Teachers as recontextualization agents: a study of expert teachers’ knowledge and their role in the recontextualization process across different subjects

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Declaration

I, Alison Kitson, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

This thesis investigates the knowledge that shapes the practice of expert teachers in physics, geography and history. The principal intention of this research is to illuminate the impact that the different knowledge structures and aims of these subjects have on teachers' decision making in their classrooms. I argue that far from being implementers of the curriculum in their classroom, the teachers in my study are actively engaged in recontextualising their discipline into school subjects, drawing on two levels of knowledge to do so. The first level consists of their knowledge of their subject, the students they teach and wider social and educational goals. These combine to shape the aims that underpin the second level of practical curricular and pedagogic knowledge. Together, these two levels of knowledge form the basis of the teachers' planning and teaching decisions and are shaped by their subject in profound ways. Furthermore, I argue that the recontextualising process evident in the teachers' lessons was also shaped by variations in the closeness of the relationship between subjects in schools and disciplines in universities.

The evidence for these claims was generated primarily through interviews and detailed lesson observations of three expert classroom teachers. Whilst across the subjects there were similarities in their pedagogic approaches, the aims underpinning these approaches reflected differences across subjects in two principal ways. First, there was variation in the extent to which the teachers drew on a conceptual structure deriving from the discipline and sought to make its epistemology visible. Second, the way in which the students and wider social goals influenced teachers' practice differed. Finally, as expert teachers in their subject, it was interesting to discern variation in how far they were able to make curricula in their classrooms that reflected Young and Muller's (2010) 'Future 3' scenario.

Impact Statement

I will consider the potential impact of my research in three contexts: on the school curriculum, on teacher development and on future research.

The school curriculum

In this research I have tried to find a common language with which to analyse teachers' knowledge and practice across subjects whilst respecting and acknowledging their differences. This is a challenging task and not one that senior leaders have engaged with well in recent years (Young and Lambert, 2014). Indeed, the task of setting and meeting targets has eclipsed an interest in defining a high quality curriculum and has generated some 'quick fix' solutions which often involve highly generic approaches to defining and measuring progress such as Bloom's Taxonomy (Counsell, 2017b). The sophistication with which the teachers in this study talked about their aims and the kinds of thinking they wish to foster in their students is at odds with the generic blandness or indeed distortion of many current approaches used to measure 'progress' in secondary schools.

Finding ways to talk meaningfully about the similarities and difference of subjects is not just of value for teachers and senior leaders. Understandably, academics often remain absorbed in their own curriculum areas. Students' experience of the curriculum is quite different, however. For example, just within the three subjects of physics, geography and history in my research, students were asked to engage with evidence in slightly different ways. Sharing professional knowledge and understanding would be a step towards a more coherence curricular experience for students.

Teacher development

The levels of teacher knowledge which I identify in my research go beyond technical 'how to' knowledge. Whilst developing a range of pedagogic strategies and understanding how to manage students' learning are important, my research emphasises the value of understanding your subject at a deep level. This is likely to include knowledge of the discipline as well as knowledge of the subject in school. It should also include an understanding of the recontextualization process and an appreciation of how knowledge-related subject goals connect with broader social aims, often in the promotion of distinctive ways of thinking and in understanding the significance of the subject to students' lives. This has important implications for initial and continuing teacher education, both of which have taken a more generic turn over the last twenty years.

Future research

In this research I have tried to connect some important theoretical concepts with the practice of teachers. These include concepts such as a Future Three curriculum (Young and Muller, 2010) and the recontextualization of disciplines into subjects (Bernstein, 2000). This study suggests that further exploration of these concepts in practice, across a range of subject areas, would be fruitful and could increase their impact on schools, teachers and curriculum. This study also demonstrates the value of identifying and researching ‘expert’ teachers in their specialism in order to understand what they know that makes them effective as well as what else they would like or need to know in order to develop further.

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Chapter 1 Introduction and rationale

Although the precise focus of this research has shifted slightly over the last five and a half years, the general aim – to understand what good subject teachers in secondary schools know – has remained constant. In particular, I am interested in how far – and in what ways - this knowledge is specific to their subjects and how this knowledge is manifested in teachers' practice. When I began my research there were two principal reasons for my interest: my own professional experiences as a teacher practitioner and educator and external trends in educational policy. I will outline these briefly before explaining how my research has evolved and will finish this brief chapter with an overview of the thesis.

1.1 The influence of my previous experiences

I have been engaged in school teaching in various contexts since 1991, when I began a PGCE in secondary history teaching. I taught history in three schools before moving to the University of Warwick to create a new history PGCE course. At Warwick I was involved in two funded research projects to explore the factors influencing history teachers' practice in England (funded by Nuffield) and in Northern Ireland (funded by the Carnegie Council) and became involved in supporting existing history teachers by providing CPD in local authorities and co-editing the main professional journal for history teachers, *Teaching History.* I then moved to the TDA (Training and Development Agency) as a Programme Director for CPD, hoping to influence policy around CPD provision. I was able to champion subject specific CPD but ultimately found the environment frustrating and returned to higher education in 2008, securing a post at the Institute of Education (IOE) in London. Since then I have been subject lead for the history PGCE and Director of ITE.

Teaching, supporting teachers and working closely with schools have been enduring features of my career and I am privileged to have experienced all three in different settings and from different perspectives, as practitioner, teacher educator, researcher and policy shaper (or more typically, enactor). These experiences have reinforced my deep respect for teachers and the teaching profession and have encouraged me to understand what teachers know and do better. The parallel influence of educational policy and the practice of schools during this time has also been a significant influence as I will explore in the next section.

1.2 The landscape of teaching, past and present

This is not intended to provide an objective history of the teaching profession but rather to offer a brief commentary on some of the trends I have observed since I began teaching in

1991. It is an entirely personal account based on my own experiences and is designed to explain where my own research interests have stemmed from.

When I began teaching, the national curriculum was just being introduced. As an NQT, I helped to design some early national curriculum assessments which were formulaic and based around 50 level descriptors. However, I also co-designed A Level coursework which accounted for 30 per cent of the whole course, developing a unit on social history in the eighteenth century which built on my undergraduate specialism, a freedom that would be inconceivable now. In my second year of teaching, the school received an Ofsted inspection and a history specialist spent most of the week in my department, watching us teach, talking to the head of department and offering guidance as well as making judgements. I had recently completed a PGCE, the only significant route into teaching at the time, spending most of the university-based element in my subject group and every local authority had a history subject adviser who supported heads of history in the area.

My point is not that the system was perfect – there were many flaws, including our desperate attempts to teach and assess the (initially bloated) national curriculum – but that subject expertise was respected and supported. Since leaving classroom teaching, I have witnessed many examples where this respect and support has been diminished. We have seen the rise and fall of Advanced Skills Teachers whose expertise was based on their subject teaching and their replacement with, first, 'Excellent Teachers' and later, lead practitioners, who may regularly support teachers beyond their specialist subject area. We have seen the demise of Ofsted subject specialist inspectors and the weakening of university-led initial teacher education with its (typically) strong emphasis on subjects. The Secondary Key Stage Three Strategy, which fortunately never had the same force as the Primary Strategies, nevertheless eroded subject specialist knowledge by offering generic guidance to all foundation subjects regarding lesson planning, objective-setting, differentiation and so forth. Given that the foundation subjects included history, geography music, physical education and art, such an approach could never respect the specialist knowledge in each of these subjects.

Meanwhile, in increasingly desperate attempts to satisfy New Labour's aim to close the achievement gap, schools began to introduce 'content free' curricula such as the Royal Society of Art's 'Opening Minds' programme, and advance up the league tables by introducing ICT GNVQ courses with an equivalence of five GCSE grades A-C and discouraging students from taking 'harder' courses such as history where their grade might be lower (see Burn and Harris, 2014). Meanwhile, schools became hungry for 'quick fix' solutions to raise student performance such as Bloom's Taxonomy which was (and still is) applied indiscriminately across subjects and common approaches to assessment – based on the false notion of incremental, constant progress within a common framework of national curriculum levels or, more commonly now, GCSE grades – made no allowance for different models of progression across different subjects. My point is that, although not everything about the landscape of the early 2000s was negative, there was an underlying trend of 'de-professionalising' teachers (Taylor, 2014) and not acknowledging the specialist knowledge of subjects and subject teachers.

When I first considered studying for a PhD, it was this landscape, coupled with my own experiences, that made me want to find out more about the specialised knowledge that the best subject teachers have and how much this varies according to the different types of knowledge they teach. It was a reaction against the assumption that teaching is an essentially generic activity where a lack of specialist knowledge matters little in the context of generic models of progression and assessment.

1.3 The evolution of my research

When I started in January 2013, my interest was primarily in the extent to which the specialised knowledge of subjects required subject specialist pedagogies. My pilot study failed to address this properly by focusing on the relationship between subject specific and generic teacher knowledge rather than on the similarities and difference across subjects. However, it did shift the focus of my research away from pedagogy and more firmly towards teacher knowledge in relation to their subjects. This was in acknowledgement that the lessons I observed across three subjects in my pilot study showed notable similarities in pedagogical approach which may be a consequence of years of generic CPD and by their own admission, was certainly a consequence of the ubiquitous 'Ofsted lesson' which teachers turn out when being observed. Despite the similarities, however, it became clear to me that these pedagogical choices were influenced by very subject specific reasoning. I therefore shifted my focus more firmly onto why teachers make certain decisions when planning and teaching lessons and how these decisions are shaped by their particular subject.

Two further influences have been important since the pilot study. The first relates back to the educational landscape which has continued to shift since the Coalition Government was formed in 2010. It is difficult to generalise about the current landscape in schools because the school system is now so fragmented. However, the government supports a 'knowledge rich' curriculum, putting more content back into GCSE specifications and enthusiastically supporting schools that adopt a knowledge-rich approach. The way this is being implemented in some contexts raises the spectre of a traditional curriculum dominated by a ‘canon’ of pre-decided, given knowledge. As I will explore in Chapter Two, this is not what Young (2008) envisaged when he advocated ‘bringing knowledge back in’. Accompanying this recent trend has been the resurfacing of an old (and unhelpful) dichotomy between traditional and progressive pedagogies. I was mindful of these recent shifts when I analysed my data and interested to see how far the teachers in my research might align themselves – consciously or not – with a particular tradition.

More importantly for the evolution of my research, however, has been my introduction to the worlds of two new subjects alongside my own, immersion in my data and my exposure to new theoretical frameworks including the field of didactics (e.g. Klafki, 1995 and Hudson, 2016), work in South Africa (e.g. Hoadley, 2010 and Shalem, 2017) and the work of Deng (2001, 2007, 2011, 2013) and Doyle (2017). Together, these influences have shifted my focus onto teachers’ role in the recontextualization process of disciplines into school subjects, the knowledge that is used to inform this process and the extent to which this is similar and different across subjects.

The research questions which shaped the final thesis reflect these influences whilst also building on my long-standing interest in teachers’ knowledge and the role of subject specialisms. The questions are:

1. What kinds of knowledge do expert teachers across three subjects draw on in lesson design and enactment?

2. To what extent and in what ways do expert teachers play an active role in the recontextualization of their discipline into school subjects?

3. How far and in what ways do expert teachers achieve a ‘Future 3’ curriculum scenario?

Note that the three subjects referred to in these questions are physics, geography and history.

1.4 An overview of the thesis

A literature review follows this chapter and sets out the key theoretical and conceptual influences on the research. As I explain at the beginning of the chapter, I have consulted a wide range of literature as I try to bring together a range of theoretical perspectives to inform my research on what teachers know and do. Chapter Three focuses on the methodology underpinning and guiding the research. This explains why I adopted a case study approach, how I defined and identified ‘expert teachers’ and why I chose physics, geography and history as subjects to focus on. The chapter also shows how the data in this research were generated. Chapters four, five and six each present data relating to one of the subjects. I start with physics, then focus on geography and finally explore history. This order made sense as it moves from the hierarchical form of knowledge of physics to the more horizontal form of knowledge in history (Bernstein, 1999). Geography, as we will see, defies such simple categorisation and it seemed fitting to place it between the other two. Each subject chapter begins with a brief review of literature pertaining to the specialist field to provide context for the history of the school subject and its recontextualization from the 'parent' discipline. I use a common overarching framework for my data analysis to provide comparability across subjects but have also attempted to respect the difference across subjects by coding my data differently within this framework. Chapter Seven brings my findings across the separate subjects together in order to reach some conclusions about the similarities and differences between them before I finally respond to my three research questions head-on in Chapter Eight.

1.5 Why this research matters

Interest in knowledge and specifically in the knowledge embedded in subjects has burgeoned in recent years amongst academics, politicians and practitioners. This has opened up opportunities to reassert the value of specialist knowledge but also to use this interest to justify a return to notions of a 'canon' and the marginalisation of specialist ways of thinking. Young and Muller's (2014) vision of 'powerful knowledge' is rooted in the ways of thinking it enables young people to engage in rather than the accretion of pre-selected knowledge. My research explores the extent to which 'expert' subject teachers cultivate these distinctive ways of thinking and the impact that different knowledge structures and recontextualizing traditions have on their capacity to do so. Much of the recent theoretical work on subjects and curriculum has lacked this practical dimension of what teachers actually do, or are able to do, and my research is a contribution to this exemplification.

Connected to the curriculum is the important field of teacher education. To achieve any vision of the curriculum, a particular approach to teacher education and development is needed, particularly as, as I argue in my thesis, teachers are not simply curriculum enactors but curriculum makers, active agents in the recontextualization process of their discipline into schools. Knowing what kinds of knowledge expert teachers draw on when making planning and teaching decisions and the ways these kinds of knowledge interact is critical to understanding how to achieve the curriculum that Young and Muller (2010) advocate. My research analyses the specialist knowledge that teachers across three subject areas bring to their practice.

Chapter 2 Literature Review

In this review I draw from a wide range of literature which encompasses sociological, psychological and philosophical perspectives, predominantly from within the United Kingdom but also beyond. This has enabled me to explore my particular interests in the light of a range of influential and, I will argue, often connected traditions.

My chief interest lies in the different sorts of knowledge from which subject teachers draw in history, geography and physics when planning and teaching lessons. During my research, it soon became clear to me that I would need to be familiar with how the knowledge structures of each subject have been described and how the value of this knowledge has been analysed. This is outlined in section 2.2. However, understanding the kinds of knowledge contained within university disciplines does not adequately address the nature of the associated school subjects. This is because of the process of recontextualization as a subject shifts from one context to another. I have outlined how and why this process happens and teachers' role in this in section 2.3. The literature in sections 2.2 and 2.3 provides important underpinnings for my final section which explores what subjects teachers know (or need to know) in order to plan and bring about valuable learning - not least in providing ways in which to consider what 'valuable learning' actually means. The kinds of teacher knowledge which emerge from the literature are not characterised by a list of topics to teach but are instead informed by theories such as didactical analysis (Klafki, 1995) and teachers as curriculum makers (Lambert and Biddulph, 2015) in order to take account of a wide range of influences.

A key argument emerging from my review of the literature is that teachers from different subject areas are dealing with quite different *types* of knowledge. This has an impact on the evaluative criteria of subjects and the ways in which students can achieve epistemic ascent (Winch, 2013). In other words, structuring knowledge and planning for progression looks quite different in physics compared with history. Each subject has its own sets of recognition rules (Bernstein, 2000) which reflect the particular epistemology and conceptual base of the subject. It therefore follows that subject teachers ought to understand both of these.

A second argument concerns the recontextualization process and suggests, first, that teachers are (probably subconsciously) active agents in this process and second, that explicit knowledge about the process could be beneficial (see Shalem, 2017). In other words, whilst teachers' planning and teaching decisions play a central role in recontextualising subjects from one context to another, a conscious understanding of how and why this process happens could be valuable.

Finally, I draw on three different, but overlapping, models of teacher knowledge in order to clarify what it is that subject teachers know or ought to know. I explore Shulman's concepts of content knowledge and pedagogical content knowledge (PCK), the didactic triangle within the German tradition of *didaktik* and the Anglophone concept of curriculum making before returning to Bernstein's work on recognition codes. An argument emerges that the choices and decisions that teachers make in their lesson planning and teaching are informed by different influences (subject, learners, society, teaching strategies) working in concert with one another. The role of subject knowledge is emphasised as a particular influence but it is recognised that aims arising from a particular subject only have meaning in the wider context of learners and society. I conclude that all the models offer something valuable and suggest that subject teachers require a special kind of knowledge that is neither the 'pure' disciplinary knowledge they may have learnt at university nor generic knowledge about teaching strategies that schools in England are fond of providing. That is not to say that those two types of knowledge are not helpful, but rather that they are not sufficient. Shulman's PCK was extremely helpful in highlighting this in 1986 but it is not clear whether it captures this 'special knowledge' fully enough. Looking to the work of Bernstein, for example, may help to clarify the process of inducting young people into different subjects.

2.1 Knowledge and the school curriculum

This section lays important groundwork for the rest of the literature review and indeed for my thesis. Given that my interest is in the different kinds of knowledge my teachers have in relation to their subjects and the way this influences their classroom practice, I need firstly to consider how the structure and conceptual bases of their subjects differ. In other words, I cannot do justice to the different kinds of knowledge that a physics teacher, a geography teacher and a history teacher have without understanding something about these subjects as forms (or fields) of knowledge. Secondly, I also need to understand recent arguments that have been advanced about the value of subject knowledge for school students. I begin the section by considering ways to distinguish between different types of knowledge structures *across* disciplines before moving on to explore the ways we might categorise knowledge *within* disciplines. I then introduce the concept of powerful knowledge before linking it with the concept of epistemic quality and outlining several ways in which the theory has been challenged.

2.1.1 Types of disciplines

Historically, disciplines were divided into those concerned with the 'inner' being and those concerned with the 'outer' world (Muller, 2009). The former – including the humanities – were regarded as superior to the latter which were deemed without moral purpose and foundation (ibid.). Later these distinctions evolved into liberal or 'pure' disciplines and mechanical or 'applied' disciplines as the sciences gained a more solid and highly regarded place as a form of knowledge. Biglan (1973), for example, explored the characteristics of 'subject matter' in order to evaluate the ways university departments were structured. Using data collected from staff working at one large and one small institution in the US, he concluded that subject matter was characterised in three main ways as summarised in Figure 2.1 below (with reference to the three subjects I am especially interested in). Since then, Biglan's classification scheme has been validated in further institutions in the US (e.g. Stoecker, 1993) and more recently in the UK (Simpson, 2017).

Figure 2.1 Biglan's three dimensions

Biglan's three dimensions (1973)	Physics	Geography	History
Dimension 1: hard-soft	Hard	Hard and soft	Soft
Dimension 2: pure-applied	Pure	Pure	Pure
Dimension 3: concerned with living or organic objects of study?	No	Yes and no	No

Biglan's 'hard' and 'soft' continuum relates to the presence of paradigms within the subject matter, that is a consensus about appropriate content matter and methodology. Drawing on Kuhn (1962), Biglan argued that the physical and biological sciences are paradigmatic whilst 'soft' subjects such as the humanities and education have content and methodologies that are more ‘idiosyncratic’ (p202). This last point is debateable – Winch (2013) implies that history has a generally accepted methodology for example – but the general point about ‘hard’ and ‘soft’ subjects maps quite neatly onto Bernstein’s distinction between hierarchical and horizontal knowledge within vertical discourse (Bernstein, 1999; Hordern, 2017b). Hierarchical knowledge demonstrates an inherent, internal progression towards more generality and abstraction (verticality) and a language that can relate this abstraction to the world (grammaticality) (Firth, 2011). By contrast, horizontal knowledge structures have less capacity for progression: new language is necessary to describe new ‘areas’ of knowledge that do not build on each other although there can be (weak) verticality within topics (Muller, 2006). Natural sciences are the best examples of hierarchical knowledge whilst social sciences and humanities are examples of horizontal knowledge because new areas of knowledge are accumulated but do not represent a hierarchy of knowledge culminating in greater abstraction. In that sense the natural sciences are therefore structured around stronger paradigms than the humanities or indeed social science, though I would argue that both strive to be paradigmatic in their own ways.

Moving to Biglan’s second category of subject matter, it is possible to see how the earlier sense of ‘pure’ and ‘applied’ (i.e. a distinction between subjects concerned with morality and those concerned with the physical world) shifted to a distinction between those subjects concerned with knowledge creation (‘pure’) and those concerned with knowledge application (‘applied’). The superiority of subject matter relating to the metaphysical no longer holds and indeed it could be argued that empirical, scientific knowledge in some ways enjoys greater status. All three of the subjects I am interested in are categorised as ‘pure’ as would most of the whole school curriculum. ‘Applied’ subjects in universities would be attached to a particular profession (such as medicine, engineering, education) and in schools and colleges would be most often linked to vocational education such as health and social care or car mechanics.

Biglan’s final category separated subject matter concerning biological and social areas from those concerning inanimate objects. This has been the least influential of Biglan’s categories, used in less than 10 per cent of research citing Biglan’s paper. This may reflect a difficulty in applying life/non-life distinctions: Stoecker’s (1993) classification of dentistry, for example, as hard and applied seemed more appropriate than her additional classification of dentistry as ‘non-life’ (Simpson, 2017). I would suggest that this is also the case with history which whilst not concerned with objects alive now is not adequately described as dealing with ‘non-life’ (unless this relates to historians’ methodology). Historians are deeply interested in people in the past (animate at the time) but use inanimate source material to investigate them; the choice of categorising history as dealing with 'non-life' objects needs some clarification.

More interesting for my purposes however is to note that geography as a discipline did not appear on Biglan's list. For the purposes of Figure 2.1, it was therefore necessary for me to note those disciplines on Biglan's list from which geography borrows (geology, anthropology, economics, sociology), which bring with them quite different characteristics. Thus, for example, geology is deemed a hard subject whilst anthropology is soft. Similarly, economics does not deal with living things but sociology does. This helpfully demonstrates that geography is a field and not a form of knowledge, a point emphasised by White (2012). Geography, White argues, is a field of knowledge because it draws from both the physical and human sciences (which are forms of knowledge in their own right) and it is therefore difficult to associate geography with distinctive concepts unique to itself.

Young and Muller (2010) mainly distinguish between disciplines in terms of conceptual distinctiveness and influenced by Bernstein, they differentiate between subjects where there are 'hierarchies of abstraction' (concepts become increasingly abstract as you progress and understanding one concept is contingent on understanding the preceding one) such as science[1], subjects where conceptual advance is through variation and diversification such as history and subjects that develop practically by the development of new skills such as art. In each subject progression depends on some kind of interaction between content, concept and skill, but 'their relative salience is what differentiates them' (Young and Muller op. cit., p. 21). The second way that Young and Muller differentiate between subjects is by objectivity. Whilst they insist that what characterises disciplines is a stable, legitimate and shared way of generating truth, these disciplines display different kinds of objectivity depending on whether the object of study is natural or social. Disciplines which focus on the natural world, they argue, can make greater claims to objectivity through empirical investigation.

Overall, these examples of how to categorise and distinguish between disciplines have much in common, based primarily on the characteristics of progression within them. Bernstein, Biglan, Young and Muller all argue, in effect, that some disciplines have a vertical knowledge structure, i.e. that one needs to know x before one can know y, with increasingly abstract knowledge and specialist language the higher up the structure you advance. Disciplines with more horizontal structures such as the social sciences are

[1] Thus, in physics for example, a good example of a subject with a highly vertical, hierarchical conceptual structure, understanding the concept of strong nuclear forces is impossible without first understanding the structure of an atom.

less cumulative, i.e. it is less apparent what constitutes the basic building blocks and in what order one should learn things. The absence of a strongly paradigmatic approach to methodology also contributes to this ‘horizontal’ structure. Within this definition, physics is an example of vertical knowledge, history is an example of horizontal knowledge and geography is somewhere between the two.

We need to be cautious in applying these definitions to school subjects. First, they could imply that within hierarchical knowledge structures there is always an obvious and agreed order in which one might sequence learning about, say, physics and furthermore, agreement over what school physics curricula should include. The work of Yates and Millar (2016) has challenged this notion as I will explore. Second, it focuses attention on knowledge as inert rather than as mediated by a person. Maton’s work (2006 and 2007 as cited in Firth 2011 and Hood 2010), by flipping attention onto the ‘knower’, adds an additional layer of complexity to Bernstein’s vertical and horizontal knowledge structures (Bernstein, 1999). Essentially, Maton emphasises knowledge’s social dimension – it is created/constructed by someone and does not exist independently of them. In terms of horizontal and hierarchical knowledge structures, Maton’s knower structures invert the usual pattern. Thus, whilst the natural sciences are characterised by hierarchical knowledge, they are more likely to demonstrate horizontal knower structures because the social profile of a scientist is largely irrelevant – what matters is the empirical evidence. By contrast, whilst the humanities are characterised by a more horizontal knowledge structure, they are more likely to demonstrate a hierarchical knower structure because the role of the ‘knower’ is more intrinsically linked to the value of the knowledge – there is an ‘ideal knower’ (Hood, 2010). What follows from this is a rather different way of conceptualising progression within the humanities: the more you understand the way knowledge is constructed (for better or worse) by others, the more you are able to aspire to being an ideal knower.

2.1.2 Knowledge within disciplines

So far I have explored the different knowledge structures *between* disciplines. In this section I will consider knowledge structures *within* disciplines, drawing heavily on the work of Winch (2013) and his development of Hirst (1965). Hirst identified three types of knowledge which have been highly influential and in many ways enduring. He proposed a distinction between propositional knowledge (knowledge that), procedural knowledge (know how) and knowledge by acquaintance (knowledge with a direct object). The first two of these, in particular, helped to broaden attention away from content knowledge alone and onto how that knowledge is constructed. This was, for example, influential in the thinking behind the 'new history' that emerged in the 1970s (Lee, 2014) which sought to frame history in schools as both a form and a body of knowledge so that students might learn about what happened in the past but also come to understand the way historical knowledge is constructed from often fragmentary evidence by people whose own opinions and contexts intrude on their judgements . There were similarities between the work of Hirst (1965) and Schwab (1978) who differentiated between subject knowledge (content, concepts and principles) and syntactic knowledge (how claims are established). Both Hirst and Schwab opened up rich possibilities in terms of progression which (in the humanities especially) brings Bernstein's focus on hierarchical and horizontal knowledge (where progression in, say, history is somewhat restricted to 'knowing more') together with Maton's notion of an ideal knower. In other words, progression can be measured not just in terms of knowing and understanding content knowledge but in also being able to apply that knowledge to various ways of thinking and to critique that knowledge on the basis of how it was generated. This potentially frees humanities subjects from a sense of inferiority that could be inferred from Bernstein's work and which has led some (e.g. Ormond, 2014) to mistakenly advance the value of humanities subjects on the basis of their objectivity.

Winch (2013) has developed the work of Hirst, most notably to reflect the work of Robert Brandom, and has expanded 'know how' knowledge to include both inferential and procedural elements. Winch rejects arguments that designate 'knowing how' as a type of 'knowledge that' by invoking the concept of expertise which involves being able to do something that can be evaluated. In other words, 'knowing how' is something quite different (though linked) from 'knowledge that'. Becoming 'expert' involves both inferential and procedural 'know how'. The more novel of these, inferential know how, refers to a person knowing when and how to make inferences in relation to propositional knowledge. To the extent that this still includes propositional knowledge, what therefore is the difference between procedural 'know how' and 'knowledge that'? The answer, suggests Winch, lies in the very limited value of (propositional) knowledge which is not dependent on the conceptual structure of a subject because in general, we make sense of new knowledge by locating it *within a broad conceptual structure of particular subjects*. The example Winch gives is helpful. In order to infer from the statement 'Napoleon was crowned Emperor of France' that consequently 'France ceased to be a republic', the student must understand substantive concepts such as governance, monarchies and republics and empire/emperor. Without this understanding, the student cannot make the inference and the knowledge remains isolated and of little use.

Thus, argues Winch, 'know how' includes knowing how to make and understand inferences which in turn depends on being able to use the language of a subject. This, he suggests, is a gradual process and one cannot claim to acquire subject knowledge until one has a significant grasp of the conceptual field which involves 'significant practical abilities based on a prior grasp of language' (p. 132).

The movement from novice to expert in terms of inferential know how is one aspect of what Winch terms 'epistemic ascent'. The second aspect, also a dimension of 'know how' knowledge, is procedural, that is knowing how knowledge in a subject is managed and created and therefore advanced. This echoes both Schwab (op. cit.) and Hirst (op. cit.) and complements aspects of Young and Muller's Future 3 curriculum scenario (2010). However, Winch draws an important distinction between, for example, knowing how new scientific knowledge is created through experimentation and actually being able to do so. What students receive in schools is 'prefigurative practice' (p. 142) in the sense that students understand the prerequisites of expert practice but are not engaging in a simplified version of that practice themselves. He is consequently critical of curriculum aims that anticipate this level of expertise too soon. For example, he is critical of the 2008 History National Curriculum's requirement for Key Stage 3 pupils to 'identify and investigate, individually and as part of a team, specific historical questions or issues, making and testing hypotheses', suggesting that 'legitimate questions may…be raised about the extent to which this particular investigative target is a realistic one' (p. 144). I will return to this point in Chapter Six.

This section raises important questions for me about how far my three teachers provide access to inferential and procedural know-how and most crucially *what knowledge they draw on to do so*. However, it also raises a question about geography because of its potentially weaker conceptual structure and the absence of an overarching methodology across physical and human forms.

2.1.3 The contribution of social realists: the theory of powerful knowledge

The work of Winch suggests that subjects are important in school and in this way he aligned himself with earlier work by social realists such as Michael Young and Johann Muller. The social realist theory of knowledge provides a solution to a knowledge 'dilemma': namely the idea that knowledge is either over-socialised and relativist or under-socialised and regarded as fixed and unchanging (Moore, 2014). Social realists provide a way through this dilemma by arguing that whilst knowledge is indeed social in origin, when created within disciplinary communities which draw on shared and agreed methodologies, it has value beyond the individual knowledge-creator. Such knowledge in fact represents the best available at any one time, even if its fallibility means that its lifespan may be relatively short lived (see, for example, Young, 2008, 2010a, 2010b, 2011, 2013, Young and Muller 2010, 2014) and in that way it is 'powerful knowledge'. Thus, social realism frees us from a position where knowledge is a given on the one hand and from a wholesale postmodern relativism on the other (Lambert et al, 2015).

In defining what is meant by powerful knowledge, it is useful to consider both what it does mean and what it does not. First, the term is not intended to be synonymous with 'knowledge of the powerful' (Young 2012) and does not imply knowledge chosen by and for the most privileged in society for reasons of social control. On the contrary, Young advocates powerful knowledge partly on the grounds of social justice and a belief that all children deserve access to it. Second, powerful knowledge is concerned with theoretical rather than 'everyday' concepts which children already know and which have been increasingly privileged in schools in recent years to the detriment of more academic and certainly more intellectually demanding knowledge (Beck 2012). Third, powerful knowledge takes young people beyond their own experiences. Young fundamentally disagrees that schools are places where experience should be privileged over knowledge, drawing on Durkheim's social theory of knowledge which separates theoretical (sacred) knowledge from practical (profane) knowledge. Indeed, he goes as far as to say that if schools are not about theoretical knowledge, what is the point of them at all? (Young, 2010a). Fourth, powerful knowledge is not isolated, fragmented knowledge: it exists within the theoretical conceptual frameworks of academic disciplines. Finally, and linked to the first and fourth points above, powerful knowledge is not a canon: it is not fixed and is likely to change over time (Young 2011).

This last point is critical and relates to Young's distinction between content and concepts: disciplines are defined and bound by concepts and 'epistemic rules' (Young 2011, p. 269) that are relatively stable and give meaning to content which is more likely to change: 'All disciplines, in order to be disciplines, have shared objects of study, and in order to be robust and stable, display objectivity — that is to say, they possess legitimate, shared and stably reliable means for generating truth (Young and Muller, 2010, p. 20)'. In this sense, Young is defining powerful knowledge as knowledge which has been 'held to account' and deemed fit for purpose by communities through peer review processes. He is also highlighting the importance of 'interrelated concepts', much as Winch was to do later in his work on inferential know-how:

> 'It is the interrelatedness of concepts in a subject or discipline that distinguishes them from the everyday concepts that pupils bring to school, and which offers them ways of going beyond their experience.' (Young 2011, p. 269)

Young draws from Vygotsky's notion of 'scientific' concepts, which might also be termed 'academic' or 'theoretical' concepts, which are the opposite to 'everyday' concepts, and from Bernstein, who proposed two forms of discourse: horizontal discourse comprising everyday, common place knowledge (context bound with no systematic ordering principles) and vertical discourse (Bernstein, 2000) which can be found in subject disciplines. Young's contention is that everyday knowledge is pedagogically valuable but in knowledge terms does not take children far enough. He further argues that those subjects which offer powerful knowledge consist of concepts, the inter-relatedness of which derive their meaning from disciplinary communities rather than from particular contexts such as schools. In other words, concepts such as revolution and migration in history have particular meanings – and relationships – which are defined by the discipline of history. Such concepts may, in fact, appear in other subjects such as geography and science, but their meaning will be different and there will be other specialist concepts with which they can be linked in those contexts. Again, this resonates with the work of Winch (2013) who argues that it is only by understanding such a conceptual framework and the language used to describe them that students know how to make inferences and thereby can achieve epistemic ascent.

Young's understanding of South African curriculum reform and Muller's own position as an academic in South Africa has had a significant impact on their work around knowledge. The changes to the school curriculum in South Africa has been helpfully analysed by Hoadley (2011) whose work has been a significant influence on my research, particularly in regard to my data analysis (see Chapter Three). Her account helpfully outlines the decision of curriculum reformers in 1997 to emphasise 'knowers' (the students) and 'knowing' (ways of learning) at the expense of 'knowledge' which was associated with particular power structures during the Apartheid regime. The knowers were emphasised in the new curriculum by making it outcomes-led, with those outcomes relating to generic behaviours and skills and with no specified content (and even more importantly, therefore no specified conceptual framework). Coupled with a specific requirement to embrace a constructivist, student-centred pedagogy, the new curriculum privileged 'everyday knowledge' over subject specific knowledge rooted within disciplines and with distinctive conceptual structures and ways of thinking. In this sense, Curriculum 2005 (actually implemented in 1997) allowed the 'knowers' and 'knowing' to shape the knowledge rather than the other way round (Hoadley, ibid.) and demonstrated precisely the problems the social realists are concerned with. Subsequent reviews of the curriculum began to address these issues after South

African students began to perform poorly in national and international standardised tests, with the South African Department of Education stating in 2009 that:

> Though all learners do engage in the construction of knowledge in terms of coming to understand certain concepts, skills and content, it has generally been accepted that these aspects inhere within the subject and not in the minds of learners in the first place. (See Hoadley, op.cit., p.153.)

