. The view advanced in this thesis is that disciplinary and educational contexts are already connected by means of the disciplinary narrative. Therefore the disciplinary narrative does not need to be transferred, although new understandings of it may develop as participants move between different contexts. Although this does not solve all the problems of transfer, it does provide a perspective which is different to sociocultural theorists' emphasis upon the contextual nature of knowledge and social realists' and conceptual change theorists' tendency to focus upon decontextualised and individualist views of transfer.

An exploration of these issues in relation to the school science curriculum also appraises research within the area of authentic learning and a new conceptualisation of the nature and possibilities for authentic learning is suggested.

9.5 Evaluation of research methodology and limitations of research

This research project has been largely conceptual and theoretical. Although it has drawn upon 'data' from the context of practice in the form of vignettes and observations about practice and upon a case study of school science, it has not been substantially concerned with the empirical. Although the project is not unique in this respect, it does not align with the majority of educational research which generally engages with data in a much more direct and, in some cases, rather limited way (Standish, 2001: 505).

At the end of the project, although it is recognised that this conceptual approach perhaps presented additional challenges for the researcher, it is concluded that a largely conceptual project, although being a risky path to take, was nevertheless justifiable in relation to the nature of the research object under investigation and the research questions that were posed. Therefore, in order to retain the original focus of the research, and to stay true to the questions which originated from the context of practice, it is concluded that the project should not have engaged more closely with data. But the author would recommend that other PhD researchers, particularly practitioner researchers, should also have compelling reasons to take a road less travelled in relation to their conceptual research projects.

This project has addressed its overall aim of exploring how students develop a relationship with knowledge and what the role of the teacher is in relation to this. It provides a new way of thinking about the educational context and delineates a clear rationale for an approach to educational theorising which places knowledge at its centre. It has also built upon existing theory within the field of educational research to suggest ways in which they may be brought into a new relation to each other.

This project has been about knowledge: this has been my primary interest, but in what ways can the conclusions of the project be applied to the field of educational research itself in a reflexive sense? Educational research has been criticised as being of low quality, irrelevant to practice, too concerned with specific cases and inadequate in the extent to which it generates a coherent knowledge-base (Hargreaves, 1996; Hillage *et al*., 1998; Tooley & Darby, 1998). A number of social realist researchers have discussed the nature of educational research and have suggested that the field needs to pay closer attention to the manner in which theory is generated and built up cumulatively (e.g. see contributors to Maton & Moore, 2010a). One key way to do this may be to acknowledge the role of knowledge in the educational process: the social realist position enables knowledge to be seen in its own right, and not only as a reflection of some essential truth or of power relations (Maton & Moore, 2010b). Furthermore, as Ball & Forzani (2007) observe, a focus on knowledge allows educational researchers to claim their distinctive object of study: the dynamic between students, teachers and educational knowledge.

This project has argued for the significance of disciplinary narratives in teaching and learning and has also linked this with Bernstein's notion of knowledge structures. In one respect, a knowledge structure is a particular narrative of the discipline; as has been argued, the cumulative and hierarchical nature of science is a key aspect of scientific disciplines' disciplinary narratives. But to a significant extent, educational research as a discipline (or more accurately as a field) lacks such disciplinary narratives in a cumulative sense. A focus on students' acquisition of knowledge, however, provides one way in which the disciplinary narrative may be strengthened.

One particular issue for educational research, and also for vocational or occupational areas more generally, is the relation between the fields of theory and practice. This thesis does not consider this issue in much depth and thus, this might be identified as one limitation of the research. But in terms of application of the notion of disciplinary narratives to the field of educational research itself, it is suggested that researchers might think about how their disciplinary narratives relate to the field of practice.

In general terms, educational research has little impact upon practice. I do not wish to suggest that research knowledge is not valuable in its own right, but I acknowledge that for research that speaks about practice and particularly that which makes recommendations for practice, lack of impact places a significant limitation on it. This observation equally applies to the research in this thesis. Hodkinson (2005: 4) is very frank when he acknowledges that "most of FE continues as if the TLC [project] had never existed". He also reports that some teachers at the project's dissemination events dismissed the TLC project findings since they only told them what they already know.

It is not straightforward to resolve all the problems relating to the interface between theory and practice. However, it might be useful for researchers to consider *what* kind of narratives of educational research relate to the field of practice and *how* they relate to it. Hodkinson (2005; 2008) recognises the significant systemic limitations that are imposed upon the improvement of educational practice in FE, and I also recognise this as a very significant factor. But, in spite of this, experience shows that the vast majority of teachers, even the most recalcitrant participants in teacher education courses, care about what they teach and they care about their students (Coffield *et al*., 2008). In general, teachers do wish to improve their own practice.