Yates has helpfully summarised the arguments for locating powerful knowledge within subjects:

> 'Underpinning [the argument for re-emphasising subjects] was the case that while the disciplines are in origin socially constructed (in that sense not essentialist or realist) and thus fallible, nevertheless in that they have been developed, challenged, extended in a disciplined way by a disciplinary community and organized processes over time, they have an epistemological power and authority different from 'outward-facing' 'problem-oriented' knowledge.' (Young 2008, p. 3)

Yates' research, explored in more detail later, has both supported and challenged the arguments underpinning powerful knowledge within school curricula but she agrees that disciplines (or more specifically the discipline of physics) 'entail some understanding and respect for the kinds of boundaries and hierarchies that are part of the subject processes' (ibid., p.13). This has echoes of Young and Muller's assertion that 'knowledge boundaries are not arbitrary' (Young and Muller, 2010, p. 20) and indeed are part of what gives disciplinary knowledge its power.

2.1.4 The Three Future Curriculum Scenarios

Young and Muller (2010) have set out three scenarios for the future which contrast different ways that knowledge might be handled in school curricula:

> *The Three Futures (or Scenarios for the Future)*
>
> ***Future 1*** — Boundaries are given and fixed — the 'Future' is associated with a naturalised or 'under-socialised' concept of knowledge;
>
> ***Future 2*** — The end of boundaries — the 'Future' is associated with an 'over socialised' concept of knowledge;
>
> ***Future 3***—Boundary maintenance as prior to boundary crossing. In this 'Future' it is the variable relation between the two that is the condition for the creation and acquisition of new knowledge.
>
> *Young and Muller, 2010, p. 16*

Future 1 (F1), an elite system which harnesses certain kinds of knowledge for the privileged few, exacerbates social inequality as those not granted access to this knowledge are given ‘dumbed down versions of elite knowledge’ (Young and Muller, 2010, p. 17). In Future 2 (F2), the removal of boundaries – for example between academic and vocational education and between subjects – is seen as the solution as more emphasis is placed on generic outcomes and ‘learner-directed trends’, mediated through digital technologies (ibid., p.17). The result is far from the greater equality intended because the removal of boundaries also removes models of progression: children cannot see how to get better. In Future 3 (F3) – Young and Muller’s preferred model – the boundaries present in F1 still have a role to play, not as givens but in order to define ‘domain-specific but increasingly global specialist communities as a basis both for the acquisition and production of new knowledge and human progress more generally’ (ibid., p. 20). The point about F3 is that it is not skewed towards content (as in F1) or skills (as in F2): what makes the disciplines distinctive is the interplay of content, concept and skills, all of which are important. Therefore the way that disciplines are constructed and warranted must be as visible as the knowledge they generate in order to maintain progress made towards ‘equalising epistemological access’ (ibid., p. 23).

Lambert has attempted to flesh out what a Future 3 curriculum might look like in geography education in relation to the GeoCapabilities project[2]:

> ‘the project asserts the pedagogic right of all young people to acquire the knowledge and the means to think theoretically (in the abstract); to discern ‘better’ knowledge and/or arguments; and to make good, supportable generalisations. What lifts this from the dangers of Future2ism is the insistence on inducting young people into specialized ‘powerful’ knowledge.’ (Lambert, 2017)

Lambert makes it clear that this is not about simply knowing a lot of geographical content knowledge: it is about invoking the disciplinary structures of geography in order to think in particular, abstract ways and to understand what makes some kinds of knowledge better than other kinds. This involves understanding *how* knowledge is generated in geography alongside an understanding of key geographical concepts which give meaning to content. This is, I believe, what Lambert means by ‘specialised’ powerful’ knowledge’. It also invokes Hirst’s distinction between propositional and procedural knowledge and Winch’s (2013) later development of Hirst’s work.

2.1.5 Criticisms of the theory of powerful knowledge

It is fair to say that the theory of powerful knowledge has stimulated fruitful debate in several parts of the English speaking world and beyond and has been warmly welcomed by those worried about an increasingly impoverished curriculum offer to

[2] See http://www.geocapabilities.org/

young people which focuses on generic skills and which does not take seriously the contribution of disciplinary knowledge to young people's capacity to think in different ways about their world. However, this has not prevented criticism of aspects of the theory and in this section I have summarised those criticisms which have particular relevance for my own research. I have phrased these as a series of questions, as follows:

What is the knowledge powerful *for?*

Are all school subjects a form a knowledge?

Is everyday knowledge under-valued?

Does the theory of powerful knowledge separate pedagogy and curriculum too sharply?

There is another criticism that I have set aside a whole section to address: the extent to which disciplines, in moving from the field of production (normally universities) to a school context, are changed in some way. I explore this fully in section 2.3

i. What is the knowledge powerful *for?*

One of the criticisms made about the theory of powerful knowledge concerns the question of 'powerful for what?' Bernstein (2000) wrote about an ideological space that opens up when knowledge from the site of production - normally the academy – is recontextualised into schools. Concerns beyond the discipline come into play in this ideological space, whether these be related to wider educational aims, practical resourcing issues, assessment requirements or pedagogical frameworks. This is a potential limitation of the social realist argument. Their general argument tends to be that the powerful knowledge emerging from disciplines enables young people to think more broadly and creatively about the world and its future – to think the unknown. This is important of course but remains quite generic. It is the role of subject specialists to interpret and apply the theory of powerful knowledge in practice.

Maude (2016) has applied 'powerful knowledge' to the specific case of school geography in order to identify what, specifically, that knowledge may be powerful *for*. He observes that whilst social realists may on the one hand seem primarily interested in the *characteristics* of powerful knowledge, they have nevertheless considered what powerful knowledge may *enable* young people to do. Maude cites various quotations from Young's work which emphasise, for example, the role of powerful knowledge in providing new ways of thinking about the world, envisaging alternatives and allowing learners to challenge the authority of knowledge (ibid., p. 71). In a similar vein, Young and Muller wrote in 2014 that social science subjects:

> **provide generalisations** that are tied, sometimes only weakly, to specific contexts; they generate facts grounded in the relatively objective methods of their peer communities. **Their findings become a resource for debates about alternative policies, and they contribute in some cases to a society's conversations about itself.** Furthermore, they make testable predictions, albeit in most cases as probabilities not certainties, and remind policy makers and politicians that the consequences of their decisions may be more 'powerful' than their intentions. (Young and Muller, 2014, p. 62, my emphases)

I would suggest that, despite Young's outward rejection of an instrumentalist approach, this quotation does offer us a way to think about content selection. Influenced by Maude, I have attempted to apply these ideas to history (see Kitson, forthcoming) by applying the general points made by Young and Muller to specific examples of how history can shape discussions about content selection and conceptual progression:

The point I am making here is that the theory of powerful knowledge is only a starting point. Because there is too much knowledge to teach and because the internal conceptual structures of disciplines cannot themselves determine exactly what to teach in schools, educationalists need to find other grounds on which to base content selections within the boundaries of each discipline. Figure 2.2 presents one attempt to identify grounds which could help to inform content selection in history; there are of course others.

Figure 2.2 What might Powerful Knowledge look like in history?

What Powerful Knowledge might enable students to do	**Examples of how history might contribute to these aims**
Discover new ways of seeing the world today.	*By helping students to understand that:* • *things have not always been as they are now.* • *decisions and developments in the past shape the present and the future.* • *things do not happen because they are inevitable.* • *people in the past (and in the present) were/are diverse and understanding their actions is difficult but important.*
Engage in society's conversations and debates about itself.	*By helping students to understand that:* • *history can help us to understand the present.* • *history can help us think about the future.* • *a longer perspective (i.e. 'bigger pictures' or frameworks) can help us to identify approaches to complex issues in the present.*
Understand the grounds for accepting or rejecting knowledge claims.	*By helping students to understand that:* • *there is a relationship between a claim and the weight of evidence behind that claim.* • *'history' and the 'past' are different. History is deliberately constructed by someone after the event.* • *the past is interpreted in difference ways by different people.*

ii. Are all school subjects a form of knowledge?

There is also an ongoing dialogue between Young and White about the extent to which the concepts of different disciplines are distinctive. White argues that concepts derive from *forms of knowledge* (White, 2012). Therefore, for these concepts to be distinctive and to reasonably 'belong' to a subject, that subject must therefore offer a distinctive form of knowledge and in this regard he finds many of the traditional school subjects wanting. Like Beck (2012), White questions whether English and MFL are forms of knowledge with their own distinctive conceptual bases. He also argues that history draws from 'everyday concepts' or borrows from the concepts of other disciplines such as economics or statistics and as I have already noted, he defines geography as a field rather than a form of knowledge without a distinctive conceptual structure.

Whether or not we agree with those subjects characterised as a field and not a form of knowledge by White's calculation, the general point he makes is an important one given that so much of the social realist argument for powerful knowledge rests on the distinctive concepts (and their interplay with concept and skills) found within different disciplines. Young has responded to some of White's criticisms by re-emphasising the crucial difference between, 'theoretical' and 'everyday' concepts (Young 2012). However, it seems to me that the differences between school subjects – and therefore their particular forms of powerful knowledge - are under-theorised at present. Young and Muller (2010) have explained that different subjects place different emphases on the relationship between concept, content and skill. However, we are not sufficiently clear about the distinctiveness between different subjects in schools and the impact that the absence of a distinctive conceptual base might have on Winch's (2013) concept of epistemic ascent.

iii. Is everyday knowledge under-valued?

In arguing for powerful, 'theoretical' knowledge over everyday knowledge, social realists have come under fire in some quarters. Catling and Martin (2011), for example, offer a strong defence of 'everyday' knowledge as equally powerful as 'academic' knowledge in geography, especially in primary schools. It seems plausible that children's sense and experience of where they live is not only going to provide an important way into a topic – i.e. as a pedagogical tool – but also provide a valid perspective in its own right. After all, one person's experience of living in, say, south east London is as valid as anyone else's. This echoes Young and White's exchanges about Auckland: is a New Zealander's experience of living in Auckland a powerful piece of knowledge or is it, as Young argues, powerful only when accompanied by a more theoretical exploration of

Auckland, perhaps using it as an example of a modern city (Young 2012)? I have some sympathy with Young here. It seems to me that the experience of the Londoner and the New Zealander is relevant and valuable, but by itself it represents limited knowledge if not linked to something bigger, something beyond the individual experience. In physics, too, the starting point may be a real life example with which students are familiar and which form part of their everyday world (if you open a window the room gets cooler) before moving onto more abstract explanations of phenomena (the reason for this is convection currents).

In fact, Young does not reject the role of everyday knowledge in the curriculum. He talks approvingly of opportunities to 'move between everyday concepts and the theoretical concepts that are located in school subjects' and states that this 'lies at the heart of the purpose of schools and aims of any curriculum' (Young 2012). In this sense, everyday knowledge serves as a pedagogical tool to move learners from the familiar to the strange (Wineburg, 2001). It is interesting that much of the objection to the notion that everyday knowledge should be a starting point rather than an end in itself comes from subjects such as geography and English. Everyone lives somewhere and most people have experiences of other places, too. Everyone experiences weather, traffic congestion and the effects of a growing population. Thus, geography perhaps more than any other subject can legitimately draw on a great deal of everyday knowledge. This is much harder in, say, physics, where everyday 'hunches' about the way the physical world works are often incorrect. Similarly in history, assuming parallels between students' own experiences and experiences of people in the past is actively discouraged.

iv. Does the theory of powerful knowledge separate pedagogy and curriculum too sharply?

In 2010, Young wrote that 'teachers cannot create a curriculum themselves' and went on to say that their job is to motivate students and make concepts real for them. This is a very static view of a curriculum; it assumes that curricula are written and created outside schools and implemented by teachers in ways that engage learners. Much depends here on one's definition of curriculum. Certainly the specifications written by awarding bodies at key stages 4 and 5 are reasonably prescriptive and whilst academies and free schools are at liberty to ignore the national curriculum, testing in the core subjects across primary and secondary schools does limit the freedom to diverge from it too much. That leaves only limited scope for the construction of curricula within schools. However, Lambert and Morgan (2010) distinguish between curriculum planning (at the level of a key stage for example) and curriculum making, which describes the curriculum *as experienced by children* and which is carried out by teachers. This has similarities with the *didaktik* tradition in Germany and I explore both curriculum making and *didaktik* in more detail in sections 2.3 and 2.4.

Although Bernstein regarded curriculum and pedagogy as conceptually distinct, in practice he found it impossible to separate the two: ‘Curriculum defines what counts as valid knowledge, pedagogy defines what counts as valid transmission of knowledge’ (1975, p. 85). Although he was interested in the extent to which there are two main ‘types’ of curricula - those that are strongly insulated or classified (for example with strong subject boundaries) and those that are weakly insulated or classified (with weaker boundaries) (Bernstein, 2000) - the key point for him was what happens when a curriculum is enacted through pedagogical choices. He describes this process as ‘framing’: by selecting, organising and pacing the content of the curriculum, a ‘pedagogical relationship’ is established between teacher and learner (Bernstein 1971 as cited by Scott, 2008). Whilst the classification of the curriculum denotes what is taught (and therefore the limits of any discourse e.g. ‘history’ as opposed to ‘geography’), framing provides a means of realizing that discourse. In even simpler terms, classification refers to the ‘what’ and framing to the ‘how’. The principle of framing therefore denotes who controls what – the who being the teacher and the what being the way in which a curriculum is enacted. This is what Bernstein terms ‘the internal logic of the pedagogic practice’ (ibid. 12). Strong framing suggests a transmission model of teaching where the teacher has strong control over, for example, the type, sequence and pace of communication in the classroom. If strong framing provides the teacher with control, weak framing implies the reverse, with the pupil (or acquirer) in control, even if they do not realize it. In terms of social order, Bernstein terms the distribution of power between teacher and pupil as ‘regulative discourse’. The more mundane aspects of pedagogy (what to communicate, in what order and at what pace) - collectively referred to as ‘instructional discourse’ - emerges from the regulative discourse because these sorts of pedagogic decisions are determined by the nature of the power relationships between teacher and pupil. For Bernstein, therefore, the curriculum as experienced by children was profoundly influenced by the regulative discourse: curriculum and pedagogy are intertwined.

Overall, the criticism that powerful knowledge separates curriculum and pedagogy too sharply seem well founded. Whilst the concepts themselves are distinct, in practice they are closely connected. I will return to this issue later with reference to teachers as curriculum makers.

2.1.6 Powerful knowledge and epistemic quality: how do these concepts interrelate?

There are (somewhat limited at present) examples of discussions about what powerful knowledge might actually look like in the context of specific subjects. In thinking about the knowledge embedded in subjects and ways in which a Future 3 scenario might conceptualise that knowledge in ambitious ways, various dimensions of epistemological understanding are being explored. Winch (2013) refers to epistemic ascent as a way to think about progression, Billingsley and Hardman (2017) refers to epistemic insight as a way to think about procedural knowledge and Morrow (2009) refers to epistemic access, meaning that children have the right to access the best knowledge available. The philosophical concept of epistemic justice has also been explored in the context of education, referring to, for example, the value we place on students' own knowledge (interesting in the light of previous discussions about everyday knowledge) and the diversity of the curriculum we provide (Kotzee, 2017). Whilst these concepts are linked, they each offer a different and important perspective on the curriculum and play an important role in this thesis. One of the most useful variations for my own research is Hudson's (2018) reference to epistemic quality in the context of mathematics in order to characterise the most valuable aspects of a subject to teach. Using the framework of a sociological theory of knowledge (that is, that all knowledge is socially produced) including the social realist argument that nevertheless some knowledge is better than others, Hudson has attempted to explain why some approaches to teaching mathematics lead to epistemically higher quality knowledge than others. In one piece of research, Hudson contrasts two examples of mathematics teaching in order to tease out features of high and low epistemic quality. The first is a piece of action research where primary teachers were supported to develop mathematical thinking in their students. In this research, the development of topic-based approaches was deemed especially successful and elsewhere, Hudson (2015) has reported the findings from a sequence of lessons on the Amazon rainforest. He concludes that what resulted was of high epistemic quality because the children were encouraged to think creatively and inferentially by drawing on particular aspects of mathematical thinking, prompted by the open-ended nature of the tasks and the skill of teacher questioning. The questions framing the topic were:

> How could we measure these life-sized insects accurately ?
> How could we mark out the different layers of the rainforest in our playground ?
> Can you compare the length of the River Tay and the Amazon River ?
> Is there a relationship between the weight of an animal and the layer it lives on in the rainforest ? (Hudson, 2015, p. 126)

Here are two examples of how the children explained their approach to the third question:

> "I did 200,400,600,800 and 1000, so there's 5 River Tays in 1000. That means there's 30 in 6000 because 5 times 6 is 30, Then I just needed two 200s to get the 400 kilometres left. So the Amazon is about 32 River Tays."

> "I did 6400 divided by 200 as a sum to find out how many River Tays I could get in the Amazon. I said, "How many two hundreds are in 6, none, in 64 none, in 640, 3 with 40 left over. Then I put that 40 with the zero in the units column and got two hundreds in 400. That made 32." (Hudson, op. cit., p. 132)

We can see here how the children were thinking creatively and mathematically as they worked out how to solve a problem. They did not all choose the same method but they each reached a correct answer nevertheless. They are therefore making inferences here about the conceptual structure of mathematics (for example, in relation to multiplication and division and units) which make sense to them. 'Know how' knowledge (Winch, 2013) is clearly visible and 'critical thinking, creative reasoning, the generation of multiple solutions and [of] learning from errors and mistakes' (Hudson 2018, p. 388) is possible.

By contrast, Hudson has concluded that a different approach, that of the Core Knowledge website in the US, presents knowledge of low epistemic quality by emphasising a propositional, 'know that' form of knowledge. Here, 'success in learning mathematics comes through practice' (www.coreknowledge.org.uk/maths as quoted in Hudson, 2016, p. 391) and the approach is one of rule following, with little thought given to the order or organisation of topics to be taught. Students taught this way are likely to receive a 'mutated' version of mathematics, that is, one where it is regarded as 'infallible, authoritarian, dogmatic, absolutist, irrefutable and certain', involving rules that 'follow strict procedures and right and wrong answers' (Hudson, ibid., p. 339). There is no proper consideration of procedural or inferential know how and certainly no room, therefore, for students to consider the purpose of mathematics and the way it can be used creatively to solve problems. The risk is that students who have difficulty understanding and absorbing the rules simply learn that they cannot 'do' maths and epistemic access is denied them.

I have dwelt on this example because it is one of the only attempts I have found which tries to articulate what 'epistemic quality' might look like in schools. The link to the theory of powerful knowledge and especially to Future 3 is evident. Epistemic quality here is about understanding and drawing on a subject's content and conceptual structure in order to think creatively and inferentially whilst also beginning to understand the process of ‘doing mathematics’ or ‘thinking mathematically’, in this case in terms of its application and multiple approaches (but it could also be in terms of understanding how knowledge in the particular subject domain in created and even critiquing that). All of these would be important features of an F3 curriculum.

2.1.7 The role of subjects in school curricula: a historical view

So far I have focused on sociological perspectives, but the role of subjects in schools has also been debated by psychologists. Dewey was interested in the ‘logical’ and ‘psychological’ aspects of subjects as far back as 1897. A ‘psychology of school subjects’ followed in the early part of the twentieth century before it was dwarfed by interests in general theories of learning. In 1948, William Brownell voiced regret at the absence of research on the psychology of school subjects. He was joined by Judd who ‘placed…importance on the particular attributes of each subject matter field’ unlike Thorndike who applied ‘general laws of learning’ to the ‘methods for teaching any particular subject’ (Shulman, 2004, p. 113). Until the 1980s, studies into the particular characteristics of school disciplines waned, with only occasional exceptions. These exceptions included Bruner, writing in 1960, who argued for ‘the centrality of the disciplinary structures of subject matters as the essential features of what should be learned in schools, if students were to have an opportunity to go beyond the information given’[3] (Shulman and Quinlan, 2009, p. 400). Interestingly, another of the exceptions was Benjamin Bloom and his famous taxonomy, currently so ubiquitous in English schools. In 1971, he reframed his taxonomy into taxonomies, arranged according to different disciplines. The result was often radical modification[4].

More recently, there has been a resurgence of interest amongst educational psychologists into cognition *and* content with a shift towards exploring general processes of critical reasoning and problem solving in specific subject areas – referred to as ‘situated cognition’. Shulman has been influential in this resurgence and what characterises his work is a constant refrain about the limits of generalisability across subject areas. This has been a key influence in my research as I explore the ways in which the knowledge structures and epistemic qualities of different subjects shape teachers’ practice in particular ways.

[3] It is interesting to note how far Bruner was referring here to what Hirst went on to define as procedural knowledge. Bruner also wrote about teaching subjects ‘in some intellectually honest form’ which is what, it seems to me, advocates of powerful knowledge are arguing for.
[4] The subtlety of this reframing has not made its way into English schools, alas, where Bloom’s Taxonomy is frequently applied indiscriminately across all subjects.

2.2 The recontextualization of disciplines from universities to schools

In 2000, Bernstein denied that the ‘logic’ of the curriculum derived from the ‘logic’ of the discipline and in doing so, implied that academic disciplines were so radically recontextualised in schools as to be virtually unrecognisable. Bernstein is in good company in suggesting that academic disciplines are interpreted somewhat ‘loosely’ in schools: Dewey referred to the process as ‘psychologising’, Bruner as ‘conversion’ and Schwab as ‘translation’ (Muller 2009) whilst beyond the Anglophone world, Chevallard used the term ‘transposition’ (Hudson, 2016). Muller, whilst he challenges Bernstein’s conclusion that school subjects bear little resemblance to their parent discipline, recognises that ‘the inevitable selections and arrangements that go to make up the curriculum create a quite different animal to the disciplines as it is practised in university’ (Muller, op. cit., p. 215). In this section I start by asking why this might matter before exploring two different conceptions of the recontextualization process: Bernstein’s (2000) pedagogic device and Gericke et al’s (2018) concept of transformation.

2.2.1 Why does this matter?

The nature of the relationship between academic disciplines and their school-based equivalents matters quite significantly to social realists such as Young because their arguments about the importance of ‘powerful knowledge’ have rested on it. The ‘epistemic rules’ of subject communities that Young (2011) describes are, according to social realists, what gives knowledge in school its unique power: it is not random or everyday knowledge, but knowledge that has the weight, authority and conceptual structure to lift it above the reaches of knowledge that is derived from the everyday. It could be argued, therefore, that if the relationship between academic disciplines and school subjects is not, should not or cannot be a close one, the argument of social realists is theoretically weakened.

Stengel (1997) suggests that there are five possible relations between academic disciplines and school subjects depending on where you place the emphasis in terms of educational aims. These are:

- Continuous (disciplines and school subjects are basically the same in their purpose, substance and practice)
- Discontinuous (disciplines may be more or less useful in serving the wider purposes of schools)

- Different but related: discipline preceding (purpose of education is to learn school subject knowledge which is a distillation of disciplines)
- Different but related: school subject preceding (aims of the curriculum go beyond a subject-based curriculum and subjects freed from the academic disciplines but are still important)
- Different but related: dialectic (the relationship between disciplines and school subjects is important but mediated through the needs of learners: one impacts on the other)

Stengel does not indicate a preference and clearly, most of these relations (with perhaps the exception of the first as I will argue) are possible and indeed exist in different contexts. The final relation she identifies derives much of its justification from the work of Dewey who sees the purpose of education as 'growth toward (inevitably) the subject-matter knowledge that has its logical expression in the academic disciplines' (ibid., p. 596). Alongside this, however, Stengel sees the role of the teacher as transformative, though not a transformation of the subject matter. Rather, she concludes, 'it is a transformation of the students' environment so as to effect the experiences that will enable the student to come to the already known' (p. 596). This rather assumes that selecting the 'already known' is relatively uncontentious and I would argue that the relationship between disciplines, school subjects and learners is more interrelated than this implies. I will develop this further in the next section by drawing on the German tradition of *didaktik*.

However, I do wish to critique one feature of Stengel's work which is an underlying assumption that, whether desirable or not, it is *possible* to conceive of a continuous relation between academic disciplines and school subjects. As I have already stated, Bernstein (2000) wrote about an ideological space that opens up when knowledge from the site of production - normally the academy – is recontextualised into schools. For Bernstein, this had much to do with the power relations inherent in pedagogical transactions but it could equally apply to the wider educational aims that come into play when a discipline is recontextualized. This is partly because there is too much to teach in all academic disciplines and selections have to be made which cannot be dictated by the discipline alone. Yates and Millar (2016) have convincingly argued that even in subjects like physics where, in Bernstein's (2000) terms, the 'logic' of the discipline might be expected to dictate the 'logic' of the curriculum, there is no consensus about what should be taught in schools. For example, there are tensions between understanding core physical concepts on the one hand and understanding the role and possibilities physics provides us with in life on the other. Thus, it is not the case that even in hierarchical knowledge structures like physics, recontextualising a discipline into a school subject is simply a matter of deciding the sequencing and pacing of a body of commonly agreed content. Disciplinary boundaries will inevitably constrain content choices but do not precisely define them: there is simply too much we could teach. In making content selections, therefore, rationales must be sought and ideology comes into play; this is of course partly about knowing something about the children you will teach but also about deciding what is most important for them to learn and what social values should be conveyed to them (Yates and Millar, 2016). In history and geography, with their more horizontal knowledge structure than physics, these issues play out even more acutely. By this token, then, one argument could be that the continuous relation between academic disciplines and school subjects that Stengel identified is simply not possible.

Bernstein anticipated this argument when he used the term 'delocation' to describe the movement of an academic discipline into schools and suggested that what emerges are 'imaginary discourses' (2000, p. 33). For example, carpentry exists outside pedagogy; woodwork only exists within it. This, Bernstein implied, applies to all school subjects because decisions during the recontextualization process are taken, not in order to preserve the 'logic' of a subject discourse but as determined by the regulative discourse and, following on from that, the instructional discourse (see p. 43). Essentially then, it is only once a regulative discourse is established (let's say for sake of argument, that a traditional transmission model of teaching is adopted) that what is taught, in what order and at what speed in physics classrooms is constructed. The starting point is the model of teaching and learning, not physics per se; according to Bernstein, pedagogy comes first.

Yates and Millar (2016) are more cautious here, however, and they make a point about disciplinary boundaries which is key: these boundaries will *constrain* content choices even if they *do not precisely define them*. A large part of this constraint surely lies in Winch's 'knowing how' in both its inferential and procedural states which, as we have seen, require a grasp of a discipline's conceptual structure as well as insight into how knowledge is managed and created. Arguably, this can only be done with reference to the parent discipline. Yates and Millar (ibid.) interviewed academic physicists and physics teachers and concluded that whilst there was general agreement about defining what was core to the discipline, there was less consensus about what aspects of physics should be taught in school and why. The problem, Yates and Millar suggest, is that 'the scope of the disciplinary field is far greater than can be encompassed in school subjects' (p.15) and 'entry point' physics as opposed to 'research knowledge creation' is almost a ‘different world’ (p.13). Thus, selecting what to teach in schools cannot be ‘derived authoritatively from the disciplines themselves’ (p.15). Choices have to be made and these choices, Yates and Millar argue, whilst strongly knowledge-based and often driven by a strong sense of the discipline as a whole, are also influenced by wider factors which may include engagement (partly a curriculum issue and partly a pedagogical one), everyday usefulness and social values. However, Yates and Millar conclude that whilst the discipline itself is not able to ‘dictate the sequencing and selection’ that goes on in writing physics curricula, these decisions do nevertheless ‘entail some understanding and respect for the kinds of boundaries and hierarchies that are part of the subject processes’ (p.12). In other words, although the physics taught in classrooms does not derive in straightforward ways from the ‘logic of the discipline’, its power as knowledge does depend on its existence *as a distinctive discipline* (albeit one that is fragmenting into different specialisms in universities).

Yates and colleagues’ interviews with university historians and school history teachers (part of the same project) reaffirmed these conclusions (Yates et al, 2017). There was a sense of shared purpose in terms of the behaviours of historians – using evidence, understanding content, constructing an argument – but reluctance to identify what, specifically, pupils should learn. Thus, decisions about exactly what history to teach in terms of content are dictated less by the ‘logic of the discipline’ and more by wider political, social and cultural aims (that national history curricula are hotly debated is well-documented - see for example Phillips, 1998a). Recontextualising history in schools involves much wider influences than the discipline of history itself although, as with physics, there is shared sense amongst academic historians and history teachers of what is means to be a historian and carry out historical enquiry.

All of this points to the conclusion that whilst academic disciplines and school subjects are not quite the same thing, they potentially share a sense of what their subject *is about* and what *its purpose is.* The language used by academics and schoolteachers is not entirely different. What I have not yet explored is whether being nearer to the academic discipline might make the school subject more valuable. The social realist argument would suggest that it would and indeed Young (2016) is enthusiastic about a recent trend in history education to expose children to the work of real historians at an early age in order to see how historians build arguments, use evidence and write convincingly. Writing about mathematics, Boaler (2009) argues that the subject called maths taught in many schools is too narrow to be really called mathematics, dwelling as it often does on copying the teachers’ methods and repeatedly reproducing them. Instead she calls for ‘real mathematics’ to be taught which involves ‘problem solving, creating ideas and representations, exploring puzzles, discussing methods….' (p. 2, as quoted in Hudson, 2018, p. 388). The question can therefore be reframed away from 'how similar are academic disciplines and school subjects?' and towards 'how closely *should* school subjects build on their related academic disciplines?' This is perhaps an easier question to grapple with in some subjects than in others. Universities will still generally have departments of physics and history, for example, even if there are a multitude of specialists within those, and the people working within them would (as the work of Yates et al, 2017, suggests) recognise and share a view about what defines their subject and its epistemology. Geographers have a harder time with this because geography as a subject is largely fragmented in universities, a reflection that geography is a field and not a form of knowledge (White, 2012) and draws on a number of other disciplines. Geography began life in schools and not the other way round; it shifted into universities because of the need to have a source of qualified geography graduates to teach children (Walford, 2001). In Stengel's (1997) typology, geography is a variation of 'different but related: school subject preceding'. Geography emerged in schools as an answer to a problem – how to teach children about the physical and human world and its interactions in an efficient and manageable way. To move closer to what academic geographers do might be desirable but much harder to achieve than in those subjects whose parent discipline often predate their appearance in schools and which are less fragmented within the academy.

Overall, what emerges from these debates is, first, a sense that school subjects and academic disciplines are simultaneously similar and different and second, that the relationship between the two may vary across subjects. Physics is a helpful example of the first point. School physics in England up to the age of 16 is fundamentally Newtonian rather than modern and largely ignores quantum physics and relativity. Even at advanced level, only a small part of the knowledge taught bears resemblance to academic research (Sturdy, 2017). I am interested in the extent to which this kind of gap between a school subject and its parent discipline might matter in terms of epistemic ascent.

I will now consider the ways in which the *process* of the shift from academic discipline to school subject has been described.

2.2.2 How has the process of recontextualization been explained?

i. Bernstein's pedagogic device

At the very heart of Bernstein's work (2000) on the pedagogic device is exactly what happens when knowledge from the field of production (i.e. universities) is recontextualised into the field of reproduction (i.e. schools), underpinned by his belief that this process is complex and deeply ideological. In what follows, I attempt to summarise at least some of the complexity of his argument. First, I think it is helpful to distinguish between processes and principles in Bernstein's theory of the pedagogic device. The *process* of recontextualization involves three fields: the primary field (knowledge producers) where decisions about what 'counts' as knowledge within a specialised discourse are made and where research paradigms are agreed and policed; the secondary field (knowledge reproducers) and between the two, a 'mediatory recontextualising field' (Shalem, 2017). This latter field therefore mediates between the fields of production and reproduction and is significant if we are to understand the development of school subjects and the knowledge that teachers bring to bear on their practice. The central argument of this thesis – that expert teachers are important agents of recontextualization in their own right – does not diminish the significance of other agents within the two recontextualization fields. These agents, Bernstein argues, belong to one of two types of recontextualization fields: an official recontextualization field (ORF) which is created and dominated by the state (manifested in, for example, national curricula and formal assessment) and a pedagogic recontextualization field (PRF) made up of pedagogues in schools, colleges, specialized journals, university education departments, textbook writers and so forth. Where there is some autonomy from government regulation, Bernstein argues, there will be a struggle between the two fields; where there is none, only ORF will prevail. It therefore follows that in tightly regulated contexts, teachers' role as recontextualization agents will be diminished. Shalem's (op. cit.) work demonstrates, however, that even in tightly controlled teaching environments (in this case, with scripted lesson plans), teachers need to at least understand the decisions made within the fields of recontextualization if they are to properly understand the evaluative criteria underpinning each lesson. I will return to Shalem's work in Section 2.3.4 when I explore what teachers know or need to know.

These recontextualisation *processes* are part of a wider recontextualisation *principle* through which the ORF and PRF create a specific pedagogical discourse. As we saw in the previous section, Bernstein's recontextualization principle determines that singular, disciplinary discourses are transformed as they are delocated and altered by ideological influences at play within the fields and agents of recontextualization outlined above. The discourse that emerges from the recontextualization process, Bernstein argues, is entirely separate from the discourse located within the field of production and fundamentally shaped by regulative discourse. I have already introduced the concept of regulative discourse, together with Bernstein's concepts of classification and framing, in section 2.1.5, but here I am developing these further in order to explain their relevance to the process of recontextualization. Bernstein uses the concept of framing to denote how much explicit control the 'transmitter' (teacher) has over issues such as sequencing, selecting and pacing the curriculum. Strong framing denotes high levels of control by the transmitter; weak framing places more *apparent* control in the hand of the acquirer (pupil), though this control may be largely illusory. Bernstein identifies two sets of rules that shape this framing. First, rules of social order known as regulative discourse and second – and contingent on the first – rules of discursive order known as instructional discourse. Regulative discourse is the more dominant and is fundamental to understanding Bernstein's pedagogic device: it effectively establishes a hierarchical relationship between transmitter and acquirer which is never equal, even when it purports to be otherwise. Instructional discourse follows from (and is dictated by) regulative discourse and relates to more mundane issues such as sequencing and pacing. This relationship is captured by Bernstein in an equation which demonstrates that regulative discourse, as the denominator, underpins instructional discourse:

$$\frac{\text{Instructional discourse}}{\text{Regulative discourse}}$$

In practical terms, strong framing denotes a traditional, authoritarian 'transmission model' of teaching where the teacher dictates the pace and level of learning rather than the students, who are characterised in terms such as attentive, industrious and careful. Weak framing suggests the opposite, with students able to exert more influence on the process of learning and more likely to be described in terms such as creative and interactive. In Bernstein's model, the recontextualization of disciplines into school subjects is therefore profoundly influenced by regulative discourse and the curriculum as experienced by students is fundamentally shaped by the type of framing selected. The impact of the discipline/subject is arguably of secondary importance.

Bernstein uses the example of physics to illustrate his points, suggesting that as physics is 'appropriated' by recontextualisation agents, the results have little to do with the 'logic of that discourse' (Bernstein, op. cit., p. 34). He goes on to write that:

> 'Irrespective of whether there is an intrinsic logic to physics, the rules for its transmission are *social facts.* And if they are social facts, there are principles of selection. These will be activated by a component of the regulative discourse. That is, the rules of order of physics in the school (selection, relation, sequence and pace) are a function of the regulative discourse. Therefore, I argue that the regulative discourse provides the rules of the internal order of instructional

> discourse itself. If this argument holds, much can be derived from the notion that we have *one discourse* and that *the regulative discourse is dominant*' (p.34).

Moore (2013) critiques Bernstein's failure to address in detail 'the issue of the relationship between an intrinsic logic of a discipline in the field of production and its efficacy as an organising principle for pedagogy in the field of reproduction' (p. 163). However, this does not appear to be of primary interest to Bernstein who focused heavily on the distribution of the rules of social order embedded within regulative discourse. Examining how this process might play out differently in different school subjects was not a feature of his work on the pedagogic device.   Moore (op. cit.) believes that Bernstein was a realist 'without a theory of realism', working at a time when the two choices of pedagogy were either a radical, child-centred 'invisible' pedagogy or a visible conservative pedagogy. If a '*radical*, transformational visible pedagogy' had been available with a concept of 'socially transformative knowledge' (p. 190), Bernstein might well have aligned himself, Moore argues, with the social realists. Helpfully, Hordern (2017b) brings together social *and* epistemic issues in his exploration of recontextualization. The variation in the amount of control recontextualization agents have is an example of its social dimension whilst the underlying conceptual structure within vertical discourse (disciplines) must also feature or else the possibilities for epistemic ascent will be impeded. This epistemic aspect adds an important dimension to Bernstein's principle of recontextualization that was not explored in any detail in its original conception.

So far, I have explored Bernstein's pedagogic device and the recontextualising principle with reference to academic disciplines as they are relocated into schools. However, the concept of recontextualization is also highly relevant for education everywhere, including within vocational education associated with specific work settings. Bernstein conceptualised the space where disciplinary knowledge and the 'field of external practice' come together as regions (Bernstein, 2000, p.52) and Barnett (2006) has drawn on and modified Bernstein's work to account for the particular processes of recontextualization that takes place within vocational education. He proposes two stages in the recontextualization process. First, he uses the term 'reclassificatory recontextualization' (p. 147) to describe the process of drawing from a diverse range of scientific disciplines in a way that can then be used instrumentally for particular tasks. Secondly, he uses the term 'pedagogic recontextualization' to describe the interaction between this reclassified knowledge and situated knowledge to shape a 'vocational pedagogy' (p. 148). It is interesting that Barnett chooses to separate recontextualization processes according to knowledge and pedagogy before reconnecting them in his model; for Bernstein, the primacy of the regulative discourse meant that everything - curriculum and pedagogy – are controlled by the rules of social order.

The work of Barnett is especially relevant here if applied to the work of teachers. Hordern (2017b) argues that the recontextualization process within education involves a relocation from singulars to regions or from a discipline to a professional knowledge base and then into curricula (p. 197) and it is certainly possible to see teachers' knowledge as regional, even at secondary level, as teachers draw on the singular knowledge of their subject as well as from other areas of educational studies. Hordern (2017a) argues that the need to face in two directions 'may be a particularly difficult balancing act' (p. 151), echoing Barnett who, though writing in the context of vocational educational specifically, refers to the challenges of 'boundary-crossing' when teachers are required to teach across singular disciplines which not only present distinctive bodies of knowledge but also distinctive languages, people and identities. Barnett argues that this is more demanding for teachers in vocational settings than for teachers in schools, but this supposes that teachers are *only* drawing on the body of knowledge of their singular subject (rather than on a wider, more generic body of educational knowledge) and also that teachers only teach singular subjects. The subject of citizenship, for example, represents a region of knowledge as it draws from history, sociology and politics (Hordern, 2020). In a similar vein, geography might also qualify as a region as it draws from geology, sociology, anthropology, economics, history and others.

There is no doubt that Bernstein's work on recontextualization and the pedagogic device has been enormously influential on the way we think about the relationship between disciplines and school subjects and the relationship between the different kinds of knowledge a teacher must keep in balance. Whilst the impact of specific disciplines with distinctive epistemologies on the recontextualization process is perhaps underdeveloped in Bernstein's work, the principle he advanced of the 'delocation' of disciplines and the space which this movement opened up which ideologies must fill has been widely accepted.

ii. The didactic triangle and transformation

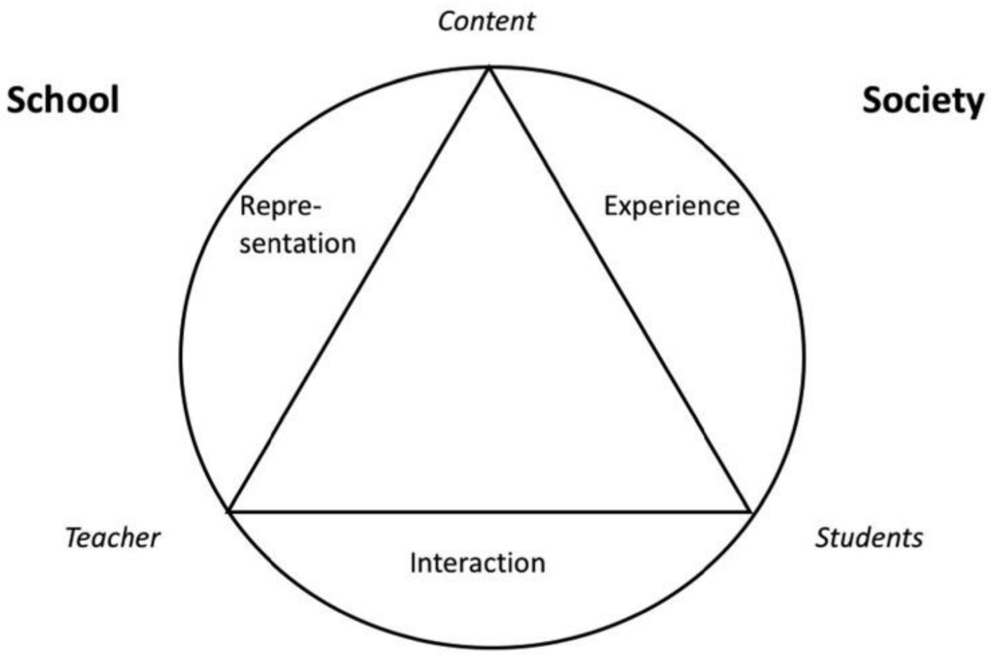
The German *didaktik* tradition emerged over several centuries, quite separately from later Anglo-Saxon traditions of teaching and curriculum and the more recent French concept of 'transposition didactique' (Hopmann, 2007). Although there are many variations of *didaktik*, there are three common dimensions throughout: the concept of Bildung, a theory of educational content and the concept of teaching as a meaningful encounter between the learner and content (Deng, 2013). *Bildung*, referring to educational purposes, is a difficult term to translate precisely but touches on ideas such as ''educated', 'knowledgeable', 'learned', 'literary', 'philosophical', 'scholarly', and 'wise'' (Hudson, 2016, p. 3). In essence, it refers to the development of the individual – the 'capabilities of the I' (Hopmann, 2007, p. 115) - that emerges during the teacher-learning process. *Bildung* is achieved not simply through the acquisition of content knowledge by young people but in the way they deploy this knowledge to make broader meanings and to develop as individuals within society:

> In Bildung, whatever is done or learned, is done or learned to develop one's own individuality and to unfold one's capabilities. The purpose of teaching and schooling from this perspective is not seen as being to transmit knowledge from society to a learner, nor to transpose knowledge from science or other domains to the classroom. Instead, the purpose is to use knowledge as a transformative tool for unfolding the individuality and sociability of the learner. (Hudson, 2016, p. 3)

Hence, using an example from Hopmann (2007), the point is not simply to learn about the First World War, but to learn, for example, about 'mankind by understanding the course of the Great War' (p. 117). In Germany, where curricula are constructed at state level, these broader meanings are rarely specified and thus the task of identifying what these meanings might be and helping young people to make sense of them is a local one, delegated to the teacher who makes autonomous decisions not just at the planning stage but also during lessons. In this sense, *Didaktik* becomes a tool to bridge the gap 'between centralised planning and local practice' (ibid., p.113), by providing a way for teachers to conceptualise their enactment of state curricula within local contexts, using the concept of *Bildung* to help them.

The didactic triangle as developed from Klafki (Gericke et al, 2018; see Figure 2.3) identifies three elements in teaching: teacher, student and content, all of which interact with each other in classroom situations. Sitting outside this triangle are wider concepts of schools and society in general. Thus, teaching is not only an exchange between teacher and student; there are three important relationships in which students make sense of content as mediated by the teacher and by their own selves and status as members of society. The aims of teachers when teaching particular areas of content are influenced by society in general as well as by the students specifically and in this sense, something is happening to the knowledge as it moves from universities to schools. The French concept of *transposition didactique* emphasises that this content or knowledge is not created with the intention of teaching and learning it; it is created to solve problems and answer questions in particular situations beyond schools. The quite different contexts of schools and society shape the knowledge according to the needs of learners and the aims of teachers (Hudson, 2016). Gericke et al (2018) refer to this process, like Dewey, as ‘transformation’ – transformation of knowledge for specific educational purposes.

Figure 2.3 The didactic triangle developed from Klafki (Gericke et al, 2018, p. 437)



The concept of transformation shares similarities and differences with other characterisations of recontextualization. To the extent that it acknowledges that academic disciplines are changed in some way between universities and schools and that the relationship between teacher and student influences this, it is similar to Bernstein’s concept of recontextualization, but Bernstein was more interested in the relationships between pedagogy and power than between wider educational goals and individual teacher aims. The ideas behind transformation also reflect Yates et al’s (2017) conclusions about the kinds of choices made during the recontextualization process and especially the role of wider educational purposes that inform these choices. However, when taken together with the didactic triangle, the concept of transformation also takes account of several interconnected dimensions of teaching a subject in a classroom on the micro, lesson-by-lesson level by introducing students into the equation.

Bernstein was very interested in teachers and students but less interested in subjects and wider educational aims whilst Yates et al are interested in teachers, subjects and wider educational aims but do not explore in any depth the relationship between teacher and student in shaping what is taught and how. Finally, the social realists could, potentially, be described as being only interested in subjects and to some extent students in the sense of achieving social justice but not in wider educational aims or the teacher. Recognising the interplay of teacher, student, subject/content within the broader context of school and society is the particular contribution of the *didaktik* tradition and the concept of transformation is a helpful alternative to Bernstein's concept of recontextualization because it acknowledges all these different relationships explicitly. This is important for my argument as it recognises that teachers are an integral part of the recontextualising process. I argue that teachers are recontextualising agents responding to four key influences: the subject, the students, themselves and wider educational aims. They orchestrate the coming together of these influences, drawing on their own knowledge and professional skills to create the right conditions for learning. This is captured in both Klafki's concept of didactical analysis (1995) and the concept of 'curriculum making' in the Anglophone tradition and I will explore both in the next section.

2.3 What do subject teachers know or need to know?

The kind of knowledge that subject teachers know or need to know in order to bring about valuable learning has profound implications for teacher education at all levels. I will argue in my thesis that this knowledge is a crucial dimension of what it means to be a teacher; it ought to be a pre-requisite of joining the teaching profession. There are disagreements about what constitutes teachers' professionalism, with on the one hand, those who equate it with the amount of autonomy a teacher has (and who argue that this autonomy and therefore the amount of professional status accorded teachers is decreasing) and on the other, those who relate it to a particular knowledge base (Taylor, 2014). There doesn't seem to be any particular reason why teacher professionalism cannot be both, but it is the 'particular knowledge base' that I am interested in here. Freidson claims that 'the authority of knowledge is central to professionalism' (1994 as quoted in Taylor, 2014, p. 172), a sentiment echoed by Winch (2014) who exhorts us not to neglect the role of knowledge in the professional curriculum. This section explores what that professional knowledge does (or should) look like.

2.3.1 Shulman's pedagogical content knowledge

> *'What is the thinking, wondering, feeling, reasoning and collaborating that characterises the work of history, mathematics or literature?'* (Shulman and Quinlan, 2009, p. 417)

A highly influential and compelling characterisation of teacher knowledge came from the psychologist Lee Shulman (1986) who proposed three kinds of teachers' content knowledge: subject matter content knowledge, pedagogical content knowledge and curricular knowledge. The first, subject matter content knowledge (often abbreviated to CK) consists of the specialist subject knowledge of particular disciplines. Here, Shulman defers to Schwab's distinction between substantive knowledge, comprising the basic concepts and principles of the discipline, and syntactic knowledge, comprising knowledge about the way claims are established. The second, pedagogical content knowledge (PCK), was Shulman's particularly novel attempt to characterise the way teachers deploy their content knowledge for the purposes of teaching. His argument was that knowing about, say, 1066 as a historian is not the same as knowing about 1066 for the purposes of teaching it. Once in the classroom, a teacher brings a different kind of knowledge about 1066 to bear on the lesson including, for example, what analogies might work and what preconceptions the students are likely to have. Finally, Shulman's third kind of teacher knowledge, curricular knowledge, consists of knowledge of syllabuses, resources and what is happening elsewhere in the curriculum.

The concept of PCK owes much to Dewey's interest in the bridge between the logical (the discipline) and the psychological (the discipline in relation to children) aspects of teaching a subject in schools (1897/1972). Dewey saw, on the one hand, subject matter in the mind of experts and on the other, subject matter as preparation for pupils. He termed the crossing of this bridge as 'psychologising the subject matter' which involves a rediscovery of the process of learning that scholars have already gone through and an effort to change forms of knowledge into representations that are meaningful to children. This is, I think, what Shulman is trying to capture in his distinction between CK and PCK and is an important feature of recontextualization.

It is the first two of Shulman's types of teacher content knowledge, CK and PCK, that have attracted most attention and they have been challenged or modified in two main ways. First, the term 'pedagogy' is potentially misleading because Shulman was not explicitly describing knowledge about particular pedagogical strategies that teachers use in particular subjects but rather the different understanding that a teacher has of their subject compared with academics in universities. To avoid confusion, Hill et al (2004) replace PCK with CKT-M (content knowledge for teaching maths) whilst Askew

(2014) prefers the term content knowledge for teaching (CKT). Second, how far is it possible to separate CK and PCK? Askew questions whether they are separate domains of knowledge, an area of much debate in the mathematics community, and concludes that a blurring around the edges seems likely. Certainly, Shulman himself argued that good PCK is partly dependent on good CK and Cochran and Jones (1998, as summarised in Munby et al, 2001) found that the links between CK and PCK become more sophisticated and complex as teachers become more experienced.

Deng (2007, 2015) offers a critique of Shulman's work by arguing that Shulman primarily sees teachers as curriculum implementers who draw on their knowledge of pedagogy and their students to tailor the discipline, rather than a recontextualised form it, appropriately. In this sense, Deng argues, Shulman is not too different to Young whose ideas also imply that teachers implement curricula rather than create them. By contrast, Hudson (2016) suggests that Shulman's work resonates strongly with the work of Klafki. Both Shulman and Klafki, Hudson argues, place emphasis on the teachers' role in shaping and selecting content as well as pedagogising it – in other words, they are both interested in the what and the why as well as the how.

2.3.2 Klafki and *Didaktik*

As we have seen, in the field of *Didaktik*, the close relations between teacher, student and subject (content) within the wider context of schools and society are identified as shaping the teaching and learning experience in classrooms (see Figure 2.3, p. 54). The work of Klafki (1995; see also Hudson, 2016) is important here in illuminating the particular role of the teacher within this set of relationships. Klafki uses to the term 'didactical analysis' to describe the thought processes that teachers move through when planning a lesson, asking questions which go beyond teaching techniques and include the wider meanings of the concepts to be taught and their significance to a student's future. He emphasises 'the primacy of objectives against all other dimensions of instruction' (Klafki, 1995, p. 14) and sees the actual teaching strategy as secondary: 'The search for method must be the final, although necessary, step in good preparation' (Hudson, 2016, p. 5). Alongside this acknowledgement of the role of planning is a further understanding that this is not where a teacher's expertise ends: they need to remain open to new situations within the lessons themselves (Hudson, ibid.).

This concept of didactical analysis is very relevant idea to my own research: it is essentially my teachers' didactical analysis that I am interested in to enable me to explore issues such as why they teach what they teach in particular ways and how far these are shaped by the subject, by the students and by wider goals. Klafki's emphasis on objectives which reflect wider meanings has important implications for what subject teachers need to know and understand.

2.3.3 Teachers as curriculum makers

The Anglophone world has developed its own, possibly less entrenched, equivalent of the didactic triangle and that is the concept of teachers as curriculum makers. Like *Didaktik*, 'curriculum making' as a concept has a long history. The phrase was first used in the early half of the twentieth century to describe all levels of planning from national programmes to individual lessons. More recently it has been used to describe what happens at the medium and very short term as schemes of work or modules are enacted in individual lessons (Catling, 2013). Most recent work on 'curriculum making' in England has been done in the context of geography and there are helpful definitions and explanations about curriculum making on the website of the GeoCapabilities project (www.geocapabilities.org).

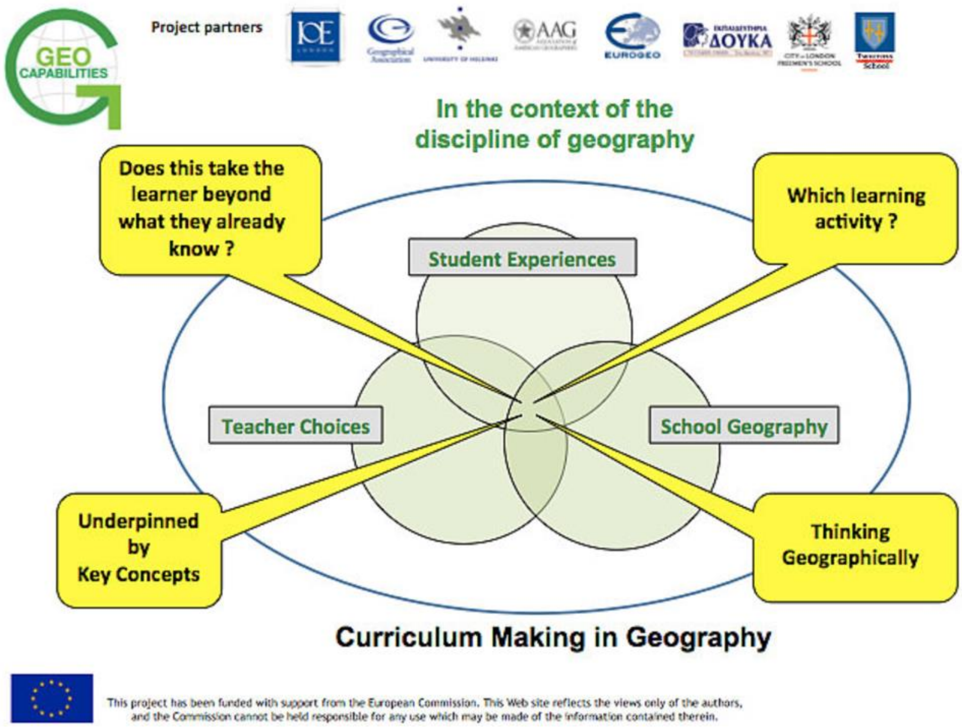
The similarities between the two concepts of curriculum making and *Didaktik* are striking. If we compare the following definition with the didactic triangle we can identify the same three features: subject (content), teacher and learner:

> 'In essence, it [curriculum making] requires teachers to hold in balance three interrelated purposes: the needs, prior knowledge and experiences of students; the nature and purposes of the discipline plus the understanding and performative craft of pedagogic technique' (Lambert and Biddulph, 2015, p. 217)

This similarity is not surprising given that both concepts emerge from the same premise: 'that students and teachers both interact with specialist subject knowledge. However, **they do so from entirely different perspectives**' (GeoCapabilities, http://www.geocapabilities.org/training-materials/module-2-curriculum-making-by-teachers/theory/). The teacher therefore needs to bridge the gap between the discipline and the needs of the learner. Lambert and Biddulph (op. cit.) argue that this process is enacted through the process of 'curriculum making'.

Figure 2.4 shows a representation of curriculum making in geography. It represents the influences on teachers and the questions they ask themselves during the planning and teaching process. The three 'pillars' of student, teacher and subject are there with specific questions and goals (such as 'thinking geographically') in the centre. Unlike the didactic triangle, however, there is no explicit mention of the broader contexts and influences of schools and society. This may in part be because this is geography-specific but I think it is more than that. In this diagram, the subject (geography could be replaced by another subject) is more central and it is assumed that the goal of, for example, thinking geographically is a valuable one – for the student and one assumes, therefore, society. Whilst that leaves the challenge of unpicking exactly what 'thinking geographically' means (I explore this further in chapter 5), a key assumption has already been made which builds on the social realist argument that the power of disciplinary knowledge is the ability to think about the world in informed and different ways. If a teacher develops an understanding of the concept of 'thinking geographically', informed by the key concepts in geography, then this will influence and indeed underpin the decisions made in relation to the three 'pillars'.

Figure 2.4 Curriculum making in geography (Geo-capabilities, n.d.)



The following extract from the GeoCapabilities website is worth quoting in full because it helpfully clarifies that curriculum making takes place in the immediate context of teachers' practice. It is not the same as longer-term curriculum planning; it is more literally the making of a curriculum as experienced by students in the moment, influenced by goals that extend beyond single lessons:

> Curriculum making is an evolving idea. However it is clear that it is *not* curriculum **design**. Nor is it quite the same as curriculum **development** or curriculum **planning**. Curriculum design, planning and development need not involve teachers at all! Curriculum making is what **teachers** do. So, why not call it lesson planning? Lesson plans are usually highly specific. They describe particular materials or learning resources and often focus on particular learning objectives, or competences, achievable within a short period. Curriculum making is also a practical matter. It includes lesson planning, **but it takes a longer view.** Lessons may have objectives, but the curriculum is guided by longer term aims or goals. (GeoCapabilities, op. cit.)

This echoes Klafki's concept of didactical analysis, outlined in the previous section, as both describe what happens at the level of individual lessons. Notice how both models make no attempt to separate curriculum and pedagogy. In both, valuable learning is derived from an interaction between subject, teachers and students. The subject is a critical (and recently neglected, at least in England) feature of valuable knowledge but in the context of classrooms it must be mediated (i.e. selected, prioritised, structured) according to the needs of the students, the skills of the teacher and the wider aims which define a subject's usefulness and its value to students and society. The curriculum making model, like the theory of powerful knowledge, sees this value partly or even largely in the distinctive ways of thinking about the world that different subjects provide. This goal of thinking geographically, historically or scientifically has been an important influence on my research, as has the concept of teachers as curriculum *makers* as opposed to curriculum *implementers*.

2.3.4 Invisible pedagogy and Bernstein's recognition rules

We have already seen Shulman's reference to the need for teachers to, for example, anticipate the preconceptions of their students and to select the best analogy to explain a particular phenomenon. Bernstein, however, looks explicitly at the conceptual structure of subjects through his concepts of evaluative criteria and recognition rules in order to explain how teachers' disciplinary knowledge is manifested in their teaching. Evaluative criteria refer to the characteristics of being 'good' at a subject - literally, how do we measure success at learning history, geography or physics? Recognition rules follow from this and set out the aspects about a subject that students need to understand and 'recognise'. Visible (traditional) pedagogies make the evaluative criteria of a subject visible to students; invisible (progressive) pedagogies do not. To understand where Bernstein's interest in this came from, it is helpful to remember his background as a teacher working in London schools which fuelled his interest into why some students fail in education. His conclusion was that a middle class background confers an advantage because it brings with it access to types of formal language or universalistic types of codes prevalent in schools.

This links to his theory of visible and invisible pedagogy which needs to be seen in the context of the time Bernstein was working. The 1970s were a time of curriculum innovation and child-centred pedagogy following the publication of the highly influential Plowden Report in 1967. Such pedagogy, designed to nurture talent and reduce educational inequality, was described by many as 'progressive', but was described by Bernstein as 'invisible' in the sense that the 'principles, rules and criteria' were not made explicit to pupils and instead they were encouraged to develop at the pace that suited them, ask the questions that interested them, discover the answers for themselves and use their existing knowledge as an important starting point. In this model, Moore (2013) argues, the transmitter claims not to be transmitting knowledge at all 'as if the pupil is the author of the practice and even the authority' (Bernstein, 2000, p. 110). The reality was, Bernstein argued, that this reordering of the hierarchical relationship was in fact an illusion: the teacher still knew the rules and the evaluative criteria used to measure success, they just didn't share it with the pupils. A helpful example of this is learning through play in the early years which, whilst an 'invisible pedagogy', nevertheless has unspoken rules and criteria because play will be judged more or less productive (Moore, 2013). What started out as a liberating pedagogy to minimise the impact of social class became the opposite as children from middle class backgrounds were better placed to manipulate the symbolic resources on offer (Moore, 2013). Bernstein noted that progressive education theories were 'asociological': the background of the child was deemed irrelevant. Young and Muller (2010) have made similar arguments in relation to alterative curricula that became popular in England in the 1990s and early 2000s as schools (and governments) struggled to narrow the attainment gap and reduce the impact of disadvantage on educational attainment. The result, they argued, was the opposite to that intended: by withholding powerful knowledge from them, disadvantaged young people were further disadvantaged because they were denied the powerful ways of thinking about the world that their more privileged peers often had access to in private (or grammar) schools.

Although Bernstein rejected claims that one particular pedagogy was universally better than another, he was also mindful that there was no evidence that progressive education led to greater social mobility or educational equality. Indeed, he argued that a more 'authoritarian' pedagogy is less demanding because it makes its rules available to the learner and preserves 'private' spaces such as play that are not part of the formal learning environment (Moore, 2013). This kind of visible pedagogy is not, however, without problems because it is not necessarily socially liberating (which is why progressive approaches emerged in the first place). Moore (2013) indicates that forms of pedagogy are linked to conceptions of knowledge when he writes that 'relativism is the natural epistemological reflex of invisible pedagogy', suggesting that whilst invisible (or progressive) pedagogy is often associated with a 'knowledge lite' curriculum in which no piece of knowledge is worth more than any other, a visible (traditional) pedagogy is often associated with canons of knowledge in the F1 tradition. Moore goes on to write, however, that if the principles, rules and criteria behind a visible, outcomes based pedagogy are derived from the logic of the knowledge itself, we might be getting somewhere. This, Moore suggests, was strongly implied by Bernstein's later thinking but he was a realist 'without a theory of realism' (p.190). Social realists now take a view that knowledge is itself liberating - rather than the pedagogy used to teach it – whilst rejecting a static conception of knowledge that replicates inequality.

Visible pedagogy, for Bernstein, meant understanding the 'recognition rules' of different subjects (i.e. their particular conceptual demands in order to understand evaluative criteria) and that success by learners will reflect how far they understand the 'speciality of the context' (2000, p.17). He wrote that 'the different classification and framing values of science and English create different specialised talk on the basis of different recognition and realisation rules' (Bernstein, op. cit., p. 22). Certainly, Bernstein recognises that in contexts with strongly classified curricula, strong subject boundaries exist and that within subject departments, pedagogic discourse is 'differently specialised' (p.10) with the consequence that teachers across subjects cannot relate to each other in terms of their function which, Bernstein states, is the 'reproduction of pedagogic discourse' (p. 10). However, Bernstein suggests that this is because of two reasons. First, that the subject department is necessary in these contexts for internal cohesion and second (and more importantly) that promotion within school only occurs 'by appropriate activities in the department' (p. 10). In other words, Bernstein appears largely disinterested in the possibility that the pedagogic discourse itself might be shaped in part by the nature of the subject.

A particular implication of Bernstein's work for my own relates to the role of teacher knowledge and recognition rules. A principal influence here is the work of Shalem (2017) who explored what is visible *and invisible* in visible pedagogy through an evaluation of two teachers who were using scripted lesson plans (SLPs) in the Gauteng primary literacy strategy in South Africa. Shalem is particularly interested in how a highly visible pedagogy with an emphasis on a structured approach to knowledge-building, in this case through phonetic approaches to reading, still has the potential to keep what Bernstein terms evaluative criteria (i.e. the way success in learning something is measured) invisible:

> 'even if curriculum coverage has been exteriorised by selection, sequencing and pacing of topics into daily SLPs and although core teaching and assessment routines are specified, **unless the teacher has strong conceptual knowledge of what she teaches**, she will struggle to decide what evaluative criteria should count in the topic of the lesson and how to make this explicit for a new acquirer.' (p.185, my emphasis)

She draws on Bernstein's theory of elaborated and restricted codes which Moore (2013) claims have been misunderstood and are better understood as 'expanded' and 'circumscribed'. Disciplines or school subjects deal in 'specialised pedagogical texts' which have their own recognition rules which need to be elaborated (expanded) for those new to the particular discourse. Once the necessary recognition rules have been understood, that elaboration can be restricted (circumscribed) because there will be a shared understanding. Shalem, drawing on Bernstein, suggests that moving from restricted to elaborated codes and back again is the 'core idea of making evaluative criteria explicit' (2017, p.187).

In her analysis of two lessons, Shalem concludes that in each case, explicit elaboration of the underlying rules of systematic phonics in response to pupil errors was not forthcoming despite these rules being an explicit aim of the SLPs. For example, the rule that the letter 'k' is only silent when succeeded by the letter 'n' was not clearly reinforced. The implication is that SLPs alone cannot transform teacher practice and that there are two possible solutions. One is to script the lessons in even finer detail (though I cannot see how this takes account of varying pupil responses) but Shalem herself proposes a strengthening of teacher knowledge so that teachers can understand why they are being asked to teach reading in this way, where this approach has come from, what debates there may be in the recontextualising field (with especially fierce debate globally about how to teach reading) and indeed what debates there may be in the field of production. This understanding will help teachers to 'classify and conceptually order situations, foreground and structure their salient features and place them in order of significance' (Shalem and Slonimsky, 2013, p. 76).

What is especially interesting about Shalem's conclusion is her assertion that in order to know what and how to elaborate, teachers need to understand the recontextualising process: 'teachers need to know enough about what the knowledge experts of their subject matter know and how the specialised discourse was transformed. Without a foot in each of the three fields [production, recontextualization and reproduction], teachers' epistemological labour of elaborating in the secondary field will remain weak' (Shalem, 2017, p.195). Shalem's work (carried out in South Africa) is also interesting in light of Hoadley's (2011) analysis of South African curriculum reform. As we saw in section 2.1.3, Hoadley was critical of Curriculum 2005 in which generic outcomes were privileged over specified, subject specific content. A key problem of this curriculum was the amount of expertise required by the teachers to create coherent subject specific conceptual pathways for learners, a point noted by Muller in 2000 when he wrote that 'success can be made of such an under- stipulated curriculum, but only if the teacher has a well- articulated mental script of what should be covered (p. 14).' However, Shalem's work suggests that teachers need more than a 'well-articulated' script, mental or actual; they also need to understand why a curriculum requires them to teach particular areas of content in a particular order and – in the case of Shalem's research – in a particular way. In other words, providing teachers with a well-defined, detailed curriculum is not enough; teachers also need to understand the rationale behind the recontextualization decisions that have been made in order to create the curriculum itself.

2.3.5 The role of teachers' disciplinary knowledge

Much of this section has pointed to the importance of teachers understanding their subject (both in terms of the discipline itself and the subject for the purposes of teaching it) without citing much empirical evidence that this sort of knowledge has a positive impact on learning. We lack evidence about the impact of different types of teacher knowledge on effective teaching, partly because notions of 'effective' are themselves contested depending on whether you emphasise test scores or other indicators.   Hattie (2009) refutes Shulman's contention that a teacher's understanding of what to teach and how to teach it is the starting point for all teachers. He points to the lack of evidence that knowing your subject well has a big impact on learning, though he goes on to acknowledge that this is more a case of an absence of positive correlation than the existence of contradictory evidence. However, there have been attempts to quantify the impact of CK and PCK on effective teaching (using pupil outcomes as a proxy) though these are presumably too small and isolated to have been picked up in Hattie's meta-analysis. Below I briefly outline examples drawn from mathematics and history education which suggest a positive correlation between teachers' subject/disciplinary knowledge and their effectiveness in relation to student learning before considering what happens when this kind of knowledge is absent.

i. Mathematics

In her studies of mathematics teachers, Leinhardt (1989) focused on instructional explanation and found that these were almost entirely shaped by the teachers' own understanding of mathematics. Lampert, in 1990, concluded from her study that 'any discourse on the learning and teaching of mathematics must first attend to the nature of mathematics itself' (Shulman and Quinlan, 1996, p. 413). Three years later, Ball (1993) offered an excellent example of PCK in action when she described the use of a lift analogy in the teaching of positive and negative integers to overcome students' misunderstandings. Hill et al (2005) found that CKT-M (content knowledge for teaching mathematics) was the 'strongest teacher-level predictor of learner gain scores in mathematics' and predicted that 'efforts to improve teachers' mathematical knowledge through content-focused professional development and pre-service programmes will improve student achievement' (Taylor, 2014, p. 178).

ii. History

Like Lampert, above, Wineburg approached the issue by asking the question 'what does it mean to 'know' history (1991)'? He gave the same historical texts to historians and school students in order to compare the way they responded, thus establishing a way to characterise historians' expertise as a benchmark against which to judge the students' responses. What he found was that the historians brought a way of thinking to bear on the texts, regardless of their knowledge or lack of knowledge of the period under scrutiny. He explains this as different conceptions of the 'epistemology of text' – the students used the texts to extract information whilst the historians puzzled over the authors' intentions and showed greater concern about the broader context in which the texts were written. Essentially, the students did not know or believe that sub-texts exist and thus made poor use of the 'sourcing heuristic', i.e. information about the provenance of the source. Wineburg's work has clear implications for teacher specialist knowledge if they are to encourage their students to 'think historically' and to move from propositional to procedural knowledge. Reisman (2012) has reported positive benefits from a teacher education programme emerging from Wineburg's work at Stanford University which supported teachers in their attempts to induct pupils into the ways that historians read.

We can also explore the effect of teachers' specialist disciplinary knowledge by looking at examples where it is absent or reduced. In 1988 Stodolsky published her studies of elementary school teachers who taught both mathematics and social studies. She concluded that the teachers taught quite differently within the different subject areas: 'the subject matters' she asserted (quoted in Shulman and Quinlan, 2009, p. 410) before going on to write that:

> …the experience of teaching and learning in these two domains are vastly different. Therefore attempts to characterise teaching *in general*, while certainly identifying some useful broad principles, would necessarily miss critical features of the specific pedagogies of each subject matter (ibid.)