It is suggested that the most useful disciplinary narratives of educational research are flexible frameworks or ideas which teachers can relate to their own practice and which provide a means of thinking through their own purposes. Such flexible frameworks align with what De Vries (1990, cited in Biesta, 2007) refer to as the *cultural role* for educational research, which contrasts with a *technical*, instrumental or 'what works' conception of educational research. Within this cultural role, teachers acquire a different understanding or lens to see their own practice (Biesta, 2007). It is proposed that this could form the basis of a key evaluation criterion for educational research projects which seek to address the field of practice. A focus upon the place of knowledge within the educational context, the notion of the disciplinary narrative and the model for forms of knowledge which has been explored in this thesis could provide one example of an aspect of an educational research disciplinary narrative which could be used by teachers and teacher educators in such a way.

This research project has been limited in the sense that it has not, other than drawing upon illustrative vignettes, engaged with specific problems or issues in the field and therefore does not offer specific solutions. As my earlier comments indicate, I do not necessarily see this as a limitation, however – both because of the broad conceptual goals of the project, and also because of the stance taken in relation to the means of improvement of practice. As many writers have observed (e.g. James & Biesta, 2007), the extent to which simple rules or recipes for effective teaching can be imported into different contexts is extremely limited. Rather, teachers need, as far as is possible, to autonomously reflect upon models or suggestions for practice and to interpret these ideas in relation to their own contexts and subjects.

Another limitation of the project is that it has perhaps taken a rather static view of academic disciplines. This could be an outcome of the analytical focus upon the role of myth and the *enduring* nature of disciplinary 'culture' in the form of narratives. It is also likely to be a result of the emphasis upon science, which, unlike social science or humanities disciplines, is less susceptible to shifts in the *disciplinary* epistemic device (Moore & Maton, 2001, discussed in chapter 3). For example, a discipline such as economics (which, in Becher & Trowler's, 2001: 178, terms "straddles the boundaries of hard and soft, pure and applied") is more likely to evolve over time between an overall emphasis on the social relation or the epistemic relation, between knower codes or knowledge codes. Another good example of this might be geography which has recently shifted towards a focus on human rather than physical geography[14]. Shay (2009) in her analysis of the history curriculum in HE, does examine such disciplinary code shifts and discusses the implications of, for example, the delay between disciplinary shift and the reflection of these code shifts within the

[14] As Muller (2009: 219) notes, such disciplinary shifts are also likely to involve conflict over methodological issues (e.g. qualitative versus quantitative).

curriculum.

This thesis has drawn upon accounts of practice from FE and has discussed a range of research relating to different education sectors, countries and subject areas at different levels. A particular focus has been a case study of the UK school science curriculum and the recontextualisation of scientific knowledge. It was argued that this was important in order to investigate the epistemic relation, or what knowledge is about. It was also suggested that this focus was complementary to other research which has addressed different areas of knowledge, particularly occupational and craft knowledge.

Ways in which the thesis' specific conclusions in relation to science may be applied to other subject areas have been discussed. It has been argued that these insights may be generalised to other subjects, albeit with certain provisos. The project has primarily focused on academic disciplines rather than on vocational or occupational areas of study, and I have highlighted some issues which may need to be taken into account in applying the notion of disciplinary narratives to those areas. Since my focus has been on the formal educational context, much of my discussion has referred to 'school' contexts, although much of this is also relevant educational institutions at all levels. Nevertheless, where appropriate, the thesis has drawn attention to the significance of educational level or sector. Given the broad focus of the project, however, such distinctions have not been considered in detail. An area which has received less attention in the thesis is university level education. Here, the relation between disciplines, research and subject is likely to be more significant and more direct. This may also provide another explanation for the somewhat static view of disciplines implied within the thesis, referred to above.

9.6 Further research

Further work deriving from this thesis could address two key areas of inquiry. First, the conceptual mode of investigation employed in the thesis could be explored in greater detail in relation to other disciplines and subject areas, particularly disciplines which derive from horizontal knowledge structures or vocational areas. This research would complement the findings of this project. It would test some of the assertions made within this thesis about how its findings may be generalised and may provide more insight into the nature of disciplinary narratives.

A further means of extending the current project would be to analyse specific cases of disciplinary narratives and to elaborate upon disciplinary narratives as narratives about and/or narratives of science, for example. Empirical work could explore how experienced teachers employ such narratives in practice. More finely grained analyses would provide a greater insight into the influence of, for example, the 'companion meanings' which are associated with certain types of narratives and the impact of these upon particular groups of students. Further work could also investigate emerging disciplinary narratives in relation to media stories or new fields of inquiry.

Second, it is suggested that a socio-epistemic theoretical approach could be extended to consider students' independent relationships with knowledge outside of the teaching context. In particular, this would focus on students' interaction with new technologies, the World Wide Web, disciplinary research resources rather than pedagogic texts, and students' own self-created artefacts. This research could address the role played by these resources in relation to disciplinary narratives, how students' relationships with knowledge are developed within the social context of their use, and how, particularly at higher levels of study, students participate in those narratives in a more direct way.

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