Mintrop (2004) reached similar conclusions, but this time the teachers in his study *only* taught social studies. One might therefore expect fewer emphatic conclusions. However, social studies has a 'tenuous disciplinary base' (p. 143) as it draws from history, sociology and anthropology, each of which has ‘very different substantive views of the world and within each disciplinary domain, contrasting conceptual paradigms’ (p. 144). Mintrop’s study was part of the wider FCL project (Fostering Communities of Learners) in which teachers identified big questions, broke these down into ‘jigsawable’ chunks, facilitated pupils’ research and designed an outcome that could synthesise pupil learning. The social studies teachers struggled to do this and fell back into generalist assumptions about learning as engaging in tasks rather than as a cognitive process with clear, definable conceptual goals. Overall, the teachers had difficulties ‘overcoming the activity default to tap into the realm of disciplinary knowledge and conceptual thinking’ (p 151)[5]. This applied equally to the experienced and less experienced teachers. Despite its small-scale (four teachers in total), this study presents us with an important insight into what can happen in the absence of strong conceptual frameworks rooted in distinctive subject disciplines.

So far, I have explored teacher knowledge in relation to their subject disciplines but there is also a more generic type of teacher knowledge. Carter (see Munby et al, 2001) draws a distinction between practical knowledge and PCK, arguing that ‘the former [is] more tied to personal and situational forms of knowledge and the latter more formal and built on the professions’ collective wisdom’ (quoted in Munby et al, 2001, p. 881). Loughran (2014) takes a similar, though not identical, path and argues that we should not confuse PCK with a teacher’s general professional knowledge about teaching. Using the example of a biology teacher teaching force or a physics teacher teaching evolution, Loughran suggests that although both are science teachers, ‘the interaction of subject matter knowledge [i.e. CK] with pedagogy creates different outcomes when the specific domain is not the teacher’s particular area of expertise.’ For Loughran, a teacher’s ‘general professional knowledge’ is the same as ‘knowledge about pedagogy’ but this raises a further problem: where does PCK end and ‘general professional knowledge’ begin? What is ‘generic’ about pedagogy and what is ‘subject-specific’? Hogden and Marshall (2005, p. 172) suggest that subjects act as ‘smoke and mirrors’ which obscure the ‘pedagogic reality’ of lessons across subjects where there is considerable commonality regarding the formative nature of learning. Nevertheless, they go on to argue that even though the pedagogic principles of formative assessment may appear quite generic, the teachers’ subject knowledge is still important in so far as these teachers are ‘apprenticing their pupils into the guild of knowledge of each discipline’ (ibid., 172).

[5] This is reminiscent of what many of my trainees often do, especially in the early days of teaching practice.

It is likely that teachers continually balance their disciplinary knowledge, their PCK and their wider professional knowledge. Kitson et al (2011), writing about history specifically, suggest that insofar as a history pedagogy exists, it is not the activities themselves which are distinctive (they can often be found in other subject classrooms) but rather 'their underlying educational logic [which] derives from the purpose they serve in the history curriculum' (p. 165).   Certainly, teachers share a common knowledge about teaching, regardless of their subject backgrounds; indeed, much current practice in continuing professional development in English schools is predicated on this fact, despite evidence suggesting this may not always be the best approach (Cordingey et al, 2015). Husbands (2011) has advanced a model of teacher knowledge which acknowledges the strong role of general professional knowledge whilst retaining a strong emphasis on disciplinary knowledge. He identifies three types of (history) teacher knowledge - knowledge about subject, knowledge about pupils and knowledge about classroom practices – which echoes the conception of curriculum making in Figure 2.4. Overall, then, there is agreement that teachers draw on different kinds of knowledge and that the decisions they make in their planning and teaching probably involves some kind of complex interplay between them.

2.4 Conclusion

This chapter has summarised literature which spans different theoretical traditions and different parts of the world. In attempting to bring together diverse theories and research, there are inevitably times when specific theories have received more cursory treatment than they deserve. However, I hope that by bringing these different areas of literature together, I have shown how they frequently connect with each other. More importantly, I hope it is also evident how the range of literature relates to my own research as I attempt to bring scholarship about knowledge, school curricula and teacher knowledge together to inform my particular interests.

Chapter 3 Methodology

This research adopts a case study approach, focusing on three expert secondary school teachers in London. Robert teaches physics, Sarah teaches geography and Tom teaches history. The data have been generated from 16 lesson observations (15.5 hours), 17 interviews (13.5 hours) and a range of documentation from each school. The data have been analysed thematically, mainly coding inductively but within an overall theoretical, thematic framework derived from the literature and refined through a pilot study conducted in 2015.

This chapter explains the reasoning behind these choices and processes. I begin with a summary of the overall research approach before describing my pilot study and the changes made to the research design as a result. Section three describes the revised research design in detail and section four outlines the actual data I collected. Sections five and six describe how I analysed my data thematically within and across the case studies and section seven briefly sets out how I have reported my findings.

3.1 Research approach

In this section I will set out the theoretical and methodological approaches and influenced my research. I start with my research questions before moving on to my epistemological approach, the choice of case study research and the theoretical frameworks which influenced these choices. I finish by explaining the rationale for working across three subject areas and the challenges this presented.

3.1.1 Framing my research questions

The initial research questions were:

1. What does it mean to 'know your subject' for the purposes of teaching it?
2. How can we best define the subject specific knowledge that teachers bring to bear on their teaching?
3. How far are key planning and teaching decisions influenced by generic professional knowledge or subject specific knowledge?
4. How far are pedagogical choices similar and different across history, geography and physics?
5. How do subject teachers in history, geography and physics define their discipline?
6. How far do the approaches of teachers in history, geography and physics reflect current thinking about 'powerful knowledge? What might powerful knowledge look

like in these three subject areas and what are the similarities and differences between them?

These were the questions which informed the pilot study but which subsequently changed in the light of its findings and my engagement with a wider range of literature. Section 3.2.3 outlines the impact of the pilot study in more detail. The research questions went through a much less substantial but nevertheless important modification during the analysis of the final data and some further reading undertaken in preparation for Chapter Seven. This is consistent with the iterative nature of case study research as indicated by Atkins and Wallace (2012) who state that 'it involves links between non-consecutive stages for the purposes of reflection and clarification; so that, for example, we might decide to return to our research design and make some changes in the light of our initial experience of collecting or analysing the data' (p. 108). Throughout the process the questions have become increasingly focused and refined but always within the overarching question of what knowledge expert teachers from across different subject areas bring to bear on high quality teaching. My interest in teachers as curriculum makers (Lambert and Biddulph, 2015) was evident from the beginning but the data and further reading such as Klafki (1995) has led me to conceptualise the three teachers as recontextualization agents and this is now reflected in the wording of question two, below, and indeed the title of the thesis. Similarly it was when reading Doyle (2017) that I came across the term 'enactment' to describe the process of making a curriculum happen and found this a helpful term to use in question one, below. Thus, whilst research questions have shaped what I have done at each stage, they have also reflected the iterative nature of the research itself.

The final research questions are:

4. What kinds of knowledge do expert teachers across three subjects draw on in lesson design and enactment?

5. To what extent and in what ways do expert teachers play an active role in the recontextualization of their discipline into school subjects?

6. How far and in what ways do expert teachers achieve a 'Future 3' curriculum scenario?

3.1.2 Epistemology and theoretical perspective

The overarching epistemological approach of this thesis is a constructivist one, described by Crotty (1998) as the view that:

> 'all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context.' (p. 42)

A constructivist epistemology rejects the possibility of interpretations that provide definitive truths, but rather suggests that we make meanings out of what we find in the world, meanings that are contingent and therefore open to different interpretations. The meanings that I have made out of the interactions with the three teachers in my research are mine alone, shaped by my research questions, the literature I have read and my own personal background. Whilst I am confident that the conclusions I have reached have good grounding in my data, I recognise that others could make sense of my data in different ways. I am also aware that the teachers in my research were themselves engaged in constructivist activity as they attempted to make sense of their expertise in our interviews. As Crotty (op. cit.) notes, 'the social world is already interpreted before the social scientist arrives' (p. 56). Within this constructivist epistemology, my methodology is interpretivist, designed to generate interpretations that are 'culturally derived and historically situated' (p. 67). My use of case study research – outlined below – demands close attention to context because knowledge of this context will enable me to reach more robust conclusions about the teachers whose practice is inextricably linked to the contexts in which they work. These contexts include their departments, their schools, their subject communities and their wider experiences.

3.1.3 Case study research

Case study was an obvious choice for my research approach. I briefly considered a more ethnographic approach which would have required a fuller immersion into subject departments but my interests were too specific for this to be effective. My interest was not in every dimension of teachers' professional practices but specifically in the relationship between the decisions they make in lessons, the quality of the curriculum that is consequently made and the knowledge which informs these decisions. A qualitative approach, involving interviews and observations, was necessary to tease out the complexity of this knowledge. However, I was also aware that my data would never be extensive enough for me to claim that a representative sample of teachers had been identified. It was therefore necessary to adopt an approach which would take full account of the context of these teachers so that their own backgrounds, workplaces and subject identities could be understood. Before undertaking the pilot study, my intention was to select nine teachers for the final study, partly to raise the level to which I could claim my research was 'representative'. On reflection, apart from the enormous data generation task (and subsequent data handling issues) and what would be a false promise of representation, I realised that three teachers in each subject would effectively make the *subject* the case rather than the individual *teachers.* This would have consequently restricted my understanding of the contextual dimension of their practice. I therefore made the decision to focus on three teachers – or three comparative case studies.

Yin (2014) describes case studies as empirical enquiries that 'investigate a contemporary phenomenon within its real-life context especially when the boundaries between phenomenon and context are not clearly evident' (p.13). The phenomenon I am interested in is the knowledge that informs teachers' planning and teaching decisions: 'The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented and with what result' (Schramm, 1971 as quoted in Yin 2014, p.15). As noted above, I had originally planned to include nine teachers in my research, three in each subject. My decision to reduce this to three teachers overall allowed me to capture the richness and complexity of each teacher in their context by observing and interviewing them more often. The cases are therefore bounded by each individual teacher. Data about their department – including in one case an interview with another department member – provides additional context for that teacher but it is the teacher him or herself and not the department that is the case study.

Stake (1995) would characterise my case study approach as instrumental and collective. It was instrumental in the sense that there were research questions driving it ('a puzzlement', p. 3) and it was collective in the sense that I was researching three teachers rather than one. As Stake goes on to write, this had implications for my research design and data analysis because 'there will be important coordination between the individual studies' (p. 4). As I will explain in sections 3.3.3 and 3.3.4, a challenge I faced was in ensuring there was sufficient comparability across subjects (by using, for example, an overarching thematic framework for my data analysis) whilst also respecting the differences between each case.

Restricting my case studies to three rather than nine potentially limits the general claims I am able to make. However, I never envisaged that my findings would shed light on the particular knowledge that secondary teachers of physics, geography and history bring to bear on their practice *in general*. First, I was not interested in identifying any kind of representational 'sample' and nine teachers would not have been enough in any case. I quite deliberately set out to identify 'expert' teachers who by definition are arguably not representative. Second, I was not interested in identifying differences across teachers within the same subject area, interesting though that would be. As Stake writes, 'the real business of case study is particularization, not generalization' (ibid., p.8). My interest was in understanding the knowledge that influences the practice of a small number (three in the final study) of teachers and relate this insight to wider theoretical concepts. Yin (2014) writes that, 'Rather than thinking about your case as a sample, you should think of it as the opportunity to shed empirical light about some theoretical concepts or principles' (p. 40). It is from the particular, when adequately described, that the reader of the research may feel in a position to make transferable generalisations.

3.1.4 Theoretical frameworks

There was some theoretical development prior to the generation of data which emerged from my engagement with the literature and which was refined during the pilot study. I was already familiar with Shulman's (1986) specific categories of teacher knowledge which shaped my pilot study much more than they shaped my final research but which remained important and useful. A second broad theoretical framework emerged about different forms of knowledge, drawing on Bernstein (e.g.1999), Biglan (1973) and Winch (2013) in particular. This framework had a considerable influence on my approach as I became increasingly interested in the extent and impact of structural differences across disciplines and how far these differences were apparent in the recontextualised form of knowledge contained within school subjects and the knowledge the teachers had in relation to these specialisms. A third framework involved Bernstein's concept of recontextualization (2000) which became increasingly important in my research. Whilst I did not set out to explore the extent of recontextualization of disciplines into subjects, my interest in teachers as curriculum makers (Lambert and Biddulph, 2015) included their role in the recontextualization process which led me to engage in the work of Klafki (1995), Deng (e.g. 2007, 2015, 2018) and *Didaktik* (Hopmann, 2007). The nature of the relationship between disciplines and school subjects led me to engage with a fourth theoretical framework, that of social realists such as Young and Muller (e.g. 2010). I was especially interested in and influenced by the concepts of powerful knowledge and a 'future 3' curriculum.

3.1.5 Choice of subjects

I identified the need for three subjects from the beginning. I wanted the research to involve a comparison between subjects and this would in fact be its particular contribution to the field. Deciding which subjects was relatively straightforward. The criteria were:

- Subjects that, though different, share some purposes or characteristics. History, geography and physics all seek to explain how the world works in some way or another and all deal with evidence in some form.
- Subjects which are nevertheless quite different, for example in the extent to which they have strong paradigms.
- Subjects which are part of the mainstream of secondary curricula in English schools.
- Subjects where there are specialists I can easily access to support my own knowledge development.

At the initial planning stage, the availability of expert teachers was less of a concern because I knew that locating experts in most subjects in London would be possible. History was always going to be included because of my own background and I was keen to work with Professor David Lambert as my supervisor which opened up Geography to me. These two subjects were already quite interesting in that history has a horizontal knowledge structure (Bernstein, 1999) whilst geography is harder to classify because of its combination of human and physical forms. Physics was intriguing because it was identified in the literature as one of the most hierarchical forms of knowledge in the school curriculum and therefore I knew would be a good contrast with the other two.

3.1.6 Working outside my specialism

One of the biggest challenges I faced in this research was in moving beyond my own specialism of history education. To properly understand what I was observing in classrooms and what teachers were telling me in interviews, I needed to be conversant with the respective subject curricula *and the reasoning behind them*. I needed to understand the historical context of such curricula and the current debates about what should be included in them. Whilst I have worked very hard at this, I cannot claim as deep an understanding of geography and physics education as history.

An early note of warning in this regard was sounded by Shulman and Quinlan (2009) which I read in the very early stages of my research:

> 'If teacher researchers wish to pursue investigations of the psychology or pedagogy of particular school subjects, they will need the kind of substantive sophistication displayed by Lampert and Ball. The legitimacy of being 'insiders' and speaking with the 'teacher's voice' does not in itself establish a warrant for the claims of teacher research.' (p. 415)

I considered this perspective at some length and discussed the possibility with my supervisor of focusing only on history and geography on the grounds that physics was likely to pose the greatest challenge to me as someone who did not study science beyond 'O' Levels. However, the value of including physics given its particular knowledge structure ultimately outweighed these concerns. I set out to learn as much as I could from specialists including colleagues from within UCL and beyond: Professor David Lambert (geography), Dr Mark Hardman (physics) and Jon Connolly (physics) from UCL and Chris Shepherd from the Institute of Physics. I have also ensured that everything I have written in chapters four (physics) and five (geography) has been checked, not only by the teachers in my research but also by geography and physics educators. Furthermore, chapters four, five and six begin with a review of literature setting out some historical context for the development of the subject and current debates. I therefore believe that I have developed enough insight and understanding to understand the case studies sufficiently for my purpose. I certainly understand the lesson sequences I observed very thoroughly and can relate these to the broader curriculum in each subject.

3.2 The pilot study

The pilot study was carried out between May-June 2015 and involved three teachers – a history teacher, a geography teacher and a physics teacher – who all taught at the same secondary school in London. They were all experienced (with between six and seventeen years of teaching experience) and all were described as effective by the headteacher. Two were heads of department; the other had pastoral middle leadership responsibilities. The pilot study was designed to explore my original research questions, outlined in section 3.1.1. At this stage these research questions were too numerous and I was chiefly interested at this stage in the relationship between 'generic professional knowledge' and 'subject specific knowledge' and the similarity and difference between pedagogical choices made across subjects. The analysis of the pilot data and my further reading led to some considerable refinement of these questions as I will explore in section 3.2.3.

3.2.1 Research design and thematic analysis of the pilot data

The generation of the data was the same for each teacher, consisting of a preliminary one hour interview (audio recorded), an observation of a one hour lesson on the same day (filmed) and a follow up one hour interview about a week later (audio recorded). Full ethical consent was sought and provided. See Figure 3.1 for a brief summary of each element of data generation. Prior to each interview I scrutinised curriculum documentation for each subject (national curricula for 2008 and 2014 and GCSE specifications for 2015).

Figure 3.1 Summary of pilot data generation and analysis

Stage of pilot data generation	Summary of purposes	Method of analysis
Initial one hour interview	*To find out educational and teaching background.* *To explore teachers' views on the aims and challenges of their subject.* *To gain insight into the aims of the lesson to be observed.*	*Interview audio recorded. Partial transcription in note form. Not systematically analysed: used as background information.*
Observation of a lesson	*To record exactly what happens in the lesson as the basis for second interview.*	*Lesson filmed. Notes taken during the lesson. Lessons fully transcribed.*
Follow up interview (one hour)	*To explore the decisions teachers made in both their planning and teaching in relation to particular aspects of the lesson.*	*Interview recorded and fully transcribed. Thematic analysis carried out on the interview data.*

The first interview provided an opportunity to gather biographical background about the teachers and their views about the nature and purpose of their subject. I recorded the interview and partially transcribed them later in note form. The second interview focused entirely on the lesson I observed and the reasons behind the decisions each teacher took. I took films of the lessons into the interviews on DVD and played sections to aid teachers' recall. I also took full transcriptions of the lessons with me and found these to be more useful because they provided a holistic view of the whole lesson and the teachers were less likely to become distracted by the way they talked or looked on screen.

Whilst I was broadly happy with the methods I used to collect the data, I was much less happy with the way I subsequently analysed it. At this stage I had not developed a theoretical framework which brought my research questions together sufficiently and I drew heavily on Shulman's (1986) three categories of teacher knowledge: content knowledge, curriculum knowledge and pedagogical content knowledge (see Figure 3.2). I did however refine Shulman's categories slightly. In order to emphasise that subject knowledge is more than content knowledge, I decided to call this 'disciplinary knowledge for teaching', a slight variation of Askew's 'content knowledge for teaching' (2014), in order to emphasise that this knowledge includes an understanding of the content *and* of the epistemology that underpins it. I then identified the theme for 'generic professional knowledge' which is almost identical to Loughrans' 'general professional knowledge' (2014). My choice of the word 'generic' emphasised that this knowledge is not subject specific and this was partly because my initial analysis of the lessons revealed a great deal of commonality across the different subjects in terms of pedagogy, at least at a surface level. I therefore wanted a sharper focus on what was subject specific about the decisions and choices made by the teachers and what derived from their generic professional knowledge.

Figure 3.2 The thematic coding used for the pilot data

Theme	Examples of what might be contained within the theme
GENERIC PROFESSIONAL KNOWLEDGE (GK)	Pedagogy *Generic pedagogical strategies which are transferable across subjects.*
	Students *Knowledge about students that is not subject –specific e.g. reading ages, special educational needs, pupils' background*
	Aims *General educational aims e.g. good behaviour, pace, engagement*
DISCIPLINARY KNOWLEDGE FOR TEACHING (DKT)	Students *Knowledge about the students in relation to subject e.g. particular misconceptions students have about physics*
	Propositional knowledge *'Knowing that' – substantive content knowledge*
	Procedural knowledge *'Knowing how' – understanding the structure of the discipline and the way knowledge is generated*
	Pedagogy *Specific pedagogical strategies unique to the subject e.g. particular experiments in physics*
OFFICIAL KNOWLEDGE (OK)	Official knowledge *Knowledge of formal curriculum and examination requirements*

Whilst I retained elements of this framework in the analysis of my final data, at this stage I was not as focused on the potential differences between the disciplines in universities and the subjects in schools as I was subsequently to become. This may have been partly the influence of Shulman who, according to Deng (2007), does not differentiate sufficiently between the two different forms of knowledge and for whom

PCK therefore represents the knowledge that enables teachers to bring academic, disciplinary knowledge into the classroom, rather than a recontextualised version in the form of a school subject. I also focused more on the relationship between generic teacher knowledge and subject specific knowledge than on the similarities and differences between subjects. In other words, analysis of the pilot data did not focus sufficiently on the most distinctive feature of my research, that is its exploration of teacher knowledge and practice *across three different subjects*. The second category, 'disciplinary knowledge for teaching', drew on Hirst's (1965) distinction between propositional and procedural knowledge but without Winch's (2013) further refinement of procedural 'know how' knowledge which was later to be important in the analysis of my final data.

3.2.2 Findings from the pilot study

i. The lessons were superficially very similar in their structure and pedagogy

An initial analysis of the three lessons revealed remarkable similarities between them in terms of structure and pedagogical choices. All three began with a starter activity which was ready for the students when they arrived and which lasted 5-6 minutes. In all cases these were relatively easy and 'fun'. Two involved recapping on previous learning and one introduced new material. There was a phase of whole class question and answer following the starter activities in each lesson, followed by an explanation of the purpose of the lesson.   Student tasks took up between half and three quarters of the lesson. These were all tasks that pupils worked on without the teachers' help (though the teachers circulated around the room helping when needed) and pupils worked on their own or more commonly in pairs/small groups. All three teachers used visual resources, two of which were film-based, and used techniques such as whole class question and answer and circulation around the room to assess progress and understanding. Students had to write things down in each lesson which would then be marked and also read work aloud as part of the plenary activities. See Figure 3.3 for an overview.

Figure 3.3 Overview of the three lessons in the pilot study

	Geography	History	Physics
Starter activity	5 mins, no intro, pupils active.	6 minutes, no intro, pupils active.	5 mins, no intro, pupils active
Introducing the purpose of the lesson	9 minutes into the lesson.	12 minutes into the lesson.	5 minutes into the lesson.
Number of pupil tasks (including starter)	Three.	Four.	Five.
Length of pupil tasks (including starter)	5 mins 4 mins 25 mins Total = 33 mins	6 mins 10 mins 10 mins 11 mins Total = 37 mins	5 mins 10 mins 9 mins 9 mins 13 mins Total = 46 mins
Time spent on whole class Q & A	10 mins	6 mins	6 mins
Use of PowerPoint	Yes	Yes	Yes (limited)
Use of visual prompts	YouTube video (4 mins)	YouTube video (6 mins)	Two practical demonstrations (8 mins)
Plenaries	Four. Last one = 13 mins and involved pupils reading work out.	Two. Last one = 10 mins and involved pupils reading work out.	Three. Not at end of lesson. (pupils also read out their work at different points of the lesson)

Although I was surprised by the similarities across the three lessons, in retrospect it was unsurprising given that they reflected current professional discourse about effective teaching and learning. The influence of constructivist theories of learning was evident (Moll, 2014), with students actively seeking out answers to questions and problems themselves, often in collaboration with each other. More recent influences – such as access to digital media in classrooms and the heavy emphasis on assessment for learning – were also clearly evident, the latter manifested through multiple plenaries, pupils reading out their work and plenty of teacher movement around the room to monitor pupil activity. The importance of engaging pupils was also clear across these lessons, each starting with an intriguing or at least motivating activity. A brisk pace was a feature of each lesson with activities typically lasting about 10 minutes and with the teachers keen to move the pupils on in their learning. This may reflect expectations around student progress within lessons, traditionally emphasised by Ofsted and often reinforced by schools.

ii. These surface similarities concealed different kinds of aims across the subjects

Despite the similarities in pedagogy across the lessons, it was clear during the analysis of the interview data that the overall aims for the lessons reflected very distinctive types of knowledge embedded in the three subjects and that similar pedagogical strategies were being deployed to achieve very different kinds of goals. Figure 3.4 summarises these goals for each lesson.

Figure 3.4 The aims of the lessons in the pilot study

Geography (Y10)	History (Y9)	Physics (Y10)
To briefly recap the causes of flooding and then examine the effects of flooding on people. Specific use of Sheffield as a case study to support in exam preparation.	To understand that there are two interpretations of the Industrial Revolution.	To think and write like a physicist in preparation for exams. To a lesser extent, to improve their physics knowledge, specifically about thermal energy transfer.

iii. Generic teacher knowledge appears less important than disciplinary teacher knowledge in decision making

I made the decision to analyse the data quantitatively as well as qualitatively which was seriously flawed. My interest in distinguishing the impact of generic teacher knowledge from subject specific teacher knowledge led me to analyse the key decisions within the lessons in order to assess the relative importance of each. Not only was this virtually impossible to do because many decisions were made in the light of a complex combination of different kinds of knowledge, but it also revealed nothing about the particular *nature* of the subject specific knowledge which I was also interested in. My finding that decisions influenced by 'disciplinary knowledge for teaching' greatly outnumbered decisions influenced by 'generic professional knowledge' was a potentially interesting insight when set against the pedagogical similarities of the lessons, but the imprecise methodology left me doubtful about the robustness of the finding. Much more valuable was the qualitative data analysis which – notwithstanding the acknowledged limitations of the analytic framework – anticipated many of the findings of my final study.

The following extract comes from the second history interview and illustrated the role of subject specific knowledge in the decisions made at both the planning and teaching stage. Simon was answering a question (from me) about the plenary which immediately followed the starter activity (film clip of the of the London Olympics opening ceremony):

> that plan was initially a little bit wrong-footed by the first response I got…. he said it gave him a *bad* impression, and he picked on a legitimate thing to talk about, in his view. He said it looked dark, it looked ominous and what-have-you. So because I was expecting them to just come across and say "It looked really good," immediately, I had to respect what he said, I wasn't going to completely say "No, you're wrong," but equally I wanted to, I needed somebody to give me a positive view so at least I've got a counterbalance……So there were some quite difficult hurdles…but I think eventually I got there, and I think the answers I got from Oscar at the end really got across the point that this essentially was a deliberate effort by the director to get across the idea that the world, that the Industrial Revolution anyway, starting in Britain, was something the world should know about and appreciate that it was British in origin.

Here is an extract from my findings written at the time:

> Simon's sense of where he wanted his question and answer to go to was driven almost entirely by his subject specific goals. There was some sense of 'driving it forward' which may have related to more generic goals such as pace but on the whole, the choices that Simon makes were heavily influenced by his overall goals which were themselves rooted in his disciplinary knowledge. So what was 'disciplinary' about this knowledge? Simon demonstrated a great deal of specific disciplinary knowledge in the way he articulated the aims for the lesson. Taking the whole sequence of lessons, we can see how he moved quite explicitly from propositional knowledge (what was the Industrial Revolution?) to procedural (why do different people claim different things about the Industrial Revolution today?). The early lessons focused on what happened during the Industrial Revolution, drawing on the second order concept of change and continuity to provide an analytic framework through which to view its impact. He then shifted the focus onto historical interpretations, a second order concept sometimes referred to (alongside significance) as a 'meta concept' in that it is less about engaging in the process of analysing the past and functions rather as a commentary on how others have already done so. This particular lesson

represented a transition within the sequence, moving from an analysis of what happened to how we and others might interpret the impact of the Industrial Revolution differently.

Although I was not at this stage clear enough about the potential difference between 'disciplinary' and 'subject' knowledge, nor was I drawing on Winch's two different types of 'know how' knowledge, this analysis anticipated the different approach I took to analysing my final research data when I focused much more on the reasons behind the specific decisions that was taken during the lessons. I was able to track the reasons for Simon's decisions back to his knowledge of the subject of history and explore how seemingly generic pedagogical decisions (to show a short film clip as an engaging starter and have a brisk question and answer afterwards) were profoundly shaped by his understanding of the conceptual structure of school history.

3.2.3 Subsequent refinement of the research questions and methodology

i. Research questions

As we have seen above, the research questions prior to the pilot study were too numerous and following the pilot were refined as follows:

1. What conception/understanding of their disciplines do expert teachers have? *How/how far does this differ across subjects?*

2. What is the role of disciplinary knowledge in the teachers' teaching aims? *How/how far does this differ across subjects?*

3. How does disciplinary knowledge interact with pedagogy to create outcomes (Loughran, 2014) or curricula? *How/how far does this differ across subjects?*

These were my 'working research questions' as I embarked on the research for the final study though were to be revised one further time during the final analysis phase.

ii. Generation of data

I retained the core elements of data generation from my pilot study, i.e. observation of lessons and interviews with the teachers which would partly involve the teachers reflecting on the decisions they had made whilst teaching. Despite the limitations of the analysis of my pilot data, I felt that the data itself was valuable. My intention at the time of the pilot was to trial this methodology and then deepen *and broaden* it in the final study. This would have meant observing nine teachers more than once and interviewing each of them more than twice. I decided this was neither practical nor desirable and opted to focus on three teachers again but this time to extend the scope of the data collected to make each teacher a richer case study. Instead of observing each teacher once, I observed them a minimum of four times in my final research study and similarly increased my interviews with each from two to four. I retained an interview which focused on one specific lesson but chose not to show clips of the filmed lesson during the interview but rather to use the transcriptions only so that the teachers would not get distracted. I also retained an interview which focussed on teachers' biographies and their personal views about the aims and challenges of their subjects. The two new interviews focused on, first, the vision the teachers had for their department (note that I made the decision only to include heads of department in my final study) and second, the decision making about the whole sequence of lessons I observed. Furthermore I interviewed students and collected a range of documentation (see section 3.4.3). This additional data provided a much richer context for the teachers' decision making, more insight into their knowledge and a greater opportunity to triangulate data.

iii. Analysis of data

In the analysis of my final data, I chose quite different categories of teacher knowledge. The categories in Figure 3.2 were not fit for purpose because of the enormous overlap between the different categories which was an interesting finding but which made the categories themselves rather limited. Separating generic knowledge of students, for example, from subject specific knowledge of students actually made little sense because teachers do not think in these terms. Similarly, separating 'generic' pedagogy from 'subject specific pedagogy' did not reflect the way teachers thought about their practice and was not supported by the pilot data. I therefore knew that a new approach to my data analysis was required which would enable comparisons to be made across subjects but would also emerge more inductively from the data itself.

3.3 Research design

In this section I will explain the how I intended to conduct my research, starting with the definition and identification of 'expert' teachers. I will explain the ethical dimension of my research and how I intended to generate and then analysis data. I end the section with a timeline which provides an overview of my activities.

3.3.1 Finding and defining three 'expert' teachers

Identifying the teachers for the case studies was a critical element of my research. I made the decision early on to focus on experienced teachers who were at a stage in their career where the preoccupations of, for example, behaviour management were less important. That is not to imply that such considerations are trivial but rather that the focus was on the teachers' attempts to teach their subject well rather than to get through a lesson. The advantage of selecting only experienced teachers, deemed 'expert' in their specialism, was that I would not need to focus on *whether* they were effective in their teaching which I did not wish to do but rather could explore what kind of knowledge *enabled* them to be. As I have already made clear, I was fully aware that these teachers were not representative of anything beyond themselves. Nevertheless, I strongly believe that truthfully capturing what three expert teachers know and how this influences their practice is a valuable contribution to a wider understanding of specialist subject teaching.

The criteria used to define an 'expert' teacher was as follows:

- Must have been teaching for a minimum of eight years
- Must be a current head of department/faculty
- Must be highly rated by their current headteacher
- Must be known to colleagues at UCL Institute of Education as effective within their subject

The last criterion was the most vague but also one of the most important. I was not in a position to identify strong practitioners in geography and physics and was dependent on the expertise of my colleagues in those subjects to suggest teachers to me. That these teachers were 'known' to colleagues already suggested that they were involved in wider activities beyond their school in relation to their subject, either as a mentor to student teachers or as a master's student for example.

The first teachers approached to participate were happy to do so. Two of the teachers were already known to me. I had worked with the history teacher for a number of years in his capacity as a mentor for PGCE students and had consistently been impressed by his level of reflection and expertise in the way he gave feedback. He also seemed to be a free thinker and not in thrall to the latest ideas in education generally and history education specifically. I also knew the physics teacher slightly through my work in initial teacher education. The geography teacher was not known to me at all and was suggested by the geography team at the institute. In all three cases I made an approach by email initially, partly to set out the commitment required from them and partly to ensure that they met my criteria of 'expert teacher'. This email was followed with a personal visit to discuss the research in more detail and with direct contact with the headteacher to secure consent and confirmation that they considered the member of staff in question to be highly effective. In the consent letter, the headteachers signed to give their consent and 'confirm that the main participant in the research, X, is an outstanding member of staff at the school and an expert practitioner in her subject.' In one case the headteacher spoke to me personally on my visit about the effectiveness of the teacher and the department he ran, suggesting that ‘outstanding’ did not do justice to the teacher’s expertise.

3.3.2 Ethical issues

The major ethical challenge I faced was not being able to guarantee full anonymity to the teachers. Whilst I have used pseudonyms throughout this thesis and have not mentioned the teachers’ school by name, the amount of biographical detail could enable a small number of people to identify my case studies. This was raised in my ethics application review and I consequently ensured that the teachers were fully aware of these limitations. I also guaranteed that they would have the right to comment on a draft of my findings. All three readily gave their consent and none raised any concerns about this (Appendix One). Prior to submission the relevant chapters were sent to each of them. All three confirmed they had received the chapters and two sent minor corrections relating to contextual background information about the department of the school.

I also gained signed permission from the headteachers of each school to gather data from teachers and students (Appendix Two). Parents of the students filmed in the lessons were given an opportunity to withhold their permission (Appendix Three). In one case a parent withheld her permission in the pilot study (and the student concerned was sent to work elsewhere for that lesson) but none did for my final data generation. Note that one school did not require parental permission for their child to be filmed because of a blanket approval that parents provide when their child starts at the school to allow filming of lessons for research and professional development activities.

Whilst parents could ‘opt out’ of their child being filmed in class, they had to ‘opt in’ to their child participating in a focus group interview (Appendix Four). In one case (history) the failure of students to bring a signed consent form with them on the day resulted in only one student being interviewed which was not ideal. In all other cases I received signed permission from all relevant parents.

3.3.3 Generation of data

Three particular considerations influenced my choice of data generation methods. First, I wanted to understand each teacher within their context as well as possible. Given that my interest was in the knowledge each teacher has in relation to their subject, their students and pedagogy and also how this knowledge is manifested in planning and teaching decisions, it was important to interview each teacher several times and to observe them teach. It was also useful to explore how their vision of their subject is represented through curriculum documentation and outward facing materials presented to, for example, parents and senior leaders within the school.   This connected with my second consideration which was to be in a position to triangulate data in order to compare what the teachers *said* with what they actually *did* in lessons and in broader curriculum planning. Thirdly, I needed to use methods which were practical and which would use my time efficiently. Using my school visits to observe a lesson and to conduct an interview worked well and supporting documentation was almost always provided electronically. My researcher 'stance' would be characterised by Kvale and Brinkmann (2009) as that of a 'miner' (pp. 47-50) in that I was trying to discover ideas and knowledge that already exists in the teachers themselves.

i. Interviews with teachers

I planned to interview each teacher four times. These would be semi-structured interviews with opportunities for follow up questions. The purpose of each interview is summarised in Figure 3.5 and copies of the interview outlines are included in Appendix Five. I decided to share the first interview outline with the teachers in advance for information but with the advice that it was not necessary for them to prepare anything before the interview. This was primarily to reassure them that the questions would be very open and would cover familiar ground. I did not plan to share the other interview outlines with them unless they specifically requested them (they did not). I also did not plan to make any notes during the interviews but to rely on an audio recording to enable a full transcription to be made afterwards.

Figure 3.5 The purposes of each interview with the teachers

Interview	**Purpose**
One	Biographical information about the teacher. Teachers' views about the purposes, nature and challenges of their subjects. Brief introduction to the lesson sequence.
Two	Contextual information about the department. Teachers' vision about the direction they are taking/want to take their department.
Three	Detailed analysis of the decision taken in one lesson (aided by a full transcription).
Four	Analysis of the sequence as a whole (e.g. what were the aims, were they met, why was it sequenced in that order)

I also planned to interview focus groups of students from the classes I observed to discuss their views on the sequence and the subject in general and to audio record these as well.

ii. Lesson observations

In my pilot study, the limitations of observing a single lesson became apparent as much of the second interview was spent explaining to me what the previous and/or subsequent lessons covered. Understanding how to sequence lessons so that they build on each other was an important dimension of the teachers' knowledge and given that I wanted to observe them teach more often, it made sense to watch them teach a class sequentially. I suggested to the teachers that a sequence might be anything between four to six lessons. As in the pilot study, I planned to film the lessons and to also make copious notes from my position at the back of the room. I chose not to interact with the students at all so making notes would not be a distraction and would help me considerably at the transcription stage.

iii. Documentation

I intended to collect whatever documentation might provide me with a richer understanding of, first, the lesson sequences and second, the teachers and their departments. I also planned to request copies of schemes of work but also any other documents that might help me to understand the teachers' and departments' vision of their subject, including materials that might be used to 'sell' their subject to others.

3.3.4 Data analysis

The intention was to analyse the data thematically (Braun and Clarke, 2006) using different themes and codes from my pilot study. I was keen to develop an overarching thematic framework which would facilitate comparison across subjects whilst also enabling me to code inductively within subjects.

3.3.5 Timeline of research

An overview of the timescales involved in my research is provided in Figure 3.6. Note that I interrupted my PhD in 2014 when I was on maternity leave for a year.

Figure 3.6 Timeline of my research up to submission

	January	April	July	October
2013	Commenced PhD; familiarisation with the literature; development of research questions			
2015	Continued reading; planning for pilot study		Pilot study	Analysis of pilot study data
2016	Preparation for upgrade; refinement of methodology in light of pilot study		Case study data for Tom collected (history)	Case study data for Sarah (geography - first sequence) and Robert (physics) collected
2017	All data transcribed, checked, read through closely and initial ‘noticings’ recorded.			Second geography sequence observed and further interview with Sarah carried out.
2018	Analysis of data, continued reading, drafts written of major subject chapters, literature review from upgrade revisited and updated.			
2019	Drafts revised, cross-subject analysis and written up. Submission prepared.		Submission	

3.4 Stage 1: generation of data and transcription

In this section I will explain how I generated the data in my final study, through lesson observations, interviews and gathering documentation. The section ends with a brief summary of the transcription process.

3.4.1 Observation of lesson sequences

I did not specify that I wanted to observe four lessons in each sequence and would have extended this to six if necessary to avoid imposing an artificial ending to a sequence. However, in the first three sequences I observed, four was the number of lessons suggested by the teachers. In the case of history, this was because the end of term was approaching and four lessons was all the teacher felt he could spare for the topic. In the case of geography, the lessons loosely followed the awarding body's recommended number of lessons for the topic, i.e. four. In physics, Robert felt that four lessons were sufficient to cover the specific topic of sound waves prior to him moving onto light waves. This consistency of four lesson sequences meant I had the same amount of lesson data for each teacher. However, as I began to analyse my data, I realised that the geography sequence was not going to be adequate because of its unusually sharp focus on physical geography with only limited reference to human geography in the final lesson. I had not originally planned to observe this sequence but an unexpected consequence of maternity cover in her department meant that Sarah dropped the Year 9 class I was meant to observe (learning the topic of India) and picked up more GCSE teaching. As I was soon due to go overseas for six months on study leave, I proceeded with a Year 10 class so that I would have data to transcribe and analyse. I subsequently made the decision that I needed to observe a sequence with more human geography and arranged to observe a further sequence a year later, this time with a key stage three class. Sarah suggested I observe four lessons again, although I was only able to observe the first three and was reliant on Sarah's slides, handouts and description of the fourth lesson. Although this meant that I had more lesson data for geography than for history and physics, this did help me to understand geography's 'hybrid' character.

I was also pleased to have observed a key stage three sequence in geography in addition to the key stage 4 sequence as my initial preference was to observe key stage three lessons to avoid the influence of GCSE specifications on what was taught. In physics, this proved an impossible aim as Robert only taught one year seven class (who were not learning physics at the time) and mainly taught key stages four and five. It was therefore agreed that I would observe him with a Year 11 class. See Figure 3.7 for an overview of each lesson sequence.

Figure 3.7 Overview of the lesson sequences

SUBJECT	TOPIC	LESSONS	AGE OF PUPILS
Physics (Robert)	Sound waves	4	15-16 years (Y11)
History (Tom)	To what extent did life change for ex slaves after their emancipation, 1863-c1968?	4	12-13 years (Y8)
Geography (Sarah)	The landscape of the UK	4	14-15 years (Y10)
	Climate change	4	13-14 years (Y9)

As planned, I filmed all the lesson sequences with one exception: in the second lesson of the first geography sequence the recorder did not work and I improvised with the voice recorder on my phone and copious note-making. I was lucky that this lesson did not involve any particular student activity which would have been hard to capture by sound or my notes alone. In general, my own field notes during the lessons consisted of timings (to aid with transcriptions later) and as much detail as possible, including recording everything the teachers wrote on the board, either by copying these down or by taking a photograph at the end of the lesson. I noted a few non-verbal features but these were not a major focus.

3.4.2 Interviews

I interviewed the history and physics teachers four times each and the geography teacher five times (because of the additional sequence). Each interview lasted between 35 and 70 minutes with most lasting about an hour. The interviews were semi structured (Braun and Clarke, 2013) and took place in either an empty classroom or office. I recorded each of them (audio only) and took no notes which enabled me to focus solely on what they were saying and to make eye contact throughout.

Figure 3.5 has already summarised the function of each interview. A major aim in the first interview was to establish a good rapport with the teachers and to avoid any sense of a power relationship (Marshall and Rossman, 2016). It was easy to avoid the latter as I am a former head of department and a current teacher educator working across London schools and was able to establish a relationship of equals immediately in the interviews by sharing my own background. Building rapport was instant with Tom as we already knew each other fairly well, having worked together with student teachers for about six years. I also knew Robert a little but the interviews were initially quite formal and we needed to build a shared understanding both of school physics and of my own research interests. I did not know Sarah but she was very open from the first interview and we quickly developed a good rapport. I had emphasized prior to the interviews (and lesson observations) that I was not interested in making judgements about effectiveness and indeed in the case of geography and physics was not qualified to do so. Coupled with my open-ended questions, this helped to put the teachers at their ease.

An important feature of the interviews were my follow up questions. Many of these were a variation on 'why' as I sought to understand the reasoning behind the teachers' decisions and views. Below is an example of a fruitful exchange with Sarah (geography) in the third interview focusing on a specific lesson and which demonstrates my use of specific follow-up questions.

> *Q1: So, I thought this was quite interesting because you could have gone straight to Malham Cove, couldn't you?*
>
> Yeah.
>
> *Q2: You didn't need to do this, so I was quite interested in why you did, and also why you chose those particular places.*
>
> Okay. Part of this is a fault of mine - excuse the pun - tectonic process. Okay, so I normally have quite a lot of ideas when I'm planning. So this is basically another starter like the image, and then I think, oh but I've thought about that, so I just want to use it. So I end up using both, but theoretically I could have used one or the other….
>
> *Q3: So you could have used this instead of the 'what's the geography going on' in the picture?*
>
> Yeah.
>
> *Right.*
>
> So I think this would work as a starter, and actually in my folder it says, starter. So, I guess the picture is my hook, and this is my starter.
>
> *Right, okay.*

> Does it really need to be labelled? I don't know. The only thing about this is, whereas for that one some of them can be a bit lazy, this one, they have to think about it.
>
> *They have to do it.*
>
> Also this one is all about formation and rocks, and the other one is just about what's the geography. So this is kind of cranking it up a level. Also, the whole thing about this; I want them to guess. I'm obsessed with that; I like them to have a go without me.
>
> *Q4: My question about that was, when you talked about intelligent guess-work, and a good educated guess, is that part of being a good geographer, or is that a teaching technique, or is it both?*
>
> I use it a lot. I think that's pedagogy.
>
> (GL1/1[6])

In the first two questions I was asking Sarah why she chose to show images of the Lake District and Dartmoor early on the first lesson of Sequence One. The third question was a follow up to gain clarification and the fourth question was a follow up to probe Sarah's use of 'intelligent guesswork' in relation to this image in the lesson.

I also interviewed Emma, Tom's second-in-department, for 30 minutes. This was at Tom's urging because he wanted Emma to outline her plans for the revision of the curriculum at key stage three which they had been working on together. I did not prepare a specific interview outline but based it loosely on aspects of the first two interviews combined (some brief biographical background and then Emma's views on the purpose of history and her vision for the key stage three curriculum).

Finally I interviewed students from the classes I had observed at the end of each sequence, with the exception of the second geography sequence. In history, for reasons I have already outlined, this was not ultimately a focus group interview and I made limited use of this data in my analysis. However I successfully interviewed focus groups of four students in both geography (Year 10) and physics (Year 11). An interview outline is included in Appendix Six. The purpose of these interviews was two-fold: first, to ask them about the sequence (what they learnt, what they enjoyed, what they felt was the purpose etc.) and then to ask them about the subject in general (its purpose, what they enjoy/do not enjoy etc.). I emphasised that I was not asking them to comment directly on their teacher here but on the subject itself as I did not want to encourage conversations about the teachers' popularity which would have been inappropriate. I also emphasised that everything they said would not be shared with

[6] See section 3.8 for an explanation of abbreviated references

their teacher in case they felt restrained to, for example, identify aspects of the subject they did not enjoy. All appeared to talk openly. I recorded these interviews and made no notes.

3.4.3 Documentation

I requested copies of schemes or work/GCSE specifications and all resources associated with the lessons. Beyond that I left it up to the teachers to decide what to share, with the proviso that I was interested in how they portrayed their subject to ‘outsiders’ and also in their vision for their subject and their department. Figure 3.6 summarises the documentation I collected.

Figure 3.6 Summary of the documentation collected for each case study

Subject	**Documentation**
Physics	iGCSE specification Order of topics taught at GCSE in the department Departmental Twitter account Departmental ‘flyer’ outlining why students might decide to study physics A Level Resources from four lessons.
Geography	Key stage three scheme of work GCSE specification and scheme of work Presentation to SLT (senior leadership team) outlining national changes to key stages 3 and 4 and departmental responses Key stage three rationale PowerPoint slides and resources from eight lessons.
History	Key stage three scheme of work. History contribution to the A Level prospectus PowerPoint slides and resources from four lessons.

3.4.4 Transcription

I transcribed 15 lessons in full (see Appendix Seven for an example). I included a small number of non-verbal observations but mainly the transcriptions were an account of what was said during the lesson and what the students did, together with timings. I also wrote detailed summaries of each lesson (Appendix Eight) and shorter summaries to include in the relevant chapters (for example see section 4.4.4.). The detailed summaries were an extremely useful part of the process of understanding and remembering what happened in the lessons. I only transcribed one interview (the first history interview) myself but to ensure the accuracy of the transcriptions and to increase my familiarity with the data, I subsequently listened to all the interview recordings and corrected any minor errors on the remaining transcriptions. The focus group interviews and the interviews with the single student and with Emma were partially transcribed which enabled me to replay sections where full transcription was necessary, particularly where I wanted to quote an extract in my findings.

3.5 Stage 2: thematic analysis by subject

This section explains how I thematically analysed my data by adopting a hybrid approach. It ends with a brief section explaining some further data gathering I undertook in the analysis phase.

3.5.1 Coding my data: a hybrid approach

After the initial process of transcribing or checking transcriptions, I read though all the interview transcriptions and detailed lesson summaries and recorded what Braun and Clarke (2014) call ‘noticings’ in my notebook (see Appendix Nine for an example). These ‘noticings’ were either points drawn directly from the data or my further observations. At this point I was beginning to see some themes emerging in relation to my research questions but I was still searching for a common theoretical, deductive framework which could provide consistency of analytic approach across the three subjects. Reading Hoadley (2011) at this point provided me with a way forward: her analytic categories of ‘knowledge’, knower’ and ‘knowing’, used in her work to describe the evolution of curricula in post-Apartheid South Africa, provided a useful framework in which to explore the different kinds of knowledge that the teachers deployed in their planning and teaching decisions. As outlined in Chapter Two, in Hoadley’s analysis (used to describe a curriculum rather than teacher knowledge), knowledge refers to the content set out in a curriculum, bounded by the conceptual frameworks of subjects. She argues that Curriculum 2005 (implemented in 1997) privileged the knowers (students) and forms of knowing (i.e. ways of learning) over knowledge by not specifying what should be taught but rather being outcomes-led. The result was a curriculum that emphasised ‘everyday knowledge’ and progressive pedagogies and which lacked a conceptual subject-specific framework which mapped out how students could make progress. Hoadley recognises that the ‘knowers’ and forms of ‘knowing’ are important, but only when held in a special relationship with knowledge. This special relationship echoed the themes emerging from the data and also resonated with the model of curriculum making on page 59 which suggests that teachers bring together their knowledge of the subject, the students and pedagogy in dynamic ways when they teach (see Lambert and Biddulph, 2015).

I attempted to code history using these headings but it quickly became clear that 'knowledge' was too broad a category and that it needed breaking down. Initially I used Hirst's (1974) two categories of propositional and procedural knowledge as I had done in my pilot study, adding progression as a third sub-category. I coded all my data under these themes initially but felt that 'propositional knowledge' was too broad. It was my re-reading of Winch (2013) which led me to separate propositional knowledge from inferential 'know how'. This was transformational in my coding of the 'knowledge' theme and enabled me recode the data in order to reach more nuanced conclusions which remained more faithful to the complexity of the data as Figure 3.7 and the text below illustrates.

Under these thematic headings (and 'sub-themes' within the broader theme of 'knowledge') I coded inductively so that I could analyse the broad categories of knowledge, knower and knowing in relation to specific subjects, thus adopting what Braun and Clarke (2006) term a hybrid approach (i.e. a combination of working deductively and inductively). At this stage I was making notes on the transcriptions of the interviews and lessons and recording key ideas separately (see Appendix 10), revising the codes repeatedly until I was satisfied with their precision. I also changed my mind several times about which theme each code belonged under.

Figure 3.7 summarises the different iterations of the coding for physics and demonstrates how I struggled to code within the category of 'knowledge' until the last version which separated 'propositional knowledge' from 'inferential know how'. 'Contexts', for example, started out under the heading of 'procedural knowledge' on the grounds that this involves students applying their knowledge across different contexts which I judged to be a procedural skill. In versions 2 and 3 I moved it to the 'propositional' category because I began to feel that this was in fact a dimension of core knowledge, adding 'consistency' in version 3 to emphasise that the point of applying understanding across contexts is to show the stability and consistency of key concepts. In version four I moved it under the heading of 'progression' because it was such a strong feature of the way Robert characterised what getting better at physics meant. Finally, I moved it under the heading of 'inferential know how' on the grounds that applying understanding across concepts requires an understanding of a bigger conceptual framework and knowledge of how to apply it. This is not, however, an exact science, and a case could be made to locate it in more than one category and in fact, I do also refer to it when discussing progression.

Figure 3.7 Changes made to the physics coding

	Version 1	Version 2	Version 3	Version 4	Version 5 (final)
Knowledge					
Propositional	Dominant but fallible. Big ideas – reductionism. Language – precision. Sequencing.	Core knowledge and stable knowledge? Different contexts. Sequencing – within and across topics? Reductionism and precise language.	Core (fixed?) knowledge leading to reductionism and precision of language. Consistency and context. Models and mathematics.	Core knowledge (reductionism, big ideas, concepts, language) – what does it mean to 'know' physics? Models and mathematics.	***Propositional knowledge*** Core knowledge (including mathematics). Terminology. ***Inferential know how*** Connections and sequencing. Contexts and models.
Procedural or epistemic insight'	Contexts. Scepticism. True value. (Epistemic insight)	Knowledge by acquaintance – experiential. Fallible knowledge/scepticism/'true value'. Knowledge creation.	How do we know things? How is physics knowledge created? How do we evaluate things?	How do we know physics? What should we trust? A way of thinking about the natural world (applying physics).	***Procedural know how*** What *is* scientific knowledge? The skills of a good physicist.
Progression	'Hierarchical spiral' curriculum.	Hierarchical spiral.	Hierarchical spiral (does this work?). Sequencing – within and across topics?	Deep understanding. Consistency across contexts.	Progression.
Knowers	Sticky misconceptions. Abstract to concrete.	Sticky misconceptions. Abstract to concrete – narratives or stories.	Sticky misconceptions. Abstract to concrete – narratives or stories.	Sticky misconceptions. Familiar to strange – narratives or stories.	Sticky misconceptions and deep understanding. Familiar to strange and the role of narrative.
Knowing	Experiential – demonstrations and practical.	Importance of dialogue. Influence of assessment (GCSE).	Importance of dialogue. Experiential learning. Assessment.	Importance of dialogue. Experiential learning. Assessment.	The role of dialogue. Assessment. Experiential learning.

	Exposition of core knowledge.				

Although I am describing one example of how the coding for the physics data evolved, I went through similar processes for history and geography. I have provided a brief overview of this process in chapters five and six. Once I was fully satisfied with my codes, I formally coded the interview transcriptions and detailed lesson summaries using the comments function in Word (see Appendix 11).

After coding the interview and lesson data, I turned my attention to the other documentation. Whilst I did not formally code this, I noted examples which supported or challenged my emerging findings.

3.5.2 Clarifiying and gathering more data

During the analysis of my data I did contact Robert and Sarah for some clarification on two points. In the case of geography, I emailed Sarah to ask her what she felt all students were entitled to learn about in geography so that I could compare this with the history data. In physics, I became more interested in why Steven had chosen not to teach the iGCSE specification in the order recommended by the awarding body and emailed him for clarification. In all cases I sent the teachers a draft version of the relevant chapter and all three responded with two suggesting minor amendments/comments.

3.6 Stage 3: thematic analysis across subjects

Yin (2014) points out that “Case studies . . . are generalizable to theoretical propositions and not to populations or universes…and the investigator’s goal is to expand and generalize theories” (p. 38). In other words, whilst I am not in a position to apply my findings to teachers more broadly, I have aimed to use my data to illuminate aspects of the ‘theoretical propositions’ more generally.

Perhaps unsurprisingly, Chapter Seven, which aims to bring my analyses of each subject together, was the most challenging chapter to write. I began the process by revisiting everything I had thus far written (the literature review and the three subject chapters) and making notes. Key themes and questions emerging from these notes were then recorded onto a large piece of card (Appendix 13). During this process I searched for some more literature to strengthen some of the emerging themes. I found Muller (2006) very helpful on the impact of different knowledge forms on curriculum and assessment and Klafki (1995) invaluable on the process of teacher decision making (‘didactical analysis’). Deng (2007) and Doyle (2017) contributed to my deepening understanding of teachers’ role in the recontextualization process which was emerging strongly from my data.

At this point I identified three particular themes to explore across the case studies: teachers’ role in the recontextualization process, fixed and/or porous boundaries (between subjects and between curriculum and pedagogy in particular) and an F3 curriculum (Young and Muller, 2010). However, I subsequently realised that these themes, whilst important, could not form the whole of Chapter Seven as this would effectively omit an important stage which was to bring my analyses of the subjects together under the themes of knowledge, knower and knowing in order to compare them. Towards the end of Chapter Seven I focused on two particular overarching themes, recontextualization and an F3 curriculum.

3.7 Reporting findings

I felt it was important to report my findings case by case, devoting a chapter to each teacher/subject. This also enabled me to provide an insight into the history of the school subject in each case and the current debates about what should be taught and how. These chapters can be read in any order. However, in order to answer my research questions, I needed to bring my analyses of each teacher together which I do in Chapter Seven. I tried not to repeat examples and points in too much detail but inevitably there is some overlap between Chapters Four to Six and Chapter Seven.

I have used abbreviations as follows to indicate the source of my data.

i. Interviews

I use ‘P’, ‘G’ or ‘H’ to indicate subject and ‘I’ to indicate interview. I then provide the number of the interview and the page number of the transcript. For example:

HI3/11: history interview three, page 11

GI2/3: geography interview two, page three

PI4/13: physics interview four, page 13

ii. Lessons

I use ‘P’ and ‘H’ to indicate subject and ‘L’ to indicate lesson. I then provide the number of the lesson and the page number of the transcript. For geography I use ‘G’ followed by ‘L’ and then 1 or 2 to indicate whether I am referring to the first or second sequence.

The final two numbers refer to the number of the lesson and the page number of the transcript. For example:

HL2/4: history lesson two, page four

PL4/5: physics lesson four, page five

GL1/3/5: geography lesson, first sequence, lesson three, page five

GL2/2/4: geography lesson, second sequence, lesson two, page 4

In the transcriptions of the lessons, I used the following abbreviations:

TQ: teacher question

TE: teacher explanation

TA: teacher answer

SA: student answer

SQ: student question

When I quote from interviews, my questions are always shown in italics and teachers' responses are in normal font.

Chapter 4 Physics

I start this chapter with a brief overview of secondary physics education including the challenges it presents to students and the current debates apparent in the literature. I then introduce the case study of Robert and explain how I analysed the data before devoting the bulk of the chapter to my findings.

4.1 What kind of knowledge is physics?

Using Biglan's (1973) three dimensions, physics can be characterised as *hard* (i.e. with strong paradigms), *pure* (it is not applied knowledge) and *unconcerned with living things.* Biglan's classification of physics as 'hard' is widely accepted and it is regarded as a prime example of what Bernstein (1999) called 'hierarchical knowledge', that is, knowledge that demonstrates an internal progression towards greater abstraction and a special language which relates this abstraction to the world (Firth, 2011). Chapman describes physics as a 'triumph of reductionism' (2015, p. 103) where 'big ideas' reduce in number as the complexity of physics increases. To this extent, as I will argue in this chapter, physics is a good example of the limits of stand-alone, propositional knowledge: the fundamental point of physics is to connect concepts together in order to infer greater meaning and reach greater abstraction.

In schools, physics is traditionally taught alongside chemistry and biology as part of a 'combined science' course, often up to the age of 16 and certainly up to the age of 14. However, whilst some of the characteristics of physicists (see Figure 4.1 below) would equally apply to other sciences (and indeed other subjects), physics does claim a distinctive epistemology (Chapman, 2015) which owes much to the work of Newton. Sturdy (2017) sees Newtonian physics as a 'monumental epistemological breakthrough' where a methodology based on experiment and observation was introduced. Natural phenomena were studied (and 'cleaned') in laboratories and mathematics provided ways to make predictions based on these observations which led to more experiments to prove hypotheses. This methodology enables physicists to generate laws about natural phenomena without going outside and thereby establishing physics' fundamentally abstract nature.

While all branches of science deal with theories, laws and models, Erduran and Dagher (2014) argue that their 'precise nature can be rather different in each domain' (p. 120).

For example, the emphasis of laws in physics is mathematical whilst in chemistry, some laws are more approximate. She goes onto argue that:

> If learners are expected to have deep understanding about the forms of scientific knowledge, it is imperative that they learn the conceptual aspects in conjunction with the epistemic aspects of scientific knowledge (p. 120).

I will return to these ‘epistemic aspects’ but it is worth noting that there is a debate amongst the academic science community about the nature of ‘truth’ in physics and in science more generally. Scientific pluralists such as Kellert et al (2006) emphasise that there may be multiple explanations of a phenomenon which reflect its different facets. The example they provide relates to biology but is still worth repeating here. Philosophers of biology have argued that gene-centred explanations should be replaced by DST (developmental systems theory) explanations because, otherwise, important causal factors of individual human development are missed. But scientific pluralists would argue that we can and should have both types of explanation as both provide understandings of different aspects of the phenomena of human development. There is some resonance here with the work of Hardman (2017) on the use of models in physics. Because the phenomena of interest to physicists cannot easily be seen, models provide surrogates but are subject to change over time and are not perfect. The emphasis on the plurality of explanations (as in the biology example above) and on the fallibility of explanatory models both demonstrate that science in general and physics specifically do not simply provide a single ‘truth’: there can be multiple truths and what is more, science can experience paradigm shifts (Kuhn, 1962). How far this is and should be explored in schools is explored below.

Figure 4.1 (Tracy, 2018) offers a helpful perspective on the characteristics of physicists and physics. Compiled as part of a set of guidelines to inform the development of future physics curricula, it highlights some big ideas of physics (as ‘crosscutting themes’) alongside physicists’ ways of thinking about and ‘doing’ physics.

Figure 4.1 Some characteristics of physics and its ways of thinking (Tracy, 2018)

Characteristics of physicists (attitudes, actions and ways of thinking)	Characteristics of physics	Crosscutting themes of physics
Physicists tend to: • seek deep understanding • use experiments and their results • seek consistency • think critically • set aside preconceptions • employ methods to test plausibility • use reason and logic • be creative • think with and construct models to predict behaviour • simplify descriptions, explanations and models • use parallels and analogies	Physics explanations are characterised by: • reductionism • universality • unification • consistency • synthesis • empiricism • mathematical formulation • applicability	Ideas that appear in many explanations are: • conservation • equilibrium • differences cause change • inertia • dissipation • irreversibility • fields • energy

I have already noted that the ‘characteristics of physicists’ are very generic and could apply to many other subjects. The characteristics of physics are more distinctive, especially the first one, ‘reductionism’. The crosscutting themes are especially interesting, however, because they suggest some overarching ‘big organising ideas’ around which the curriculum might be planned. Despite physics’ hierarchical structure, which could imply a fixed set of concepts and an order in which to teach them, examples of what the ‘big organising ideas’ of school physics curricula might be different as Figure 4.2 illustrates.

Figure 4.2 Alternative ‘big ideas’ to structure a physics curriculum around

Tracy (2018): ‘crosscutting themes’	Conservation, equilibrium, differences cause change, inertia, dissipation, irreversibility, fields, energy
The National Research Council of America (2012): ‘core ideas’	Matter and Its Interactions Motion and Stability: Forces and Interactions Energy Waves and Their Applications in Technologies for Information Transfer
Chapman (2015): ‘groupings’	Forces and fields; The nature of matter; Materials; Electricity and magnetism; Electromagnetic radiation; Radioactivity; Energy transfer; The earth in space; The universe
Frost (2005): ‘big stories’	We live on a hot rocky ball which is hurtling through space We live in an expanding universe Matter is made of particles Radioactivity Radio waves and light waves are different facets of the same phenomenon Fields

	Change and energy transfer The made world
Duit et al (2014): physics standards	Energy Interaction Matter System

We can see that there are 'big ideas' in common (energy for example) and that differences are often a matter of presentation with some concepts conflated with others but nevertheless implicit (for example 'fields' are implied within 'interaction'). However, these differences do suggest that the curriculum of physics is far from 'fixed' and there is room for a debate about how to structure the presentation of physics knowledge. Nevertheless, despite these differences, the principle that this knowledge becomes more abstract as it becomes more advanced is crucial in physics; the specific areas of study and research feed into a decreasing number of increasingly large ideas. In this regard, physics represents quite different knowledge to history and geography, where progression is represented by the proliferation of concepts and language.

4.2 Physics as a school subject

4.2.1 Historical context

As a discipline, physics existed by 1840 but was not part of university curricula in the UK until the end of the nineteenth century (Sturdy, 2017). By then, however, it had been taught in secondary schools in the US for about 200 years and ever since, 'physicists have sought to change the way it's taught' (Otero and Meltzer, 2017). As early as 1906, a university physicist from Chicago was suggesting a more innovative way to teach the subject:

> When science was introduced into the schools, it was naturally taught … dogmatically and deductively. But it is now time for us to realize that science is our process of interpreting natural phenomena… . Hence if young people are to become adept in science, they must be taught how to interpret for themselves. They should develop the habit of making sound interpretations of phenomena—a habit which can be acquired only by scientific study (Mann, 1906).

This is a startlingly modern perspective on science teaching given its date and would not be out of place in much more recent literature. Debates about how students should engage with physics and whether they should develop understanding purely from knowledge transmission or through experimentation have persisted ever since and there remain striking differences across different education systems. In the UK there have been examples of curriculum innovation in physics since the 1970s, from the Nuffield Foundation approach which favoured experiential, hands-on learning, to 'Twenty-First Century Science' GCSE courses which emphasised the way science is used by society. More recently we have seen a shift to a more traditional knowledge-based approach, illustrated by the current national curriculum and revised GCSE specifications. It is debateable how far the emphasis on practical work emanating from the Nuffield Foundation became in embedded, especially in less well-resourced schools, and certainly evidence now suggests that practical work is often considered to be an 'add on' by teachers in England and not properly connected to the other work that is done in physics classrooms (Abrahams and Millar, 2008).

Hardman (2017) suggests that the heavier emphasis on physics knowledge in the 2013 national curriculum arguably comes at the expense of a more critical engagement with science as a form of knowledge. In 2002, the National Strategy Framework for Teaching Science advocated that 11-14 year olds should 'engage with developing and critically evaluating models in relation to different phenomena' (p. 94) and this emphasis continued through various iterations of the national curriculum until 2013, when a focus on substantive knowledge eclipsed 'an understanding of the skills, processes and nature of science' (p. 95). We can see therefore that debates about the extent of practical work, how far this is embedded in teachers' practice and how far students should develop a broad understanding of NOS (nature of science) are still very much open to debate as I will explore in more detail in section 4.3.

4.2.2 The relationship between school physics and academic physics

We have seen in Figure 4.2 that the way big ideas are presented in curriculum materials differs within and beyond the UK. Beyond core content knowledge, there are also debates about scientific literacy and 'Nature of Science' (NOS). The first focuses on the way science is used by society in general whilst the second addresses the epistemic dimension of science. The point is that the physics curriculum is not as predictable and 'fixed' as we might imagine, a point well made by Yates and Millar (2016) who argue that the content of school physics curricula is not a given. For example in Australia, where Yates and Millar conducted their research, there is debate around the role of mathematics in school physics and the extent to which it should play a central role. Furthermore, there is also debate about whether the emphasis should be *about* the discipline as well as the discipline *itself* – for example by looking at its contribution to society over time.

Issues of recontextualization (Bernstein, 2000) are important here. Yates and Millar (op. cit.) argue that there is simply too much physics to be taught in schools and that different aims come into play during the recontextualization process which derive from the context of schools. Thus, they argue, the discipline alone cannot determine the sequencing or selection of physics in school, despite its strongly hierarchical structure. Sturdy (2017), writing from the perspective of a practising physics teacher in England, highlights the enormous gap between physics in universities and physics in schools: ‘only a small part of the substantive content of A Level physics approaches the kind of material study undertaken in the disciplinary field’ (p. 57). School physics draws heavily, Sturdy argues, on Newtonian traditions of enquiry and content selection rather than on modern physics (Einstein onwards) and whilst Newtonian or classical physics still furnishes school physics with key conceptual categories, physicists in universities are engaged in work which has its roots in modern physics. Sturdy goes on to suggest that school physics is not a watered down version of what happens in laboratories but rather an introduction to a (at the time) revolutionary method that made more abstract thought possible. He would like to see more connections made between the two contexts and calls for teachers to pay more attention to the connections between school physics and the discipline: ‘what aspects of knowledge from the discipline can be rendered suitable for schooling, while retaining its intellectual coherence.’ (p. 61). Deng (2001), in contrast, argues that the key ideas in school physics differ sufficiently from the corresponding ideas in academic physics that it is not a teacher’s familiarity with academic physics that is the problem. He wants to see greater support provided to physics graduates who embark on a teaching career so that they have a solid understanding of *school* physics as well as *academic* physics.

Not only is the content of physics curricula unpredictable (though much more predictable internationally than either history or geography), the discipline cannot *entirely* determine the sequencing of what is taught. Yates and Millar (op. cit.) argue that whilst physics is a largely linear subject (i.e. there is a logical order in which to teach many things), learning *about* the discipline as well as the discipline itself does not suggest or require any particular sequencing. They therefore conclude that the discipline itself cannot dictate the sequencing and selection of physics curricula, especially if some of the ‘wider’ aspects of teaching science (NOS, scientific enquiry, scientific literacy, history of science) are included. Nevertheless, within the core content of physics, there are some concepts that need to be taught in a particular order to be fully understood and this is much more the case than in either history or geography.

4.2.3 Student understandings of physics

> A new physics teacher may find that much in the way physics is represented in school science is quite different from their own understandings…..Effective physics teaching is always a challenge. It requires an ability to keep in mind the essential concepts of the subject, while appreciating students' current ideas and the ways the subject is represented as target knowledge in school. Teachers need to plan learning routes informed by these three distinct ways of thinking about physics if they want to get into pole position to develop student understanding. Taber, 2006, p. 11

It is interesting to see Taber use the term 'essential concepts' separately from 'the ways the subject is represented as target knowledge in school' in recognition of the different ways physics curricula are constructed and the need to reinforce the most fundamental ideas throughout. Taber's third 'way of thinking' is for teachers to appreciate 'students' current ideas', reflecting that a particular challenge of physics is the extent to which its concepts are not only abstract but counter-intuitive too. This has led to much research into student understanding, pioneered in the UK by Rosalind Driver. The summary of international work on children's misconceptions, *Making Sense of Secondary Science: Research into children's ideas*, which is now in its second edition (Driver et al, 2014), includes chapters on many of physics' big ideas and concepts including gravity, magnetism, particles, forces and energy. There are more chapters devoted to misunderstandings in physics (ten) than in biology and chemistry (seven each). The kinds of misconceptions reported in the book include:

- Gravity only affects heavy things (instead of gravity affecting everything)
- A force is the property of a single object (instead of interaction between two objects)
- Light only bounces off mirrors but not other objects (it does)

It is no surprise that there is more research into teaching and learning physics than in chemistry and biology combined (Duit et al, 2014) because the particular nature of physics knowledge confounds students' everyday knowledge whilst remaining largely abstract.

A further aspect of what we should (and should not) expect students to understand about physics relates to its epistemological status and the extent to which it represents the 'truth' or not. Historically, there has been a debate between scientists such as Einstein who have argued that there is an underlying order waiting to be discovered (the ontological view) and scientists such as Bohr who argued that nature is messy and that there is no reason to assume that order exists (an epistemological stance). In a classroom setting, some students may feel the need to find an underlying pattern where none may exist. They may have a pre-existing conception of how the universe should be ordered and may look for results to match their pre- or misconceptions.

Hardman (2017) has considered the epistemological issue in relation to the use of models in physics lessons and whilst he believes these should be the subject of more explicit critique, he is aware of the ‘anarchy’ this could lead to:

> ‘If we wish to present an authentic view of science in the science classroom, then we cannot let students believe that science is the progression of increasingly accurate models, approaching the truth of the world. However, it may not be wise to fully expose young scientists to what Feyerabend (1975) calls the ‘anarchy’ of scientific method: scientists use whatever methods they need to advance science.’ (p. 93)

It would seem likely that there is a limit to how far we should sensibly expose students to epistemological and even philosophical debates about the scientific method and its relationship to truth. I will return to this theme in Chapter Seven in relation to all three subjects.

4.3 Current debates about school physics

There have been debates about how relevant science curricula are in the current climate and whether they need to shift their emphasis. Some (e.g. Sturdy, 2017; Perks, 2006) see knowledge acquisition as the key aim whilst others see a bigger role for science to inform current debates and future uncertainties. Hodson (2003) lists the various ‘slogans’ in science education over the previous forty years – ‘Being a Scientist for a Day’, ‘Learning by Doing’, ‘Process, not Product’, ‘Science for all’, ‘Less is more’, ‘Children making sense of the world’ and ‘science as a way of knowing’ (p. 645) and he himself suggests an emphasis on political action though a focus on STSE (science, technology, society and environment). The generic term used to refer to science explicitly contributing to current debates is ‘science literacy’, though there is no single definition of this. Influential in the UK was The Nuffield Foundation report of 1997-8 *Beyond 2000: Science Education for the Future* which criticised the static nature of the science curriculum and advocated change. One outcome was the GCSE course ‘21st Century Science’ which emphasised the contribution of science in current debates and a critical engagement with the reporting of this in the media. This course has since been dropped because it was heavily criticised for diluting the science curriculum and undermining core knowledge. In his argument for science literacy, however, Hodson makes the point that ‘ordinary citizens will increasingly be asked to make judgements about matters underpinned by science knowledge or technological capability, but overlaid with much wider considerations.’ (p. 650).

In Germany, the concept of Bildung (see p. 53) has been influential in framing the aims of science education by asking, for example: 'what is the significance of the content for students' actual and future life' (Duit et al, 2014). Duit et al claim that there is 'wide agreement' amongst science education researchers that the 'nature of science' (NOS) is relevant for the teaching of physics and the development of scientific literacy, but that teachers 'do not regard NOS as an explicit objective of their teaching' (p. 439).

NOS differs from scientific literacy because it has an epistemological focus with key elements including:

- Distinction of observation and inference
- Empirical basis of science
- The theory-ladeness and subjectivity of knowledge in science
- Science as a human enterprise and
- The tentativeness of scientific knowledge

(Duit et al, 2014, p. 438).

Billingsley and Hardman (2017) use 'epistemic insight' rather than NOS because, they argue, students in schools are generalists – and ideally will be engaging with the nature of a range of disciplines comparatively so a term that can be used across subjects is arguably more helpful. Doing so, the authors argue, could help students to compare science with other subjects, situating science in a 'wider multi-disciplinary mix' (p. 57).

In terms of providing epistemic insight through practical work, Abrahams and Millar (2008) found that teachers tend to separate the teaching of substantive scientific knowledge and the procedures of scientific enquiry with the former dominating and the latter only really becoming a focus for assessment purposes. The assumption teachers make, the authors argue, is that students can develop an understanding of designing experiments, analysing data and interpreting evidence by themselves. What they want to see is greater attention to the connection of observations during practical work with theoretical ideas *at the same time*, rather than subsequently. Currently, however, Abraham and Millar suggest that we have some way to go 'to develop models of practice in the use of practical work that more effectively integrate its roles in developing substantive and procedure understanding' (p. 1945). Their argument is supported by Duit et al (2014) who suggest that 'neither students nor science teachers possess an adequate understanding of NOS' (p. 438).

Overall, the literature suggests that teachers (and school curricula) are more inclined to focus on content knowledge than on an integrated understanding of how that knowledge is generated. Furthermore, Erduran and Dagher (2014) argue that school science is focused more on discrete content than on the relationship between theories, laws and models:

> Understanding the mechanisms of knowledge growth would ensure that students distinguish scientific knowledge as a coherent network of theories, laws and models, rather than as discrete and unrelated pieces of information. A holistic and relational representation and presentation of scientific knowledge is likely to promote students' meaning making of why and how we know in science. (p. 114)

Here, Erduran and Dagher are suggesting that the failure to appreciate and understand the connectedness of science is caused partly by a failure to engage in an understanding of knowledge creation. This, they argue, contributes to a failure by students to understand the 'interconnectedness' of physics (Main, 2014, p. 48).

Given that the interconnectedness of physics is one of its distinctive features, a failure to enable students to understand this appears a quite serious omission. Research in the US has suggested a mismatch between what physics teachers think they do (hands on activities, inquiry, higher order thinking) and what they actually do ('traditional teaching' including lectures, PowerPoint, copying notes etc) (Sunal et al, 2016).

4.4 Introduction to the case study

In this section I provide contextual information about Robert, his department and his school. An overview of the data generation for physics is provided, followed by a summary of the lesson sequence.

4.4.1 Robert and his department

In autumn 2016, when I observed him, Robert had been teaching in classrooms for 15 years, but had been involved in physics education for 24 years. He has worked in a variety of schools, including as a head of department, a position he held when I observed him. He has a degree in Astronomy, a PhD in physics and a PGCE in secondary physics.

Prior to working in education he was a government research scientist but didn't enjoy 'measuring things to nine decimal places' and completed a PGCE in order to retrain as a secondary physics teacher. He has taught physics in five schools and has also worked in university-based initial teacher education. His current post is head of physics in a private girls' school in London. He has also worked with primary schools for the government and has experience of the kind of science education most primary children receive ('one of the things they are very bad at is assessing the reliability of data').

In his current school there is – unusually - no overall Head of Science – so the traditional responsibilities of that role are divided across the heads of physics, chemistry and biology. Other than Robert there is one other physics teacher in the school (although he is actually a geographer). Few of the senior leadership team of the school are scientists which can be a frustration, for example when the methods they suggest to boost exam results do not work in the context of physics. All the students study each science separately and follow the iGCSE specifications, both of which make the school atypical. It can be a struggle to encourage the girls to take physics at A Level because they tend to be more interested in biology and chemistry to enable them to study medicine[7] but Robert has taken a pro-active approach to raising the profile of physics in the school. Figure 4.3 contains a sample of the school's physics twitter feed (written by Robert) from the month of February 2017 and demonstrate Robert's commitment to sharing new research and opportunities in physics with his students.

[7] There has been much research carried out into girls' reluctance to study physics (e.g. Murphy and Whitelegg, 2006)

Figure 4.3 Sample tweets from Robert's school physics twitter account from February 2017

'Amazing advances in quantum mechanics'
First ever blueprint unveiled to construct a large scale quantum computer
https://www.sussex.ac.uk/news/all?id=38900

'The Night Sky for Feb, including a lunar eclipse in half term'
https://www.theguardian.com/science/2017/jan/29/february-night-sky-planets-constellations-moon-starwatch …

(Retweet) *Cambridge scientists have uncovered a bridge between stars in space*
http://www.cam.ac.uk/research/news/a-bridge-of-stars-connects-two-dwarf-galaxies … ***#spacescience*** ***#Astrophysics***

'BBC News - MRI pioneer and Nobel laureate Sir Peter Mansfield dies'
http://www.bbc.co.uk/news/uk-38919614 …

'BBC News - Event Horizon Telescope ready to image black hole'
http://www.bbc.co.uk/news/science-environment-38937141 …

(Retweet) *Follow* ***#AAASmtg*** *& get insight into latest results from* ***@CERN*** *Large Hadron* ***#Collider*** *presented shortly* ***@AAASmeetings*** *http://cern.ch/go/Nbc8*

(Retweet) ***Institute of Physics*** **@PhysicsNews** *23 Feb 2017 How amazing is today's google doodle celebrating* ***@NASA****'s discovery of The TRAPPIST-1 planetary system? We love it!*

(Retweet) ***NASA****Verified account* ***@NASA*** *22 Feb 2017 Take a trip 40 light-years away to one of the seven Earth-sized planets in the TRAPPIST-1 system.*

'What is Heisenberg's Uncertainty Principle?'
https://www.theguardian.com/science/2013/nov/10/what-is-heisenbergs-uncertainty-principle?CMP=share_btn_tw …

4.4.2 Robert's school

Robert teaches at a private selective girls' school in London. The school admits students between the ages of 3-18 with 258 students in the senior years (11-16 years). Just under the half the students are from a minority ethnic background and they have above average attainment on entry which is selective and based on admission tests. It costs approximately £16,500 a year to send your child to the senior school.

The examination results are very strong at GCSE and A Level. In 2018, over 30 per cent of numbered GCSE grades awarded were Grade 9 compared with about 4 per cent nationally. Over 50 per cent of all grades awarded at GCSE were graded A*, 8 or 9. Within science specifically, 72 per cent of grades were A* across biology, chemistry and physics, making it one of the highest performing departments in the school.

4.4.3 Generation of data

I observed Robert teach four times, each lesson lasting one hour, in the autumn of 2016. I then interviewed him four times for a total of 184 minutes. I also interviewed a group of four girls from the class I observed immediately after the fourth lesson. This interview lasted for 29 minutes.

I also analysed the GCSE physics scheme of work (effectively the i-GCSE specification), publicity material for A Level physics (Appendix 13) and the departmental twitter account.

4.4.4 Overview of the lesson sequence

The sequence was taught to a class of Year 11 girls who were preparing for their GCSE. The specification followed by the department is the Edexcel International GCSE and the lessons covered part of Section 3 (waves) and specifically, sound waves. The first lesson largely revisited what the students had learnt before about amplitude and frequency, establishing that amplitude relates to volume and the distance particles move from their equilibrium position and frequency relates to pitch and the speed with which the particles oscillate. The lesson ended with a discussion about the range of frequencies that humans can hear and why sound cannot travel through a vacuum.

The second lesson introduced the difference between a transverse wave and a longitudinal wave (sound waves are longitudinal). Again this was largely revisited work done previously by the students. Amplitude and frequency are revisited in the context of a longitudinal wave and students are introduced to an equation about how to measure the wavelength and speed of a sound wave.

During the third lesson, the students continue work on calculating wavelength before going outside to carry out an experiment to measure the speed of sound. When they return to the classroom they use an equation to calculate the speed of sound based on the results from their experiment. The lesson ends with a discussion about reliability and true value.

In the final lesson, the students discuss the accuracy of their data – focusing especially on accuracy versus precision and the possibility of systematic errors. They then complete some practice exam papers where they must draw and analyse graphs accurately (see extracts from this test - which I also completed - in Appendix 14).

4.5 Analysis of data

I analysed the data as set out in Chapter Three, drawing on the theoretical frameworks of ‘knowledge, knower and knowing’ derived from Hoadley (2011) and Winch’s (2013) two types of ‘know-how’ knowledge. Figure 3.7 and the accompanying text sets out and explains the five iterations of the coding used to analyse the physics data. I found this data the hardest to code but the process also led me to revisit Winch (2013) and to separate propositional knowledge and inferential ‘know how’ knowledge more formally which helped me to make sense of Robert’s knowledge about physics.

Figure 4.4 The coding used for the physics data

Knowledge: *What* is to be taught?
Propositional knowledge (‘know that’): core knowledge (including mathematics); terminology Inferential ‘know how’: narratives; connections and sequencing; contexts and models Procedural ‘know how’: what *is* scientific knowledge; the skills of a good physicist Progression
Knowers: Who are the *learners* and what are their needs?
Sticky misconceptions and deep understanding Familiar to strange and the role of narrative
Knowing: What does the *learning* look like?
The role of dialogue Assessment Experiential learning

4.6 Knowledge: *what* is being taught?

This section explores Robert’s understanding of the knowledge of school physics, including propositional knowledge and Winch’s (2013) two types of ‘know how’ knowledge. It ends by considering how Robert conceptualises progression in school physics.

4.6.1 Propositional knowledge ('know that'): core knowledge and terminology

i. Core knowledge

The core knowledge for this sequence was dictated by the specification of the awarding body, Edexcel (see Figure 4.5). Robert covered all the content listed except those statements that I have italicised which he either did not cover or mentioned only once (in relation to an echo). In the next section I will question whether any knowledge in physics could be described as 'stand-alone' knowledge but in so far as the specification provides a list of things to be taught, clearly Robert had to design lessons that 'covered' these things. He was also clear that there were concepts that the students had to 'get' in order to move to the next stage. There were several examples of this in both the lessons and the interviews. In Lesson Two, after starting the lesson with a brief student-friendly clip about transverse and longitudinal waves, Robert asked the students if they had done this before. When they replied yes, he said that 'today need to be on top of it' (PL2/2). There is quite a of repetition built into the physics curriculum at the school and this quotation hints at the reasons Robert subsequently gave in an interview: that physics is hard and revisiting concepts makes it more likely that students will understand them eventually. I will say more about this when I explore progression later but for now, it is enough to point out that although these students had been taught much of the content of lessons one and two before, they now needed to be 'all over' it to quote Robert again (PI4/5). If they were not, the quantitative material to come in lessons three and four would have no qualitative foundation.

Figure 4.5 Core and supplementary content for the Edexcel IGCSE physics course to be examined in summer 2017 (Edexcel, 2013, my italics)

Core	**Supplementary**
• Describe the production of sound by vibrating sources • Describe the longitudinal nature of soundwaves • State that the approximate range of audible frequencies for a healthy human ear is 20Hz to 20,000 Hz • *Show an understanding of the term ultrasound* • Show an understanding that a medium is needed to transmit sound waves • Describe an experiment to determine the speed of sound in air • Relate the loudness and pitch of sound waves to amplitude and frequency • *Describe how the reflection of sound may produce an echo*	• Describe compression and rarefaction • *State typical values of the speed of sound in gases, liquids and solids*

Robert used the expression ‘to hammer it in’ twice in the interviews to reinforce this idea that there are moments when it is crucial for students to understand a piece of core knowledge. By the end of the sequence he was happy that all the students did understand longitudinal waves (‘I think they were very secure in that’ PI4/7) and mainly understood volume (amplitude) and frequency (pitch):

> Yeah, broadly they’re on top of the work. One or two of them still confuse pitch and amplitude, but more of the students were correcting each other on that. They seemed much more on top of it than perhaps they would have beforehand. Where I expected trouble, and there was, was the experiment on the speed of sound where they have to draw a graph, and measure the slope of the graph, which they didn’t get. That’s not actually to do with the sound, because I’m going to do the same experiment - the same graphical technique with them this week (PI4/7)

Overall, then, Robert was happy that they had understood the core knowledge about sound reasonably well.

Another way to analyse what Robert perceived to be core knowledge was by looking at what students had to copy into their books during the first two lessons. I have summarised this in Figure 4.6. Note that Robert wrote other things on the board during all four lessons but these were more spontaneous in the course of discussion and there was no explicit instruction to copy these down.

Figure 4.6 Information that students copied into their books during the sequence

Lesson One	*Amplitude is how far you displace an object. The louder the sound the bigger the AMPLITUDE* *The frequency/pitch is not how far we move it but how fast we move it.* *Frequency in hertz (Hz)*
Lesson Two	*<u>Two types of wave travel</u>* • *Particles in a medium vibrate about their mean position, transferring energy but not matter* • *Longitudinal wave – vibrate along the direction of energy transfer* • *Transverse wave – vibration perpendicular to the direction of energy transfer* *<u>Longitudinal waves</u>* • *Can be thought of as 'density waves' in a material medium (solid, liquid or gas)* • *AKA 'pressure' or 'compression' waves because <u>compressions</u> alternate with <u>rarefactions.</u>* • *Slinky spring* • *Experiment <u>waves along a line of students</u>* *<u>Wave speed</u>* • *<u>Distance</u> wave travels in a second (m/s)* • *= wavelength (m) x number of waves in a second (s)* • *In symbols, $v = f\lambda$* • *To find the speed of sound, measure a distance and a time.* • *Speed of sound in a solid > speed in a liquid > speed in a gas* • *Medium, not source, generally determines wave speed*

We can infer from Figure 4.6 that there were four crucial dimensions of core knowledge that Robert wanted his students to understand:

1. What amplitude and pitch mean
2. The role of particles in sound waves
3. The difference between transverse and longitudinal waves

4. How to measure sound waves and the speed of sound mathematically

In the next section I will explore in much more detail how this knowledge depended on students connecting many concepts together.

A final aspect of core knowledge I will mention here is mathematics. In Robert's sequence, the students used two equations, one to calculate the speed of a wave ($v = f\lambda$) (which can also be expressed as $v = d/t$) and one to calculate the frequency of sound waves (f=1/time period). They also interpreted and drew their own graphs. In the student interviews, the students were divided about the place of mathematics in physics. One student was particularly vehement in her dislike of equations - 'I have never understand them [equations] – I always rearrange them wrong…I'm really bad at maths. It's the maths rather than the physics' – whereas another likes the fact that you simply learn the equations and then apply them in the exam. Notwithstanding students' varied views about it, part of the core knowledge of physics is its mathematical content.

Finally, how fixed is this core content according to Robert? Robert agreed that there are 'big ideas' in physics that are a given – 'you can't do a physics course without knowing about electricity at some point, it wouldn't be possible' (PI1/5) – but argued that whilst the content is 'always the same', the concepts are not:

> So everybody would do electricity, but within electricity the degree of difficulty within each and the number of concepts themselves would vary. So for example, a certain group say look I agree that everybody should do electricity, so we might all agree that at this stage they should know about this, this and this. But some people and I have noticed… some people would say that also by then they should know about these. And the reason they do that sometimes is that they haven't actually thought it through. I'm not saying I'm right and they are wrong, but what I am saying is that they have it as a stamp collecting exercise. (PI1/6)

Here, Robert explained that within the topic of electricity- which would appear on virtually any programme of physics - the concepts within that topic may vary. Some concepts will be relatively basic and form part of the 'core knowledge' of electricity and others will be more advanced. Robert suggests that some people lose sight of the 'important things…what is really important…..and what happens is as you get further into the exam world, this underpinning big idea gets shrouded in mist and actually it is quite easy as a teacher to get sucked in…..' (PI1/6). In other words, Robert was suggesting that some teachers teach a larger number of concepts than is necessary to gain understanding of the 'big ideas'. Thus, whilst the big ideas themselves are fairly constant across curricula, there are a range of concepts within each one that teachers can choose to teach. There is a slight confusion in the terminology used here as Robert uses 'content' in this extract as synonymous with 'big ideas' and 'concepts' as separate from them whereas elsewhere in the interviews, 'concepts' and 'big ideas' are coupled together. This lack of clarity about the terminology used to describe the physics curriculum was also evident in the literature.

ii. Terminology

Like Sarah in geography, an important part of the core knowledge of the physics sequence was understanding and using specialist terminology correctly and precisely. Figure 4.7 summarises the different kind of terminology that Robert used or introduced during the sequence. Only two words appeared entirely new to students – 'lambda' and 'oscilloscope' - though some words seemed less familiar than others and would not have been used often in previous lessons. As you can see, many of the terms in the first column were either relatively unfamiliar or new whereas the terms in the middle and right-hand column – relating to mathematics and experiments – were much more familiar. Robert's main focus was therefore on the physics-specific terminology relating to sound waves.

Figure 4.7 The specialist terminology used in the sequence (new words in bold, less familiar words in italics, familiar words in normal font)

Physics specific terminology	Mathematical terminology	'Procedural' terminology (related to analysing and writing up experiments)
Amplitude	Graph	Anomaly/anomalous
Frequency	Average	Reliable
Hertz	Equation	Precision
Transverse wave	Y axis/X axis	Accuracy
Longitudinal wave	Decimal	True value
Compression	Units	Systematic error
Rarefaction	Millisecond	Significant Figures
Energy/energy transfer		

Particles *Displace* Velocity **Lambda** *Wavelength* **Oscilloscope** Vibration/vibrating Energy/*energy transfer*		

Robert used two pedagogic techniques to embed familiarity with and understanding of this terminology. First, several of the terms can be found in Figure 4.6, meaning that they were copied into students' books. Second, Robert emphasised certain terminology at certain times and modelled how the students should be using it, for example in Lesson Two when the class was discussing the movement of a longitudinal wave shown on the IWB (interactive whiteboard):

> TQ – so – even though the particles are joggling backwards and forwards, what is shifting towards the door?
>
> SA – energy
>
> TE – **energy is transferred by the wave.** It's happening right now – **energy is being transferred by particles** from my voice box to your eardrums which is why if we pumped all the air out of the room, we wouldn't be able to hear any sound – no air particles to carry them (my emphases) (PL2/3)

In the interview focusing on this lesson, Robert described this as an example of 'talking in bold' (hence my emboldening of the text):

> *I was just conscious that at certain times you get the right answer from a student, but you repeat it using exactly the phrase you want them to be using. Does that make sense?*
>
> Yes.
>
> *So, they've said energy here, and you've said yes, energy is transferred by the wave. So, presumably that's because you want them to be precise in the way they...*
>
> Yeah, and that's mindful of the exam as well, but it's also just modelling. So I'm taking what they've said, and it's good and I want to reward them by using that again, but also some of them didn't always hear what they say, so you just sort

> of - so that's right - energy - you're correct - energy is being transferred by the wave. If you listen back, **I probably did say that in bold,** if you want to know what I mean; pause and sort of louder. (PI3/8, my emphasis)

Another example of Robert modelling the correct use of terminology also appeared in Lesson 2:

> TQ: Are you happy about how to make a loud wave? What did you do?
>
> SA – moved it harder
>
> TE – displaced, moved it further away.
>
> (PL2/5)

Here 'displaced' it is the more precise term to use in this example and Robert took the opportunity to model it. Of even more significance is the following example from Lesson One where Robert takes the opportunity to be more precise about 'air' after the 'wobble board' activity:

> TQ: What did people nearby feel?
>
> PA: air moving
>
> TS: yes, **air particles moving**. That gives a sign that something is carrying the sound – looks like it's to do with the **air particles**. (my emphases)
>
> (PL1/3)

By rephrasing 'air' as 'air particles', Robert is providing more precise terminology as well as reinforcing core knowledge about the big idea of particles. Across the sequence as a whole, Robert used the following core terms multiple times either verbally or in writing on a slide: amplitude 23 times, frequency 35 times and longitudinal 10 times. These multiple references would help to embed the proper usage of these terms in students' minds, especially as some (e.g. frequency) have everyday meanings which can get in the way of their understanding in the more specialised context of physics.

4.6.2 Inferential 'knowledge how': connections and sequencing, context and models

i. Sequencing and connections

In answer to my question about what a Year 11 student would ideally understand about physics, Robert quickly identified the importance of making connections: 'They would start to link together how the concept in this links with the concept over here. Because in some ways physics is a kind of 400 year success story in reductionism (I1/6).' Later in the same interview, he identified the single big idea that underpins everything else in physics: 'For me, if they could just leave understanding the whole world is made of particles and how they move and interact pretty much defines everything, then that would be enough' (PI1/6). In a subsequent interview, Robert talked about 'four or five key concepts that underpin everything, like cells, energy and interdependence'. The two specific key concepts underpinning the sequence were energy and particles:

> … everything's about energy being moved - everything we see on the microscopic - the air currents in this room, the temperature in this room is determined by the behaviour of particles at the microscopic level. So if I can keep saying in terms of the particles then that helps as we start to draw it all together at the end, kind of thing, because I'm consistently talking about those key words. (PI3/8)

Robert mentioned particles 17 times across the sequence, even though he wasn't teaching about particles explicitly but only in relation to the concept of soundwaves. What was especially interesting in terms of connections (and sequencing) were the assumptions Robert made about what the students already knew and understood about particles before he started teaching the sequence and what explicit connections he chose to make in the lessons. In terms of prior knowledge, it was assumed that students already understood:

What a particle is

That particles are in the air

That particles can move quickly/slowly

That sounds are caused by vibrating particles

That there are no air particles in a vacuum

That particles are very close together in a solid and less close together in a liquid

Without this underpinning knowledge, explaining how sounds get louder/quieter and higher/lower and understanding how sounds move would be difficult. Sounds are made when a source of energy (e.g. the banging of a drum or a human voice) causes particles to vibrate. The quicker they vibrate, the higher the frequency (pitch) and vice versa; the further apart they are displaced, the bigger the amplitude (volume) and again, vice versa. Fundamental to understanding this is understanding that the world is made of particles. While Robert assumed much of this knowledge and certainly did not explicitly teach the students about 'particles', he did help students make the connections with prior knowledge at various points in the sequence and I will illustrate this with an example from Lesson One:

> TQ: The last bit today – how do we get sound from one place to another? You should have done this in year nine but some of you may not have done. Sound

is special – remember the wobble board – what did you feel? Wind – air particles. What happens if you take the air particles away?

PA: No sound

TS: Right, no sound – so sound cannot travel through a vacuum but can travel though any material medium- solids, liquids and gasses.

With one small group:

TQ: How do we know that sound travels through water?

PA: Dolphins and whales

TQ: And how do we know it travels through a solid?

PA: Don't know. Can't get inside a solid!

TQ: Have you been in a tube train? How do you know a train is coming? Sound travels down the tracks – sound actually travels faster through a solid than liquid because particles are closer to each other in a solid.

(PL1/7)

The first part of this extract refers to why sound cannot travel through a vacuum and only made sense if students had a good understanding that gas (including air) is made of particles and vacuums are an environment where all particles are removed. The second part relied on prior knowledge about the spacing of particles in different materials which explains why sound travels faster in a solid than in either liquid or gas because particles are closer together.

The importance of this underpinning knowledge about particles suggests that the sequencing of knowledge matters in physics. This sequencing operates on a number of levels: within individual lessons, within a series of lessons, within a whole topic and across a key stage and beyond. I am not talking here about complete predictability in physics curricula which Yates and Millar (2016) have shown not to be possible. However, the extent to which connections between concepts can be made is key to understanding and making progress in physics and this relates to the order in which things are taught. Again, it would be a mistake to be too dogmatic about this: the specification that Robert was teaching (see Figure 6.2) lists light waves before sound waves but Robert starts with sound because students find it easier. He also moves 'energy resources and energy transfers' before 'waves'. However, as we have seen, although the precise order of light waves and sound waves may not matter, it was important that students knew about particles before they could understand what waves are and how they behave. Beyond particles and energy – which underpin everything – there are other examples of how the sequencing of topics can matter. For the only time in my data analysis, I have returned to my pilot data here so that I can compare two different approaches to sequencing topics at key stage 4 (see Figure 4.8).

Figure 4.8 Two approaches to sequencing knowledge at GCSE

The order of topics taught at GCSE physics in my pilot data	The order of topics taught at IGCSE physics in my case study data
Energy Electricity and circuits Forces and motion The particle model Nuclear physics Electricity and magnetism Waves Space	Forces and motion Energy resources and energy transfer Electricity (mainly circuits) Solids, liquids and gases (in effect the particle model). Waves Magnetism and electromagnetism Radioactivity and particles (nuclear physics) Astrophysics (space)

In the case of Mark (from the pilot study), there were clear reasons behind the sequencing of every topic which connected to the prior knowledge required (and note that basic knowledge of particles would be assumed from key stage 3). For example, Mark suggests that the topic of forces and motion lays important groundwork for later topics such as the particle model (because students need to understand pressure) and electro-magnetism (because students needs to understand that mixing electricity and magnetism together exerts a force) so its position in Year 10 makes sense. The particle model itself (also taught in Year 10) is necessary in order to understand nuclear physics in Year 11 whilst space, taught at the very end of the course, builds on the topic of waves. In addition to the conceptual logic behind the sequencing, there was also a pragmatic reason about the relative difficulty of different topics – for example, circuits are an easier aspect of electricity than magnetism. Robert agrees with Mark's reasoning and emphasises the underpinning big ideas first identified in the report 'Beyond 2000' (Millar and Osborne, 1998) for the revision of the science curriculum from early years to key stage 5 which included, for physics, particles, forces and energy.

Robert's GCSE curriculum is broadly similar to Mark's, with these three underpinning 'big ideas' appearing early on, together with electricity. However they teach 'waves' and nuclear physics in a slightly different order.

Within the topics, whilst there is a degree of logical sequencing (e.g. momentum comes last within the topic of force because it draws different aspects of the topic together) this is not rigid. As we have seen, Robert did not follow the ordering recommended by Edexcel (light waves before sound waves). Robert described the overall logic of the sequence as moving from qualitative to quantitative dimensions, that is, from understanding what is going on with waves to understanding how to describe this mathematically, a key difference between physics at key stage 3 and 4. In the fourth interview, he explained why introducing the experiment to measure the speed of sound would not have worked sooner in the sequence:

> I couldn't do the speed of sound earlier, because I want to do the other speed of a wave calculations to get them to think a bit more about being in a calculation mode rather than just a sort of write down facts about it - qualitative. At Year 11 they need to be doing it quantitatively - not qualitatively. The qualitative work needs to be much more detailed about what the individual things are doing at the microscopic level rather than the room level.
>
> *So, if you'd switched those two around, how might that have affected their understanding?*
>
> I think if you put it the other way around I think doing the experiment would have interrupted the flow of moving in this kind of cognitive progression from the easier to the harder. So I did that first, and then we did the context. Otherwise, it would have broken it up, and it might have caused more confusion. So I wanted it at the end, really. It fits better, I think. It just fits better. Otherwise it breaks up the flow of what they're doing. (PI4/6)

The phrase 'cognitive progression' is interesting here, referring to the students moving through concepts that become progressively more complex until they move into 'a calculation mode'. This idea of each phase of the sequence building on the previous one recurs in the interviews as illustrated in Figure 4.9.

Figure 4.9 Reasons given by Robert for the order in which the sequence was taught (my emphases)

Content	**Reasons given by Robert in interview four (PI4/5)**
How do sounds get louder/quieter and higher/lower? (Lesson 1)	Well, the first thing is, I think they need to be clear about bringing what they've already done up to a level where it's at the forefront of their mind and at their fingertips to use, because they've done it a couple of years ago….so that's the first thing. So we have to go back to what sound is, and then we need to re-secure about

	some of the basic terms, because we're going to go places with those terms, like amplitude and frequency and pitch and so on, and what a vibration is.
How do sounds move? (Lesson 1)	They need to be all over the fact that sound is vibration before they can go with some more complex things
What kind of wave is sound? How can we measure the length of a longitudinal wave? (Lessons 2 and 3)	Then we need to move to the more abstract world of waves which will come up again and again and again later on. So we need to think, well what is a wave - what makes a wave behave like it does - what makes sound a wave, and how do you link the abstract concept of a wave to the concrete example of sound? So, in a wave we've got this; what's that in a sound? It's how far the particles are moving, or it's what the pitch of a sound is, or it's the - which means that when we go onto other things about waves - more general things, they've actually covered it twice
How do we calculate the speed of sound and what experiment can we use to do this? (Lessons 3 and 4)	Then we move to quantitative as well as the abstract because they need to calculate the speed of sound. Then there's also the contextual thing which is that the speed of sound is an experiment, because a lot of the things we've done at that pink sheet is not about the speed of sound; it's about doing good experimental work. So how do you trust your data - if you can't trust your data what can you do to improve the data? How much can you not trust your data, and how does that affect how far your answer is from the true value?

Not only do these extracts demonstrate Robert's deliberate sequencing of concepts, it also demonstrates the principle of revisiting knowledge which he builds into the curriculum so that students have an opportunity to develop deep understanding of complex ideas.

ii. Contexts and models

In answer to my question about the characteristics of a superb physicist, Robert answered 'that they can apply it [their understanding] in context' (PI2/6)). As an example he refers to giving one pair of students a metal rather than a plastic slinky:

> That's why I gave the girls at the back the metal thing; Rebecca's very smart, and I wanted to see if she could think about why it [sound] might travel faster through a solid, and so on, and how that model applies to that. So, it's always about, can they apply their knowledge in a new context without going, but we haven't done

> solids, or we haven't done ice skates, or whatever it is. That's always the key sort of litmus thing about whether they've got it (PI2/6).

Another example of applying knowledge in different contexts was the test paper at the end of the sequence which asked the students to comment on an experiment to calculate the speed of sound – using a hammer, a metal block, a microphone and a timer – which was different to the experiment they had conducted as part of the sequence, using a trundle wheel, a stopwatch and some blocks of wood outside. The principles of measuring the speed of sound were the same – and incidentally required students to understand that light travels faster than sound – but the context was different. Robert suggested that students are not generally very good at this ('The research evidence is that that is not something done well by most students and only the more able ones can do it well', PI4/3) and to help them he used familiar contexts first. For example, he used the context of keyboards (Middle C) and surfing (as examples of waves). In an interview, he told me how he uses someone's birthday to note that they have 'completed another orbit' (PI1/3).

These are good examples of how Robert tries to apply the concepts of physics to the everyday world and the students appreciate this. In answer to my question 'what do you like about physics?', one student told me 'It relates to the real world – you can apply it anywhere. Like sound – you can apply that when you're out and about. You can't really do that with chemistry.' Not surprisingly, then, on the departmental publicity flyer used to outline why students should choose A Level physics (Appendix 13), the range of contexts 'that link physics to everyday life' including 'sport, food industry, archaeology, telecommunications, building design and astronomy' are highlighted.

I sometimes found it hard to distinguish between a context and a model when analysing the sequence. Models are what physicists create and use to represent abstract phenomena in the world. We cannot see particles, energy, waves or magnetism so we need models to represent what they are and what they do. Robert used many models in the sequence including the 'wobble boards', tuning forks, Mexican waves, slinkies and animations on the IWB. I have categorised models as a form of inferential 'know how' knowledge because their explanatory power rests on a connection to be made between the model and the actual phenomenon. Unless this connection is made, the model cannot provide the kind of understanding that can then be applied across other contexts. In this sense, the models provide the means by which a qualitative understanding of physics concepts can be developed and applied beyond the model itself across a variety of contexts. However, the contexts may themselves be models. For example, the tuning forks helped to model the vibration of air particles and this understanding was later applied to the wobble boards and their demonstration of the effect of quick/slow and large/small movements on the sound produced. Robert emphasised the importance of understanding basic models and warned of the problem when undergraduates (and future physics teachers) move onto more complex models without it: 'The trouble in practice is that the second year undergraduate hasn't actually grasped the basic model. It's just that they solved the equation and it is done but to ask them to explain it to a 12 year old…' (PI1/7).

4.6.3 Practical 'knowledge how': what *is* scientific knowledge and the skills of a good physicist

i. What *is* scientific knowledge?

Writing in the Guardian, Osborne and Millar (2007) argued that:

> 'School science has consistently failed to give its students any acceptable knowledge of how we know what we know and how to begin to assess the claims which science advances.'

What is interesting about the case study is that Robert has a social realist view of knowledge – that it is simply the best we have at any given point but it is fallible – and is sceptical about scientific 'truth' - 'we are just guessing really' (I4/16) – but it was not clear how far this affects his teaching. His own understanding of the nature of knowledge in physics was very sophisticated:

> People like Einstein really struggled with this search for the truth, in that is there something we can - and other people were like, no there isn't - it's just our least worst guess at the moment. It's not like we can sort of, oh no there it is - that's it - that solves everything. It's a different sort of thing. You know? It's more like, this is what we have in the world - we can use these models and these explanations - they tell us how it will do things. That's been successful, because it's allowed us to predict this or make this or do that, rather than a kind of narrowing hunt for the [truth]. (PI4/9)

Here, Robert talked about models as a substitute for truth, a point he elucidated later in the interview as I pressed him on the notion of physicists seeking truths:

> *Don't physicists spend quite a lot of their time trying to refine and prove?*
>
> Yeah, but that's what I'm saying; there's a difference...
>
> *Isn't that trying to get closer to...*
>
> No, that's about improving the model. That's not necessarily the same as seeking a truth, as in the true thing is that. (PI4/10)

Understanding that models are not 'the thing itself' is an idea that some (e.g. Hardman, 2017) believe should be better understood by students. There are things that models cannot explain and there are ways that the models evolve and change over time but at no point can we equate models with 'truth', not least because as we saw earlier in the chapter, notions of truth and a definitive underlying order to the universe are themselves open to question.

Robert says at one point that 'the quest for the truth is quite interesting – but that's a bit deep though probably isn't it, at this level?' (PI4/9). Whilst this suggests that perhaps this dimension does not play a significant role in his teaching, in an earlier interview, he defined 'thinking like a physicist' as partly recognising 'the limits of what we know' alongside a scepticism 'about daily stuff' (PI1/14). However, it seems likely that he pursues this through the practice of physics itself (i.e. through experiments- see the next section on skills) rather than through explicit conversations with students about the limits of truth.

In Interview Three, Robert acknowledged the limitations of surfing as a model for sound waves but also explained why he didn't raise this with the class: 'No, because that would have been more confusing to about half of them. **If you're not careful they won't get the original thing you want them to do**' (PI3/4, my emphasis). The emboldened text is revealing here and poses a serious question about the extent to which it is possible for students to access complex ideas about the nature and limitation of knowledge alongside gaining and understanding that knowledge in the first place. I quoted Hardman (2017) earlier in this chapter and it is worth repeating here:

> 'If we wish to present an authentic view of science in the science classroom, then we cannot let students believe that science is the progression of increasingly accurate models, approaching the truth of the world. However, it may not be wise to fully expose young scientists to what Feyerabend (1975) calls the 'anarchy' of scientific method: scientists use whatever methods they need to advance science.' (p. 93.)

Here, Hardman acknowledges a tension between 'authenticity' and 'anarchy' which has implications for the realisation of an F3 curriculum (Young and Muller, 2010).

ii. The skills of a good physicist

Whilst discussions about the nature of scientific knowledge and the limits of truth did not appear to play a major role in Robert's teaching, he was committed to enabling students to understand physics' distinctive epistemology which he described as 'This is what we've seen happens, and this is how we think it works. Rather than it being, this is the truth' (PI4/9). This more experimental dimension of 'what we've seen happen' and therefore 'this is how we think it works' was certainly evident in the sequence, from wobble boards and tuning forks to measuring the speed of sound. Robert did not attempt only to 'transmit' knowledge; he sought to demonstrate or allow students to experience different models from which they all constructed knowledge together. In defining enquiry, Robert provided an expansive account of the skills he wants his students to develop:

> It's [enquiry is] about trying to make sense of the world - how the world works. It's about **asking questions**, but by asking questions scientifically there are certain rules you have….in order to actually put our hand on our heart honestly and say, we can trust the results we've got as a result of our questions. So if I want to know something simple - does a hot tennis ball bounce higher than a cold tennis ball? - …… I better make damned sure I **don't change anything else** apart from the temperature of the ball, or else I can't tell…..So it's about **evidence** without proof, rather than proof without evidence….in science we can't prove anything, but at the minute this model still works, because it explains this and this and this, and when we tweaked it a bit we could also explain that. The next question is; can we explain this over here? So, what would that mean? Well, that means we'd need to **measure** that, and if you're going to measure that we need to keep all this the same, and we need to make sure that we've got enough **reliable data**, and is there any **bias** in there - is there a **systematic error** - is there something we've forgotten? It could be that our experiment was right, but our theory is wrong, because in this experiment there's something else we need to consider which we didn't even know about before. (PI4/15-16, my emphases)

I have emboldened the specific skills mentioned in this extract. Examples of most of these skills can be found during the sequence and especially in the experiment to calculate the speed of sound. In Lesson Three, Robert emphasised that this was 'one of the most unreliable experiments in the whole of science…so we need to repeat it' (PL3/7). After the students used the data they collected outside to calculate the speed of sound, he provided the correct Figure (330m/s) and praised those students who were within 10 per cent of the true value. He ended the lesson by suggesting ways they could improve the experiment, for example by filming it to remove their reaction time.

In the interviews, Robert often referred to the problem of bias in experiments and the danger of students repeating them until the results confirm their misconceptions. This potential manipulation of evidence is equivalent to 'source mining' in history, where historians hunt for the evidence to support their hypothesis, so it was interesting to see it raised in physics and it was a helpful illustration of why knowing about (and being able to implement in practice) the ideas of variables, bias, reliability, systematic errors and so forth is such an important feature of school physics.

In addition to these skills were the skills of mathematics as identified in section 4.6.1. Good physicists need to be comfortable with handling numerical data and equations. In this sequence alone, students were required to be familiar with different units (and converting one unit to another), graphs and applying formulae.

Overall, Robert appears to engage explicitly with some of the principles of NOS (which I have emboldened below) more than others:

- **Distinction of observation and inference**
- **Empirical basis of science**
- The theory-ladeness and subjectivity of knowledge in science
- **Science as a human enterprise** and
- The tentativeness of scientific knowledge

(Duit et al, 2014, p. 438, my emphases)

4.6.4 Progression

Taken as a whole, the data from my case study suggests that the following features characterise what 'getting better at physics' looks like for Robert:

- Knowing about and understanding increasingly sophisticated concepts (via models)
- Connecting concepts together and relating these to physics' 'big ideas'
- Applying understanding across an increasingly diverse range of familiar and unfamiliar contexts
- Refining approaches to data gathering and analysis
- Applying increasingly sophisticated mathematics

As is the case with the other subjects, the extent to which Robert's students achieve these aims is beyond the scope of this thesis. However, there was evidence from the sequence itself that Robert was structuring his teaching to enable this kind of progression to take place. This has the potential to provide a route to epistemic ascent: Robert enabled his students to develop conceptual understandings and to make connections between them in ways that allowed them to apply their understanding in different contexts. Moreover, Robert provided opportunities for students to understand how we know what we know and how to critique experiments which produce apparently convincing data but which may be flawed. Whether he fully achieves an F3 curriculum is more debateable; his own understanding of the nature of scientific knowledge is very sophisticated but it is not clear how far this does – or indeed can – inform school physics.

In terms of how Robert plans for the progression of his students, he talked in the first interview about physics as a 'spiral curriculum', a concept which built on Bruner's cognitive theory in the 1960s (Johnston, 2012). By this he meant that an opportunity to revisit topics was built into the curriculum so that at key stage 4, for example, there would be some repetition of material covered at key stage 3. This, Robert explained, was necessary because physics is difficult to understand and doing certain things twice makes it more likely that they will be understood: ‘So the point would be, when they did it in Year 8 or 9, they would have maybe half got on top of everything. Whereas, now I need everything at 110 per cent in order to go further, if you see what I mean’ (PI3/5). Robert stressed that in the revisiting stage, the original models become more complex rather than being discarded (as can sometimes happen in chemistry) and that students are taken further in their understanding. In this sequence, the students knew most of the content of lessons one and two (and indeed had already covered it twice before according to the students I interviewed) but were introduced to a small number of new ideas such as measuring the frequency of waves and the speed of sound and analysing the representations of sound produced by an oscilloscope.   Many of the demonstrations and experiments were also new.

There is nothing inherent within the knowledge structure of physics that makes the revisiting of content essential. The students had an interesting perspective on this which echoed Robert’s, suggesting that it is helpful to revisit content because ‘you might not understand it when you’re younger and it is good to consolidate it.’ It should be noted however that these students were very focused on doing well in their GCSE and revisiting was seen as useful mainly because before GCSE, ‘it doesn’t matter if you don’t understand it as well’ whereas now, it is useful to ‘go over what we did so we revise it better for GCSE’. However, when I asked them if they would have found the lessons tough without having done sound before, one of them answered that she ‘still would have understood it, would have had a crack at it.’

4.7 Knowers: who are the *learners* and what are their needs?

The concept of teachers as curriculum makers (Lambert and Biddulph, 2015) and the didactic triangle (Gericke et al, 2018), explored on pages 61-63, identify the students as equal in influence to the subject in terms of what is taught in schools. The relative absence of the students themselves in the social realist theory of powerful knowledge has been criticised as artificially separating curriculum and pedagogy (see pp. 42-43).

4.7.1 Sticky misconceptions and deep understanding

As I have already noted in this chapter, physics is known as a counter-intuitive subject where misconceptions amongst students are common. Robert referred to these as ‘sticky misconceptions’ (PI2/3) – misconceptions that stick around and are hard to shift unless explicitly addressed by the teacher. An example of this can be found in Lesson

Two when, following the surfing clip, Robert chose to dwell on a particular point about waves moving up and down. In a Mexican wave, for example, individuals simply move up and down even though the wave appears to move along. It is the same with water waves: '[surfers] are bobbing up and down on the water but if you're sitting on the beach the waves are coming towards you. You might think the surfers would be carried into each other but they bob up and down just like ducks on a pond. What causes the surfers to move forwards is tilting and falling down the wave' (PL2/2). I asked Robert about this in an interview:

> *So, the point here is about the movement...*
>
> Up and down, yeah. The particular misconception is that the pencil bobbing up and down will somehow make its way towards - now, the thing that causes that in a water wave is the fact that there's also a tide. That's a problem; the tide brings things in and out. (PI3/4)

In fact, as Robert acknowledges, – and as I will explore in the next section – the surfers in the sea are therefore quite a misleading model of sound waves but one that he anticipated and addressed in the lesson.

A further example Robert gave of a 'sticky misconception' is a tendency to confuse amplitude and frequency: 'so they think that if it's moving faster it's louder. It's not' (PI2/4). The way Robert approached these misconceptions is a good demonstration of Shulman's pedagogical content knowledge (1986), an important aspect of which is to be familiar with and therefore anticipate common misconceptions in your subject.

An important theme running through the interviews was the difference between being able to answer a question correctly – especially if it involves mathematics – and understanding why that is the right answer: '…especially if they're smart they sort of go….look I don't get that. I see that if I just use that formula I get the answer and that's what I have to do to get the marks so I will just do that. But they don't understand why' (PI1/8). The sequence, in moving from qualitative to quantitative understandings, is designed to avoid this, by ensuring that the students have grasped what a sound wave is, how it moves, how it becomes louder and higher and so on before the quantitative elements are introduced. The experiment outside was a tangible illustration of these qualitative understandings in that the students could see that sound does not reach you from a distance instantaneously: the process of particles vibrating and transferring energy takes some time.

However, the test paper at the end of the sequence dealt with sound on a more abstract level. Making sense of a graph which showed an oscilloscope trace produced by different kinds of sounds required, for example, memorisation that the height of a wave relates to amplitude (volume), that the distance between waves relates to frequency (pitch) and that the frequency of waves can be measured using the equation f=1/time period. It would be possible to answer these questions correctly without remembering or understanding much about the role of particles in energy transfer (see Figure 4.7). Connecting qualitative and quantitative understandings is challenging and Robert referred to this as 'deep understanding'. A lack of deep understanding is evident when students are asked to apply their knowledge to different contexts: if their understanding is superficial, they will find this very difficult to do. The following question on the test paper – which most students left out because it hadn't been covered properly yet – is an example of a question that requires more than memorisation or an understanding of formulae: 'A sound wave and a radio wave have the same wavelength. State why they have different frequencies'. This requires a deep understanding of the properties of different waves rather than the memorisation of an equation or rule. However as Figure 4.10 demonstrates, several of the questions on the test could be answered by remembering the quantitative rules rather than the qualitative understanding behind the rules.

Figure 4.10 The quantitative and qualitative understanding required for the end of unit test (see Appendix 14)

	What students needed to know – quantitative	**What qualitative understanding could be helpful**
Select the graph (out of four) that shows the trace for the loudest sound at the lowest frequency	The louder the sound, the higher the wave looks on the graph. The further apart the waves on the graph, the lower the pitch of the sound Frequency is related to distance between the waves.	Not essential but could be helpful to know that volume/loudness = amplitude as this may be how they were taught it. Similarly, that pitch = frequency. This could be linked to wobble boards – the bigger the arm movements, the louder the sound (represented by higher waves) and the faster the arm movements, the higher the sound (represented by waves close together). This only makes sense in the context of particles – particles moving fast/slow and displaced far or not. None of

		this essential to answer the question.
Draw conclusions from experiment data and suggest ways to improve the experiment	How to plot a graph of distance against time and draw a line of best fit. Know and apply the equation to measure the speed of sound	Know how to improve the accuracy and precision of experiments. In order to do this, it would be helpful to know that sound travels more slowly than light because one way to improve the precision of the data would be increase the distance between the sight of a hammer banging a metal block you hearing it as this will reduce human reaction time as a proportion of the total time.
Measure the frequency of a sound wave on an oscilloscope	That waves shown this way need to be measured peak to peak or trough to trough to measure the time period and then calculate frequency. That you must observe the units shown (e.g. one square = 0.001s). How to calculate wave frequency.	Could be helpful to know that amplitude = volume and frequency = pitch
Describe how to measure the speed of sound outside	How to calculate the speed of sound mathematically – i.e. the equation. Understand that the distance over time is the key. Understand that light travels faster than sound	

Robert aims to use language in a way that keeps students' eyes on the bigger, fundamental ideas of physics. I have already explored how he introduced and reinforced key terminology and I have also emphasised the importance of making connections between concepts. Here, I want to say something briefly about how these two things come together, driven by Robert's understanding of his students and the ideas they are likely to find most challenging. In the first interview he used force as an example which I will quote here in full:

> If you take the concept of a force, the most common thing that people start doing is they start doing equations and things like that. So I always ask with all of them, whether they are undergraduates or postgraduates or whether they are Year 7 or Year 6, what is the force? And almost nobody can answer it. They try and you give all kind of psychological things going on where they try to say it's scientific and I need to give long words – it's an interaction between things that causes them to feel things. So I say, like love? Is that a force? And they're like… no.
>
> For example, if they could get the idea that a force is a push or a pull, that is pretty good up until about the third year of a Physics degree and then you might say – what other things that a force can do? Well a force can only do three things really. A force can change an object's shape, or its speed or its direction. And we use all kinds of words like twist or squash or speed up or slow down or stop, but actually what we are changing its speed or its shape or its direction. Now that kind of concept, if that could be parked with a big red flashing light around it in their brain, and we are talking about things like, what is the trolley doing, the trolley is speeding up. Okay, so it is changing its speed which means there must be a force acting on it because it is changing its shape, its speed or direction.
>
> **And so I keep driving them back to this basic concept through my use of language if you see what I mean**. By saying, okay. In other words, I have got this concept, I have got what they are seeing and I am trying to facilitate them making their own way back to it by saying, okay remember a force can change its shape, hold its shape, speed or direction?   They say yeah. So that means there is force acting on it? Yes, okay, because it's changing its speed. **So you are just sort of driving them back, rather than just learning a series of disparate kind of facts as they may do in a different subject**. (PI1/9)

Here, Robert explained how he uses particular language to emphasise the three things that force can do: change an object's shape, its speed or its direction. This is the 'basic concept' that Robert wants the students to remember and which will act as an overarching framework to help make sense of everything else they learn about forces and he 'drives them back' to this framework through his use of language. In the sequence he does this, as I have already noted, by his repetition of the 'basic concepts' of sound such as amplitude and vibrations. Robert wants his students to have a 'deep' understanding – and he has a deep understanding himself of what his students understand and don't understand.

4.7.2 Familiar to strange and the role of narrative

I have already noted the way that the contexts Robert provides in the lessons provided particular ways 'into' a topic that are accessible and here I want to invoke a phrase familiar to history educators to describe how this works. Robert starts the whole sequence with a 'familiar' context which, if not quite everyday, is one that is clearly rooted in the real world. The clip he begins the lesson with shows an owl in Canada who detects a lemming in the snow by hearing it rustling. Humans would not be able to hear the lemming but the owl's face acts as an amplifier or satellite dish and the feathers collect and channel sound inwards. The class discussion immediately proceeding the clip went like this:

> TQ: So even under the snow, the owl gets the sound. What was the owl doing – what was it listening for?
>
> PA: Rustling
>
> TQ: how has the owl adapted through evolution? What did it have?
>
> PA: a dish face
>
> TS: yes, a dish face, most were feathers and the actual face is quite small. And why two ears? What does that help it to do?
>
> PA: amplifies sound
>
> TS: no, the dish amplifies it, it's the stereo – we have it – it tells us where we are
>
> TQ: anyone seen bats like this? – we'll be looking at them later on – echo location.
>
> (PL1/1-2)

This clip provided a familiar entry point to an abstract idea, a context that requires physics to explain it. Incidentally, we can see how quickly Robert used the kind of terminology he wanted the students to be familiar with from the very beginning, especially amplifies and echo. It is only in the next two lessons that the contexts and models become more abstract, with representations of transverse and longitudinal waves on the IWB in Lesson Two and oscilloscope traces in Lesson Three. Starting with these more abstract or 'strange' contexts and models would have removed physics from the 'real world'. The same principle applied to the topic of waves as a whole as Robert chose sound as the 'entry point' to waves 'because it's possibly the least abstract of all the concepts and they've got experience of it' (PI4/9).

In a sense, there was also an underlying narrative in these lessons. The narrative started by looking at physics in action: how is an owl able to detect a lemming that is buried underneath snow? In other words, how does sound work? In order to answer that question, students needed to understand what sound *is,* which means thinking about particles and the different ways the sound energy causes them to vibrate. Once we can explain *what* is happening and *why* (which is essentially key stage 3 work) we need to describe what is happening mathematically through experiment and equations. This enables physicists to apply knowledge about sound to make predictions and design new things. Robert did not touch on the last aspect here and in that sense, it might be possible to say that the narrative didn't quite have an 'ending'. I also wouldn't want to make any claim that the students themselves were aware of the 'narrative'. But it struck me that the sequencing of the lessons and the content within the lessons were not only about understanding the physics but also told a story of sound in a way that made sense to young people.

4.8 Knowing: what does the *learning* look like?

The concept of curriculum making in geography as mapped out in Figure 2.4 (page 59) has as one of its central questions 'which learning activity?', a question which emerges from the coming together of teacher choices, student experiences and school geography. If we replace 'school geography' with 'school history' or 'school physics', the model is equally helpful as a way to conceptualise curriculum making in other subjects. One of the key choices teachers make when enacting a curriculum centres on activities and which ones are the most appropriate as a way of enabling and supporting learning. I have therefore included Hoadley's (2011) third category of 'knowing' here and interpreted this to refer to broad influences on pedagogy that influence the choice of teaching activity. This completes the triad of 'knowledge' 'knowers' and 'knowing'.

4.8.1 The role of dialogue

As with the other two subjects there was a strong role for dialogue in the sequence. The lessons were very interactive, with a total of 184 exchanges between Robert and the students. Many of these were quick factual exchanges relating to the answers on a test or the method of writing up experiments whilst others encouraged students to make connections or to make their use of language more precise. The proportion of time spent on teacher-pupil whole class interaction was very stable across the sequence (between 37 per cent and 45 per cent in each lesson) and if you include pupil-to-pupil talk, the overall time spent engaging in some form of dialogue was 67.7 per cent of the four lessons.

4.8.2 Assessment

It was not my preference to observe a Year 11 class but the structure of the science curriculum in most schools and the shortage of physics specialists means that they tend to be focused primarily on upper school teaching. Inevitably, this meant that the demands of the GCSE course were a significant influence on the lessons I observed, especially 'exam practice':

> The other thing 'as a teacher' is that how does the young person in front of me make the most effective use of their knowledge in such a way that they gain maximum credit from the examiner? They have to know their stuff, but they also have to be aware of the chicanery they will have to go through in order to demonstrate it. And that could be something as boring as what the command words in an exam paper mean. To understand how it works, you know. You have to kind of… it's a trade-off between the two isn't it? (PI1/4)

Robert's use of the word 'chicanery' struck me here, suggesting that students have to pretend or enter into some kind of deception to play the examiners' games. For Robert, he is balancing their understanding of the physics with the need to prepare them for the examination. This was most evident in the final lesson of the sequence when the students completed a 'pink sheet' (which they did for every key experiment required by the specification) and completed an informal test with mock GCSE questions on it. Completing the pink sheet required a very particular approach and Robert dwelt on terms such as accuracy, precision and systematic errors in some detail before saying to the students 'the reason I'm dragging this out is that every question on these pink sheets will require you to know this language' (PL4/3). Later he pointed out that 'in exams you need to add 'I measured the time with a stopwatch'. Too often people don't get credit because they miss obvious things- the examiner won't be as clever as you' (PL4/4). Towards the end of the lesson, Robert spent some time going over the graph that students drew as part of a test question and checking they knew how to get all five marks. He used the acronym 'SLAPU' – which students were familiar with – to ensure that students considered scale, line (of best fit), axes (are they labelled?), plotting (are points plotted correctly?) and units. Finally, he asked students to find the command language of a particular test question (which in this case was 'suggest') and clarified that this means there are lots of possible right answers. In the student interview, one student disliked experiments because of repetition, citing it as her least favourite aspect of physics: 'we do too many [experiments] and we've been doing the same ones since year 7. It gets really tiring and afterwards you have to say what do you have to do to make it a fair test because in the exam you have to know it'. There were some murmurs of agreement as she said this, with another student saying that although some practical elements were fun – such as the wobble boards – 'it's when you have to evaluate and explain all the obvious stuff – that's when it becomes laborious.'

The influence of the examination was less evident in the first three lessons and Robert did not comment in the interviews on the amount of content required by the specification. His context probably matters here: working in a selective private girls' school meant he taught mainly well motivated, hard-working and academically able students. While some may not like physics and find it harder than others (and certainly Robert was conscious of a range of attainment in his class), the majority of students were able to make quick progress in their learning. Reflective of this is the choice of an International GCSE course which is regarded as harder than a regular GCSE.

4.8.3 Experiential learning

Throughout the sequence there were opportunities for students to 'experience' phenomena through the use of different models. In his discussion of the 'Mexican wave' which the students did early in Lesson Two to model a transverse wave, Robert described it as 'a visceral experience' (PI3/3) and a different way to reinforce an idea. When I asked him why he went back to the Mexican wave analogy later in the lesson he explained:

> Yeah, because the key thing is; it's how far you move from where you start. So, if it's this vibrating, it's not this distance - it's this distance. So, with the Mexican wave, it's clear I've gone from this height to that one, and then back. So my displacement from where I started is this far. What would that look like? You've modelled that, so **you physically know** - well how far did I move? Well, if I was this one how far would I move? So that's the idea. It doesn't always work, but that's the plan. (PI3/10, my emphasis)

This connects back to the misconception I outlined earlier about a pencil being moved by waves in the sea when actually it is the tide that moves it. Individuals in the Mexican wave move up and down but not in the actual direction of the wave and this is what particles also do – they vibrate but it is the energy that moves along, not the particles themselves. Robert wanted the students to 'physically' know this, i.e. to experience it for themselves. In the lesson he told the students that 'people studying physics for a long time find this hard to visualise – it's why I'm spending time on it' (PL2/5).

Another very physical technique Robert used was the slinky activity which forced the students to 'actually think to do it':

> So they're putting themselves into the position of the wave, and having to do it, because it's not just when they do it right, but if they get it wrong they tend to feed back to themselves about how to correct it. So if I said, make a louder wave, and

> they made a higher-pitched wave, the others will go, no you need to move your hand like this. So it's a self-correcting kind of demo that they have to get right themselves by physically moving that, otherwise the wave doesn't do what they think. (PI4/1)

Here, Robert talked again about a physical dimension, this time combined with self or peer assessment and correction because mistakes are easy to physically see.

4.9 Summary

The most distinctive features of Robert's expertise were his understanding of the interconnectedness of physics knowledge, his anticipation and responsiveness to student misconceptions and his approach to making very abstract ideas more concrete for his students. The first of these, the interconnectedness of physics knowledge, was the strongest recurring theme throughout the interviews. Main (2014) suggests that:

> So many students see physics as a mess of disparate elements and miss completely its real beauty, which lies in its interconnectedness and the power and simplicity of its basic concepts. (pp. 47–48)

Robert's students are unlikely to see physics as 'a mess of disparate elements' given his commitment to emphasising a small number of underlying big ideas in physics and the way they interconnect which were evident in his practice.

Robert's responsiveness to student misconceptions echoes the emphasis placed on this within research traditions and connects with the third notable feature of his practice which was to make abstract ideas more 'real' through models and everyday examples. Of all the teachers in my research, Robert was the most aware of the precision of student understanding and the need to constantly assess and correct it throughout the sequence. This relates to physics' 'hierarchical structure' (Bernstein, 1999) and the need to understand a particular concept first before another can be accessed.

Running alongside this deep commitment to conceptual understanding was a commitment to exemplifying how we know this knowledge through multiple models and experiments. Robert wants his students to understand the epistemology (his word) of physics and to be able to evaluate their own data critically. He is less inclined to explore the limits of what we know, even though he is himself well versed in these debates.

One of the themes in the literature – the application of scientific knowledge within society – was less evident in my interviews with Robert. He does provide examples of how physics knowledge can be applied in the 'real world' but he did not talk about science's role and purpose in society explicitly. What he was clear about, however, was that physics does provide a distinctive way of thinking and the strong implication in the interviews was that this is valuable to young people.

Chapter 5 Geography

In this chapter I start by exploring what kind of knowledge geography is before providing a brief overview of the history of the subject in schools. I end this initial overview with some comments about current debates within geography education. I then introduce the case study and explain how I have analysed the data before spending the majority of the chapter outlining my findings.

5.1 What kind of knowledge is geography?

Morgan and Lambert (2005, p. 4) make clear that as an academic discipline, geography has a 'fragmented and contested nature'. This derives not only from the division between human and physical geography but also from the other disciplines with which human geographers engage. According to Biglan (1973), his three dimensions of subject matter across different academic areas (none of which included geography specifically) apply quite differently to disciplines related closely to geography, namely geology, anthropology, sociology and economics (see Figure 5.1).

Figure 5.1 Biglan's (1973) dimensions of disciplines which contribute to the field of geography

Biglan's three dimensions (1973)	Geology	Anthropology and sociology	Economics
Dimension 1: hard-soft	Hard	Soft	Soft
Dimension 2: pure-applied	Pure	Pure	Pure
Dimension 3: concern with living or organic objects of study	Unconcerned	Concerned	Unconcerned

Whilst all three disciplines are characterised as 'pure' (i.e. none is an example of applied knowledge), there are differences in the extent to which they represent 'hard' or 'soft' knowledge (this mainly relates to the difference between physical and human knowledge) and in the extent to which they are concerned with living objects of study. The omission of geography from Biglan's analysis offers some support to White's (2012) argument that geography does not offer a distinctive form of knowledge and is therefore a *field* rather than a *form* of knowledge because it draws from the physical and human sciences (which are forms of knowledge in their own right). Thus, geography is a 'hybrid' subject, created to help school students in the nineteenth century understand the physical and human world and the interactions between the two (Walford, 2001). The absence of a unifying epistemology in geography poses a challenge to social realist arguments defending the role of subjects because of their connections to an academic discipline with a clear epistemology. It also poses a challenge to geography educators attempting to pin down the unique characteristics of geographical knowledge *and understanding*. The current trend of academic geographers becoming increasingly specialised (urban geographers are being replaced by specialists in urban transport, immigration and so forth) makes it even harder to reach a simple definition of what academic geography is. There are distinctive and competing notions about 'how best to think geographically and how most effectively to research geographically' (Hubbard et al 2005 as cited in Firth, 2011, p. 298; see also Jackson, 2006 and Lambert, 2016). Becoming an academic geographer means choosing a disciplinary tradition and many will move between more than one:

> 'What is evident here is that geography and geographers are differentiated from the inside out and the difference between physical geography and human geography is a distinctive characteristic. Geography is a multi-paradigmatic discipline and geographers work with different concepts of scientific knowledge and its development,' (Firth 2011, p. 299).

Bonnett (2008) tackled the question of 'what is geography?' head on and concluded that 'geography is a wide subject matter and an equally wide constituency of contributors….to hear geography's story we must listen to voices from across the world and from many different intellectual traditions' (p. 121). He goes on to write:

> 'Its [geography's] wide sweep, its long history and its curiosity about the world outside the window, make geography an awkward discipline for the classroom or lecture theatre. Geography's difficult institutional history within academia indicates how hard it is to mould a non-specialist activity into something that resembles conventional specialisms.' (p. 122)

Bonnett's phrase 'an awkward discipline for the classroom' is an interesting one and I shall consider how far this is true in my case study.

5.2 Geography as a school subject

5.2.1 Historical context

Much of the historical context of school geography from the early twentieth century is provided in the next section as part of my focus on the relationship between school geography and academic geography. This brief section therefore simply notes how geography emerged as a school subject and university discipline in the 1800s and early 1900s.

Geography is not a discipline shaped by a long tradition; indeed it was not initially a discipline at all in the sense that its existence in schools predated its existence in universities (Walford, 2001). The Geographical Association was founded in 1897, two years before the first university department of geography was established at Oxford. In 1903, Mackinder, a prominent geographer of the time, urged other universities to follow suit which they slowly did. One of the main rationales for having university geography departments was the need to provide subject expertise to future geography school teachers.

There is evidence that the term geography denoted a specific 'subject' as early as the seventeenth century but it was only the 1840 Education Act that allowed 'modern' subjects such as geography (and history) to be taught in schools and even this did not apply to fee paying schools where the introduction of such subjects was often delayed (Walford, op. cit.). Geography has not historically enjoyed a high status as a school subject and Walford (op. cit.) has noted:

> For a long part of its history, geography was seen by many as a rather 'bread and butter' subject' it was recognised that a knowledge of its elements was needed by all as a part of general knowledge, but wasn't it mostly as a gazetteer of terrestrial bric-a-brac that could be safely dropped from study later? (p. 2)

Walford does go on to note, however, that the status of geography has more recently (Walford was writing in 2001) increased.

5.2.2 The relationship between school geography and academic geography

It is worth summarising some of the developments in academic geography in order to consider how far school geography does and should reflect recent trends in the discipline. I will, by necessity, do this in very broad terms, summarising further what others such as Morgan and Lambert (2005) and Walford (2001) have already attempted to summarise. The purpose of this section is therefore not to be definitive or comprehensive but rather to enable me to make some general points about how – and if – school geography responds to changes in the discipline of geography in universities. Broadly speaking, geography in its earliest incarnation in universities focused on regional geography but this emphasis shifted after the second world war towards a more scientific approach, with an emphasis on experimentation and quantification (and therefore an emphasis on generalizable patterns and trends – spatial science). From the 1950s and 60, there was a further shift in human geography away from spatial science and towards a greater focus on local and individual levels of analysis from which emerged an interest in a person's 'sense of place'. More recently, attention has also been focused on the political economy (as poverty and inequality have increased) whilst postmodern influences have focused on the identity of groups (e.g. women) who may be hidden in geographical representations. These last two trends are potentially in tension with one another: 'for some geographers what the cultural [or postmodern] turn represents is a loss of faith in the belief that there exists the possibility of a 'better world' (Morgan and Lambert, 2005, p. 17).

Physical geography has also changed over time. For example, from the late 1960s onwards, process studies have dominated geomorphology (i.e. a focus on how things happen rather than simply the stages of development) with techniques to study, for example, fluvial processes on hillslopes. These approaches are common in schools today but physical geographers in universities have also developed interests in the interaction of people and their environment (e.g. water quality and pollution) and pay greater attention to global issues, especially the environment. A greater focus on these particular issues at A Level was recommended in the ALCAB[8] report (ALCAB, 2014) suggesting that school geography had not kept up fully with the shifts in physical geography in universities.

The post-war trend in academia towards spatial science (and away from regional geography) did find its way into schools in the 1960s (Walford, 2001) because of the higher status accorded to more 'scientific' subjects. However, its appeal was limited and from the 1970s, comprehensivisation and a trend towards greater child centeredness led to more issues-based, diverse approaches. Schools' Council funding played a role here in opening up different approaches such as 'Geography for the Young School Leaver' created by Avery Hill College of Education targeted at 'lower ability' students who, after 1967, would be staying at school until the age of 16 (ibid.). The 1980s saw questions about geography's purpose come to the fore as the country

[8] ALCAB stands for A Level Content Advisory Board. These were established in mathematics, languages and geography to provide academics with a platform to advise the government on the forthcoming changes to A Level specifications.

underwent a period of profound social, economic and political change (e.g. the decline of industry, the growth of privatisation and free market economics and sharper social divisions). Schools were required to prepare children for the world of work which led to an emphasis on transferable skills (literacy, numeracy, problem solving), links with industry and a focus on the local area. Geography became a medium for other priorities as if teachers were permitted not to worry too much about geographical knowledge itself. The introduction of the National Curriculum in 1991 signalled a secure place for geography in the school curriculum but also appeared to rob geography of its radical edge. Factual knowledge was emphasised but was quite conservative and UK and western-centric. California, not China, was on the curriculum, as were the Falkland Islands and 'capes and bays' (the latter a topic that had taken fifty years to disestablish – see Morgan and Lambert, 2005; Walford, 2001). Subsequent revisions of the National Curriculum reduced the amount of factual knowledge required and by 2007, the curriculum emphasised overarching conceptual and procedural knowledge and allowed considerable freedom for teachers to choose the contexts in which to develop these types of knowledge. 2013 signalled an end to this freedom with a renewed emphasis on factual knowledge, though so few secondary schools are now obliged to follow the national curriculum that it is hard to say what impact it has had.

Thus, whilst there has been an overlap in trends across universities and schools, there are more examples of school geography dancing to a different tune of political expediency and social trends since the 1980s (Marsden, 1997). It was perhaps not surprising that school geography increasingly followed a different path given the decreasing involvement of academic geographers in school geography (see Marsden, 1997 and Butt and Collins, 2013) especially when, from the 1990s onwards, academics became more preoccupied with research outputs than in what was happening in schools (Walford, 2001). Consequently, there are plenty of examples where school geography curricula may not reflect current academic preoccupations. The concept of centrality, for example, still popular in schools, is not mentioned at all in a popular university geography textbook (Daniels et al, 2012 as cited in Maude, 2017). However, the emergence of A level content advisory boards (ALCAB) across geography, mathematics and modern foreign languages to inform the most recent revision of A Level specifications has offered some hope that connections between school subjects and academic disciplines have not been entirely lost. The report of the ALCAB panel on geography (ALCAB, 2014) identified content and concepts which are important in university geography but not necessarily in school geography, such as 'global systems and global governance; changing places; landscape systems; and water and carbon cycling' (p. 2) and 'representation, meaning and identity' (p. 6) and their recommendations were accepted by the government.

5.2.3 Student understanding of geography

Taylor (2013) has noted that there is a large body of research into children's understandings of geography but that it can be 'hard to find' (p. 306) because it is not always clearly located within the field of geography education but rather at the intersection of geography and psychology or sociology. Nevertheless, research about children's understanding of concrete and abstract substantive concepts exists, especially at the more scientific end of the spectrum of geographical knowledge. My own observation, having searched for relevant literature on various databases, is that much of this research relates to primary aged children (see for example Platten, 1995 and de Azevedo, 2004) and is very wide ranging and impossible to summarise here. Taylor (op. cit.), compares this research output with the 'Project Chata' research carried out in history by Lee and Shemilt (Lee, 2005) which focused on second-order conceptual understanding as the basis for thinking about progression. Geography has no comparable research base and hence the research into children's understanding that exists, though helpful, does not contribute to a greater sense of how we might support children to 'get better' at geography as a whole.

5.3 Current debates about school geography

Epistemic questions about knowledge structure and creation have not received as much attention in school geography as in school history over the last fifty years and a procedural focus on the way geographical knowledge is created and warranted is arguably under-theorised in geography education or at least under-represented in schools. Firth (2011) draws on Bernstein's theory of grammaticality – 'how a theory deals with the world' and 'how knowledge claims are made and validated' (p. 302) - to argue that 'how knowledge claims are judged to be better than others and the rules or criteria for doing this will need to be considered [in schools], as well the impacts of such knowledge on the world' (p. 302).

A helpful example of what a bigger, more critical focus on the process of knowledge construction might look like in classrooms is provided by Morgan and Lambert (2005). A more critical appraisal of the topic of development might recognise, for example, that textbooks offer partial accounts of development and rarely explore the reasons behind the existence of developed and developing countries. Teachers, Morgan and Lambert suggest, need to pose questions such as ‘how are different groups represented in this text?’ and ‘what messages about development are offered?’ (p.64). The very term ‘developing’ and ‘developed’ sets up a hierarchy that current discourses around post-development might challenge. In this sense, then, ‘curriculum needs to be seen as a representational text.’ (ibid., p. 64). This would shift geography firmly into the territory of Young and Muller’s ‘Future 3’ (2010) because of the emphasis on the process of knowledge creation and selection as well as on the knowledge itself.

5.3.1 How is the knowledge of school geography ‘*powerful*’?

The question of why geography education is *valuable* elicits – as in all subjects – a wide range of possible answers depending on who you ask. One way through a multitude of different aims is Lambert’s notion of the mutual relationship between the vocabulary of geography (its factual knowledge) and its grammar or syntax (its concepts and frameworks) (Lambert, 2011). What follows is an attempt to explain how Lambert’s identification of core (factual) knowledge, content knowledge (concepts and frameworks) and procedural knowledge (enquiry, geographical thinking) can work in concert to create his vision of ‘powerful geographical knowledge’ (2016) and how far this aligns with the vision of other geography educators such as Jackson (2006) and Maude (2017).

i. Core knowledge

> The acquisition and development of deep descriptive and explanatory ‘world knowledge’; this may include (for example) countries, capitals, rivers and mountains; also world wind patterns, distribution of population and energy sources. The precise constituents and range of this substantive knowledge is delineated locally, influenced by national and regional cultural contexts (Lambert, 2016, p. 404)

Here, Lambert is clearly making a case for rigorous core knowledge which takes children well beyond their everyday worlds (though they may use these worlds as important starting points) and which provides a balance between depth and breadth, encompassing human and physical geography and including places around the world. Elsewhere, Lambert has written about a ‘knowledge turn’ in geography in which he argues that schools need to take seriously ‘the need to introduce all children to knowledge that some of them may never otherwise encounter’ (Lambert 2011, p. 254). However, whilst he laments the infrequent use of atlases in schools in recent years (e.g. see Lambert and Mitchell, 2015), he questions Hirsch’s (1988) currently popular (in some circles) view of core knowledge which confuses knowledge with closed facts and which regards knowledge as inert and gaining that knowledge a largely passive experience. Lambert argues that we need to make broader meanings from the core knowledge through an engagement with bigger concepts and ideas. One of these, the interaction of humans and the physical world - one of geography's most fundamental ideas - sits above factual knowledge and shapes the meanings children take from geography. It is to these broader meanings that I now turn.

ii. Content knowledge

> The development of the relational thinking that underpins geographical thought…. this includes place and space for example, the local and the global, the human and the physical and notions of environmental interdependence and interaction. This knowledge component is arguably more independent of local circumstances and influences, being derived from the discipline: concepts like place, space and environment are complex, evolving and contested and, referring back to our earlier metaphor, can be thought of as fundamental components of geography's syntax. They are sometimes referred to as geography's 'big ideas', 'key concepts' or 'second order' concepts [….]
> (Lambert, 2016, p. 404)

Here, Lambert explores the conceptual frameworks around which geography's factual knowledge might be organised in order to illuminate bigger meanings. Brooks argues that there is a growing consensus about geographical concepts (Brooks, 2013) and certainly place, space and scale seem relatively uncontentious but there are other contenders – time, interdependence, diversity and environment for example. The 2007 national curriculum for geography (DFES/QCDA) identified nine key concepts for the first time (see Figure 5.2). These were absent in the 2013 National Curriculum though there are hints of them in the new GCSE criteria AO2: changes, interrelationships between people and environment and interconnections between places at different scales/different contexts and it is possible to see common conceptual ideas emerging over the last decade (see Figure 5.2).

Figure 5.2 Academic geographers’ definitions of geography’s key concepts compared with the 2007 national curriculum and current GCSE specifications

Who/what	**Concepts**	**Notes**
Holloway et al (2003) as discussed in Morgan and Lambert, 2005.	Space, place, landscape, environment, system, scale and time	
Matthews and Herbert (2004) as discussed in Brooks, 2013.	Space, place, environment and maps	
Stoddart (1987) as discussed in Brooks, 2013.	Location, position, distance and area	Reflecting his argument that the common purpose of geography is to ask and answer big social questions.
Jackson (2006)	Space and place, scale and connection, proximity and distance	Emphasises the role of relational thinking which he argues is geography’s ‘distinctive contribution to knowledge’.
Slinger, 2011 as discussed in Taylor, 2013.	Quantification, time, sustainability and enquiry	Examples of ‘threshold concepts’.
National Curriculum for Geography, 2008	Place, space, scale, interdependence, physical and human processes, environmental interaction and sustainable development, cultural understanding and diversity	The current National Curriculum for geography does not mention key concepts.
Current GCSE Geography Assessment Objective Two	Changes, interrelationships between people and environment, interconnections between places at different scales/different contexts	

As we can see in Figure 5.2, some concepts such as ‘space’, ‘place’ and ‘environment’ are reasonably consistent across all definitions (though not ubiquitous) whereas others, such as ‘cultural understanding’ in the 2007 National Curriculum are more isolated. Stoddart’s concepts reflect his own interest in the use of geography to respond to big social problems whereas Jackson emphasises relational thinking and connections. As a non-specialist and relative newcomer to the field, I can see important themes emerging in these debates and some consensus about underlying concepts but also a lack of agreement about the purpose of such concepts. Interestingly, Taylor (2008) has borrowed from history ‘second order concepts’ and proposed four of her own for geography: diversity, change, interaction and perception/representation (three out of four of these concepts also appear in the 2007 history national curriculum – DFES/QCDA 2007). These ‘content free’ concepts provide a potential bridge between the more abstract hierarchical concepts of, say, space and enquiry questions that explore specific topics. Taylor is interested in the potential of ‘content free’ or second-order concepts to define progression in geography as something that is underpinned but not defined by substantive knowledge. Part of her motivation here is to find a way to characterise progression that is neither based on knowledge accumulation alone nor phrased so generically that it could apply to any subject (Taylor, 2013).

Whatever the concepts that are selected to frame a curriculum, together they need to articulate a sense of geography’s purpose and what Lambert terms ‘relational thinking’ – and above all to promote what it means to ‘think geographically’ (interestingly, the Geographical Association’s Manifesto focuses on this term more than on specific concepts – GA, 2009). Where it might become more problematic is in the area of progression. There have been various attempts to set out what ‘getting better’ at geography looks like, some of which (i.e. pre-2014 iterations of the National Curriculum) have been over-complicated or used in deeply flawed and dishonest ways (Biddulph and Lambert, 2017). The GA’s *Assessment and Progression Framework for Geography* (2014) is structured around three objectives and is intended to provide the basis for teacher planning rather than for frequent assessment. However, whilst Objective 1 (contextual world knowledge) and Objective 3 (geographical skills) are reasonably straightforward, the second (‘understanding of the conditions, processes and interactions that explain features and distributions, patterns and changes over time and space’) is less so. It is this middle ground between substantive knowledge and skills that I would argue poses the greatest challenge: how might a student’s progress in ‘thinking geographically’ best be described in terms that are widely understood and agreed upon? It is here that a lack of clarity about what progress might look like across an agreed set of concepts becomes problematic, at least if the concepts themselves, collectively, represent what thinking geographically is about.

iii. Applying geography

> A propensity to apply the analysis of alternative social, economic and environmental futures to particular place contexts; this draws on a range of skills developed through appropriate pedagogic approaches such as decision

> making exercises; in addition to intellectual skills such as analysis and evaluation this also encourages speculation, imagination and argument. If we accept that it is what students are able to do (including, to think in new ways) that gives geographical knowledge its 'power', then this category of what we might think of as 'applied geography' is crucial. (Lambert, 2016:404)

Geography by its nature has practical elements to it. Important geographical skills ('geographical enquiry' in the 2007 national curriculum) include enquiry, using a range of sources including maps and GIS, specific fieldwork techniques and communication. But applying geography goes beyond skills. It involves applying the kinds of understanding about the world to particular scenarios and futures. Lambert's use of the word 'propensity' seems especially apt here, for it is the disposition to apply an understanding of geography to any situation that is the ultimate prize – to 'think geographically'. The implication is that geographers think about the world in distinctive ways and respond to situations in ways that mark them out from historians, scientists, linguists and so on. As Jackson (2006) argues, 'thinking geographically' is a 'uniquely powerful way of seeing the world…[it] provide[s] a language – a set of concepts and ideas – that can help us see the connections between places and scales that others frequently miss' (p. 203).

Morgan (2013) offers a helpful sense of what it means to 'think geographically' by outlining a number of possible features. He begins by considering it as a 'way of seeing' and quotes a passage from Sir Halford Mackinder in 1890 about what the word 'Punjab' means to him. For Mackinder, 'Punjab' goes beyond its place on a map; it also conjures images of its terrain, its climate, its relationship to the rest of India, its farming, its relationship to the rest of the world through trade and politics. Morgan suggests that this 'encapsulates a whole theory of geographical thinking. To think geographically is to have a trained capacity to construct a mental map to see patterns, to recognise relationships, to see movement, to take that map and 'clothe it in meaning'.' (p. 275). One practical outcome of this way of 'thinking geographically' for young people might be to read a newspaper and 'make sense of the world' they find on its pages (p. 275).

Applying geographical thinking to a range of situations, present and future, and being sensitive to different experiences and the meanings we might attach to particular definitions would all demonstrate, I think, Lambert's 'propensity to apply the analysis of alternative social, economic and environmental futures to particular place contexts.' Maude (2017), in his helpful attempt to apply the concept of Powerful Knowledge to school geography, places strong emphasis on the application of geography in order to, for example, think about the world in new ways and follow and participate in debates on local, national and global issues. The range of such issues could include, for example, population growth, globalization, information movement, climate change, shifting patterns of employment, migration, sustainability and interdependence (Fargher et al, 2017, p. 2) and geography provides a particular lens though which to view them.

5.3.2 Conclusion

Questions about what geography *is* and what, in a school context, it is *for* continue to be debated. The concept of ‘thinking geographically’ is a potentially powerful answer to the latter but how to translate it into a curriculum framework is still work in progress. The connections, for example, between thinking geographically and geography’s key concepts are still somewhat opaque, at least from the perspective of a non-geographer. This might matter when trying to characterise what getting better at geography means. In drawing on concepts such as powerful knowledge, Future 3 and epistemic ascent, some geography educators such as Lambert (2016) are advancing a model of progression that involves core knowledge, the interconnection of this core knowledge to form bigger sorts of understandings *and* a serious engagement with how geographical knowledge is constructed, how this can be critiqued and why the perspective of the knowledge creator (e.g. textbook writer, researcher, photographer, statistician) matters.

5.4 Introduction to the case study

In this section I will introduce Sarah, her department and her school before outlining the data that was generated for the case study.

5.4.1 Sarah and her department

Sarah has been teaching for 16 years, 12 of those at her current school as head of department. Since 2012 she has also been head of humanities (geography, history and politics) and she currently oversees all the student teachers in the school. Sarah graduated with a degree in geography from the University of Sheffield, focusing exclusively on human geography in her second and third years. She has a PGCE in secondary geography, also from the University of Sheffield, and a Masters in Geography Education from UCL Institute of Education which focused on ‘geography in school and education’. She almost trained as an English specialist in primary schools and has ‘no regrets’ about her final career choice. Sarah regularly attends the annual conference of the Geographical Association to keep her subject knowledge up to date.

Sarah’s department, consisting of five members of staff, is very successful with five groups at GCSE most years. One of the department members is an active member of the Princes Teaching Institute (PTI). Sarah is passionate about keeping the department's subject knowledge up to date.

5.4.2 Sarah's school

Sarah's school is a mixed, non-selective secondary school in a relatively affluent area of London. It has 1,643 students on roll, 430 of whom are in the sixth form. Its GCSE results are about the national average, with 72 per cent achieving English and Maths at a grade C or above in 2017 compared with the national average of 43 per cent. Half its students are White British, one tenth are from other White backgrounds and one third come from BME (Black and Minority Ethnic) backgrounds. There are lower than average numbers of students with special educational needs and students eligible for free school meals. The last full Ofsted inspection was carried out in 2011 and the school was rated outstanding overall.

5.4.3 Generation of data

I observed Sarah teach seven lessons, spread across two separate sequences. As I have explained in Chapter Three, it was not my original intention to observe two lesson sequences but it became clear that the scope of geography was very difficult to capture in a single sequence. I observed the first sequence of four lessons in autumn 2016 and the second sequence a year later in autumn 2017. This second sequence also lasted for four lessons but I was unable to observe the final lesson. However, I was given all the resources and PowerPoint slides for that lesson and Sarah talked me through it in the final interview.

I interviewed Sarah five times for a total of 277 minutes. The first four of these took place in autumn 2016. The fifth interview took place in autumn 2017 in order to discuss the final sequence in detail. The interviews followed the pattern set out in chapter 3 with the addition of the final fifth interview which combined interview outlines three and four.

I also interviewed a group of four students who were in the Year 10 class I observed in the first lesson sequence. This interview lasted for 27 minutes.

Alongside the interviews and observations I collected documentation where available. This included:

- the key stage 3 scheme of work (Appendix 15)
- a rationale for changes to the key stage 3 curriculum, written in 2014-15 and based on departmental discussions and documents drafted by another member of the team (Appendix 16)

- a presentation to the Senior Leadership Team about the geography curriculum in 2014 (see Appendix 17 for an extract)

5.4.4 Overview of the lesson sequences

Sequence one: The landscape of the United Kingdom

This four-lesson sequence was taught to a Year 10 class. The content was defined by Edexcel as part of the new GCSE specification and this was the first time Sarah had taught it. The specific topic I observed was called ‘The UK’s evolving physical landscape’ which forms part of Component 2: UK geographical issues in the Edexcel B GCSE course. The overarching enquiry question for the four lessons I observed - suggested by the awarding body in its optional scheme of work - was ‘Why does the physical landscape of the UK vary from place to place? (Pearson Edexcel, 2018, p.18) and the content is divided up as follows in the specification:

4.1: geology and past processes have influenced the physical landscape of the UK: glacial erosion and deposition, upland and lowland landscapes, UK’s main rock types.

4.2: A number of physical and human processes work together to create distinct UK landscapes: how distinctive landscapes are formed by weathering, post-glacial river processes etc., why distant landscapes result from human activity over time

In the first lesson, Sarah introduced contrasting landscapes of the UK and explored how they were formed, introducing or reminding students of key terms such as glaciation, tectonic processes, V shaped valleys and Continental Drift. In the second lesson, Sarah finished work from the previous lesson (time was a major limiting factor in this sequence) and then focused on the distribution and characteristics of the UK’s main rock types. The next lesson continued a focus on the geology of the UK with students marking major geological features on a map, including the Tees-Exe line. In the second half of the lesson, students looked at the effects of weathering and climatological processes on the Lake District (upland) and the Weald (lowland). The final lesson was also split into two parts: first, students looked at mass movement (slope processes) and post-glacial river processes and second, students moved onto ‘people and the landscape’ using the South Downs as an example of the how humans shape landscapes.

Throughout the interviews, Sarah shared a concern that she was going into too much depth in what were supposed to be introductory lessons and that she doubted whether students would remember much of what they had been taught. The department – in common with many departments across the country – was struggling to teach the breadth and depth of content in the new GCSE specifications and Sarah felt under pressure not to overrun beyond four lessons for this reason.

Sequence two: Climate Change

This was a four-lesson sequence taught to Year 9 which built on two previous lessons on climate and geological times in the past (which made the point that climate has changed in the past too). The sequence outlined here focused more specifically on global warming and humans' contribution to this.

In the first lesson of the sequence, Sarah focused on the evidence for climate change in the past, evidence that it is currently speeding up and that it is humans that are contributing to this. Students found out about ice cores and dendrochronology as ways to investigate climate change before records started in 1850. She ends with an explanation of glacial retreat. The second lesson focused on how humans increase the rate of climate change. Students were introduced to the idea of the Anthropocene and they analysed data about annual greenhouse gas emissions by sector. In the third lesson students participated in a 'marketplace' activity in which they found out and shared examples of impacts of global warming. The fourth lesson focused on what might help to reduce global warming and its impacts and introduced the ideas of adaptation and mitigation.

Throughout the sequence, Sarah was careful not to overwhelm the students with gloomy messages: she referred, for example, to humans' ingenuity to solve problems using the latest technological advances.

5.5 Thematic analysis of the data

As explained in section 3.5 of Chapter Three, the data was analysed under the broad thematic framework of 'knowledge', 'knowers' and 'knowing'. I went through the same process that I describe for physics in that section with the geography data. Appendix 18 provides an example of some of the notes I made under the three thematic headings as I began to sketch out some initial codes. Under the theme of 'knowledge', I identified some possible codes that were to remain in the final version such as 'terminology' and 'places' and others that I later subsumed into other codes such as 'map skills' which later became part of 'geographical skills' or 'seeing the world as a geographer' which I decided was too 'big' to have as a single code and I therefore broke down what Sarah meant by this into three separate codes: 'relational thinking', 'interaction' and 'reading the landscape'. 'Progression' became a separate code for all three subjects because of its importance and the way it brought the different types of knowledge together.

Within the theme of 'knower' the early codes I identified included 'meaning and engagement', 'relevance', 'accessibility' and 'morality'. The essence of these remained through various versions but I ultimately paired codes together that I felt were linked such as relevance and morality (because the moral issues Sarah discussed related to very current debates). I also subsumed 'accessibility' into 'maturity'. 'Awe and wonder' was included as a separate code in the end rather than connected with 'engagement' because I realised that Sarah said very little explicitly about engagement but used various techniques to persuade students of the incredible beauty or significance of places and topics *in order* to engage them. Thus I felt that 'awe and wonder' more specifically reflected what Sarah said and did.

Within the theme of 'knowing', my initial notes suggested 'assessment' (though the substance of my notes really related to progression at that point), 'dialogue' and 'familiar to strange'. I retained the first two but later felt that 'familiar to strange' did not merit a code of its own (unlike in physics where I located it under 'knowers'). I also added 'visual images' because that felt like an increasingly important element of Sarah's practice when I revisited the data.

Figure 5.3 The codes used to analyse the geography data

Knowledge: *What* is to be taught?
Propositional knowledge ('know that'): core knowledge, student entitlement; terminology Inferential 'know how': relational thinking; interaction; reading the landscape Procedural 'know how': evidence; skills Progression
Knowers: Who are the *learners* and what are their needs?
Awe and wonder Relevance and morality Maturity
Knowing: What does the *learning* look like?
The role of dialogue Assessment Visual images

5.6 Knowledge: *what* is being taught?

The ‘knowledge turn’ in education (Lambert, 2011) has been enthusiastically received by Sarah and her department. In the first section below I will begin by focusing mainly on what Sarah sees as core (propositional) knowledge in geography. This section also includes what Sarah thinks students are entitled to know about and ends with her reflection about the scope of geography and the challenge for teachers to remain up to date in their subject knowledge. In the subsequent two sections I will then consider in more detail what students are supposed to *do* with this core knowledge. Finally I will outline what the data suggests about Sarah’s understanding of progression in geography.

5.6.1 Propositional knowledge (‘know that’): core knowledge, student entitlement and terminology

For Sarah, building substantive knowledge was a major aim in both sequences and in her teaching in general: ‘you’ve got to have a really core underpinning knowledge’ (GI2/2). The PowerPoint presentation to SLT included under the heading ‘preparing students for the future’ the decision by the geography department to ensure ‘that students have a solid geographical knowledge from which to build at all key stages’. On more than one occasion Sarah referred to the problem of people thinking they know more than they do like ‘armchair geographers’ who watch documentaries on TV: ‘people think they have knowledge - they think they do, but that’s dangerous because it depends where that knowledge is from’ (GI1/17).

In terms of who decides what core knowledge is necessary, the influence of the new GCSE course was very apparent in sequence one through the heavier emphasis on physical geography and the greater depth and breadth of content/substantive knowledge required. These demands are influencing what is taught at key stage 3, where physical geography has a bigger presence than before and other GCSE topics are being pre-empted. This is interesting in the light of geography’s knowledge structure: physical geography, which has a more hierarchical knowledge structure, requires some ‘building blocks’ of understanding whilst general familiarity with the themes at GCSE is seen as advantageous. The revised national curriculum has been a further influence, although this is not prescriptive enough to remove choice at an individual school level. Overall, whilst Sarah and her department welcome a greater emphasis on substantive knowledge, she is also worried that they are now trying to do too much at key stage 4:

> I believe it in [more substantive knowledge], but geography is so massive, they're still trying to teach all this - they're still trying to teach all they used to teach but now bringing in lots of physical geography…but they've now added on all these other things that we now teach in geography like energy security, climate change, India.
> *So it's as well as, rather than instead of?*
> I would argue…we've got rivers and coasts which we've always taught, and urbanisation which we've always taught. Great, we've now added all the exciting stuff that's been attracting children in the last sort of 10 years, which I think is great, but we're trying to get the knowledge back in, but with stuff added on. (GI1/6-7)

In a later interview, Sarah reflected on how geography as a subject is always increasing in scope – 'we're adding to it all the time' (GI5/7) – because things happen in the world that are *immediately* relevant to geography or which have an impact on what academic geographers choose to study.

Sarah identified how keeping knowledge up to date can be a challenge in two ways: first, that teachers must ensure that they keep abreast of current examples of physical and human events and developments (for example in Sequence Two, Clock 23 in Berlin or the increase of plastic waste in the ocean which had just featured on a David Attenborough documentary) and second, that teachers' knowledge can quickly become out-dated. One of Sarah's colleagues, for example, was concerned that he'd been teaching something wrong:

> He was saying to me yesterday - he was sitting there and he was like, I'm really trying to get my head around Milankovitch Cycles…..it's like long-term climate change. Then he said, I think we've been teaching this wrong. Now, he didn't mean that we are rubbish and we've been teaching it wrong, but actually things have changed, and we need to keep on top of it. (GI1/5)

Sarah certainly believes that students have an entitlement to the most up-to-date knowledge available and that it is a 'massive risk' that teachers will not keep up, either through choice or necessity.

i. Core knowledge: places and processes

Three elements of core knowledge were evident in both the sequences and the interviews: places, processes and the interaction between humans and the physical world. I will explore the first two in this section and the third in the next section.

In terms of places, the first sequence demonstrated Sarah's claim that she is 'obsessed with them knowing where places are….' (GI3/13), with locational maps showing the locations of, for example, the Pennines, Malham Cove, the Lake District, Exmoor, the

Weald and the South Downs as well as more general features in the UK such as upland and lowland areas and rivers. Locational knowledge is a prominent feature of the school's key stage 3 scheme of work, especially through the three 'place' topics of Russia, Africa and China. It is interesting to note what places are 'in' and 'out' at any given time: China replaced Australia recently and there is mention in the key stage 3 curriculum rationale that 'we need to get India and the Middle East in', almost certainly as a result of the revised National Curriculum (DfE, 2013). The places that Sarah wants students to understand and value are varied: 'we often talk about geography from local to global, so…London - UK - Europe and so on' (GI1/8).

The second dimension of core knowledge that Sarah emphasised consisted of physical and human processes. A wide range of physical processes dominated sequence one (glacial processes, past tectonic processes, slope processes) in order to explain what shapes a landscape. In sequence two, there was an exploration of the processes through which humans are accelerating global warming. In both sequences, these processes contributed to a narrative which influenced the ordering of the lessons. When asked about the lesson order in sequence one, Sarah pondered whether she could have swapped lessons one and two around and decided that it was better as it was because 'I think it does tell a story' (GI4/1). In both cases, the narratives started with physical processes and characteristics before moving onto human characteristics. In sequence two, for example, the existence of climate change before humans evolved is the starting point. Sarah suggested that 'causes, impacts, solutions' was 'very much a geography thing' (GI4/9) and this certainly reflected the ordering of sequence two where a particular problem or issue – climate change – was under scrutiny. The same pattern applies to India at key stage 4:

> So, for the India scheme work I wrote, I did just follow spec, because it's like, well what is this economic growth - why has it happened - right, now what are the impacts of these economic growths on people, on environment - right, now what are the solutions? (GI4/9)

Sequence one did not quite follow this pattern however: its stronger physical content reduced the 'issues-based' nature of the lessons which was only evident in the final stage of the final lesson when Sarah explained diversification as a human response to physical and economic challenges facing farmers. The sequence as a whole was dominated by physical processes and characteristics.

It was interesting to note that students were required to copy notes into their book from PowerPoint slides in the first sequence, rather like the students in the physics sequence. Both classes were studying for their GCSEs which is likely to have been a factor as this was not a feature of the second sequence.

ii. Student entitlement

Sarah was happy to provide a list of core knowledge that she believes every student should know about:

Physical systems (climate, rivers, coasts, hazards)
Urban issues
Population
Sustainability
Economic change and development

What is interesting about this list is that each one is a big idea, theme or issue which can be supported by a range of different specific examples. A parallel in history might be ‘revolutions’ or ‘empires’ which tend not to be the kind of answers you get when you ask history teachers about core knowledge (Husbands et al, 2003). This connects with the relationship between the general and the particular in geography to which I will return shortly.

iii. Terminology

Sarah emphasised the specialist terminology of geography. Indeed, she went as far as saying:

> Well, I guess it makes a subject expert if you’re using the right language. ***That’s what makes you a geographer*** and that’s why you’re sitting in geography and not doing another subject. So, I’d say a non-geographer would use - yeah, it looks a bit worn away over there. Well, actually no, the proper term is erosion. So, I think terminology is very much about knowledge, or knowledge is very much about terminology. (GI3/20, my emphasis)

Figure 5.4 summarises the range of geographical terminology used in each sequence. A consistent feature of Sarah’s teaching was an insistence that students use precise, specialised terminology rather than vague descriptions as the following exchanges about a photograph of the Lake District with the prompt question ‘what’s the geography’ illustrates from sequence one:

> TQ –what’s the geography?
>
> PA – two sides like this (shows a V shape)
>
> TQ what do we look at in valleys in geography?

PA – geology

TA – Good, V shaped valleys, we're really getting there. Two more?

PA – erosion

TQ – good, yes, one more?

PA –lots of trees and greenery

TE – yes, connected to the eco system and biodiversity

(GL1/1/2)

This exchange not only demonstrated Sarah's use of specific terminology but also how the use of this terminology enabled her to connect student responses to bigger ideas - for example turning 'trees and greenery' into 'eco system and biodiversity'. In both sequences, the emphasis was also on precision, with 'greenhouse gasses' replacing 'pollution' in sequence two and 'wearing away' becoming 'erosion' in sequence one. So the specialist terminology served two functions: it enabled students to be more precise in their meanings *and* to adopt a shorthand for bigger ideas. This latter purpose connects to the next section, inferential know how, because of the way a single term might open the door to understanding other, probably more overarching concepts. In her last interview, Sarah talked about 'being efficient with your words' (GI5/28) and that the use of this terminology 'means you're not an armchair geographer, you are a geographer' (GI5/29). The difference between the 'lay' geographer who watches documentaries on the TV and a 'real' geographer is important to Sarah and one major difference is in the specialist language deployed.

Figure 5.4   Specialist terminology used in each sequence

Examples of specialist terminology used in sequence one	*Examples of specialist terminology used in sequence two*
Tectonic plate movement Convection currents V shaped/U shaped valleys Continental Drift Misfits Glaciation/past glacial processes Tees-Exe line Soil creep Landslide Weathering Diversification	Dendrochronology Ice cores Greenhouse gasses Methane Deforestation Anthropocene Antarctic albedo Adaptation Mitigation

5.6.2 Inferential 'know how': relational thinking, interaction and reading the landscape

Sarah was very committed to helping her students see the world 'as a geographer'; indeed I will argue in this section that the geographical knowledge she teaches largely serves this primary goal. Geography for Sarah, I will argue, is all about making the kinds of conceptual connections that Winch (2013) captures through the idea of inferential know-how knowledge.

In the third interview, for example, Sarah said 'I will do anything to get them to recognise that as a geographer you see things in a certain way' (GI3/2) and there were many examples of this both in the interviews and in her practice. I will start with one particular example which I will explore in some depth to identify some component parts of what Sarah means by 'seeing the world like a geographer' or, to use the phrase more commonly used in the literature, to 'think geographically'. The quotation below comes from the first interview in answer to a question about what Sarah hopes students take away from their study of geography:

> I wanted to have a display. I've just never done it; have an outline of a body and say, **this is how a geographer thinks and sees the world**. I think that would kind of tie into what my aim is. So, around the eyes I would put, to look at through a social, economic, environmental and possibly a political perspective by the time they get to Year 12. To travel; by the feet it might be like walking around and wanting to explore. Asking questions about things is really important. So I'm probably saying maybe two slightly different things, but I think it - **I always say to them, put your goggles on. What geographers do is they look at the same thing environmentally, socially, economically, politically and I don't think any other subject does that. I think that's really important for what we teach them.** (GI1/9; my emphases)

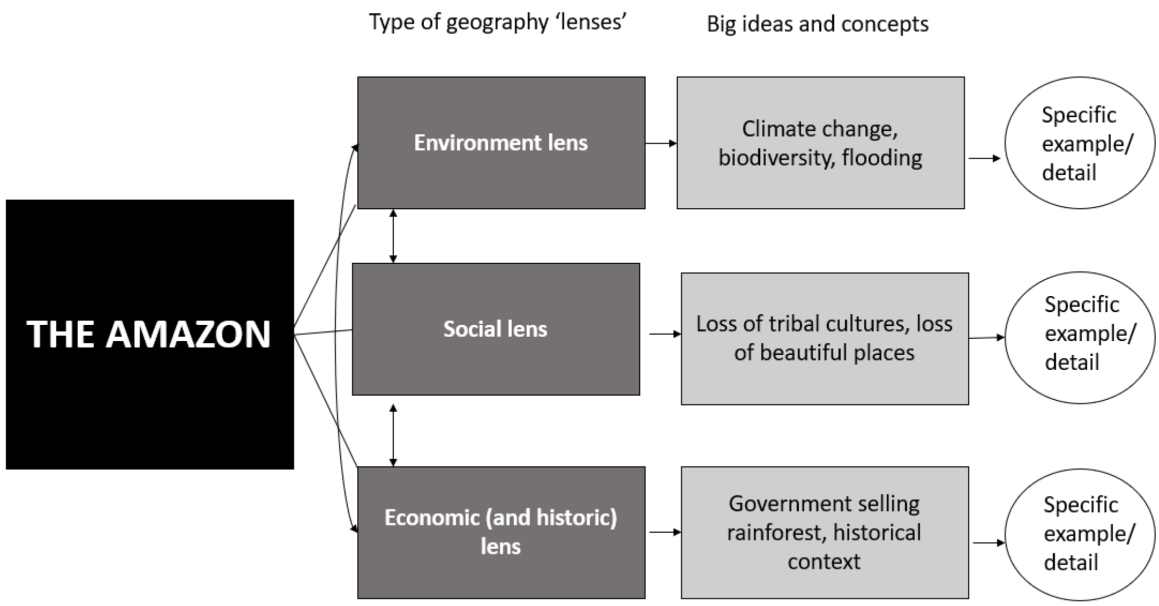
This concept of 'putting your [geography] goggles on' is a powerful one as it conveys quite literally the idea that geographers look at the world in a distinctive way. Sarah went on to provide an example:

> … deforestation in the Amazon. You'd look through it environmentally as the impact on biodiversity and perhaps on climate change and perhaps on local river flooding. Yeah, so small environment right through to global, but loads of environmental things, and not just biodiversity but all the other little bits on the environment that it can impact on. Socially it could be loss of tribal culture that live in those environments. The other social element might be the loss to us, in terms of our wellbeing, and the fact that these places are beautiful and then future generations won't see them; that kind of thing.
>
> Economically you've got a really tough one, because you have to understand why those countries want to exploit those resources. Why should they not make progress say like we do? I say that to kids; is it alright for us sitting here in this

nice classroom, having a nice meal and hopefully a great future ahead of you with careers and things - what about a child in Brazil who deserves the same as you, but actually their government's selling their rainforest in order to facilitate that to happen. So that's the economic side of things. (GI1/10)

I have tried to map out what Sarah said here visually (Figure 5.5) in a way that connects the quotation with issues raised in the literature earlier in this chapter and that Sarah goes onto to explain or demonstrate elsewhere.

Figure 5.5 Deforestation in the Amazon as an example of 'seeing the world like a geographer'



First, Sarah mentioned three different ways to 'look' at the topic. I have used the metaphor of lenses here to reflect Sarah's reference to 'goggles' though elsewhere Sarah also used the word 'perspectives' too. The three 'lenses' she mentioned in reference to the Amazon are environmental, social and economic (though I would argue that the last of these is combined with a historical lens in this example). This, then, is the first distinctive way geographers look at particular places: from different angles, drawing on other disciplines such as anthropology, science, economics and history. Second, each lens sheds light on different big ideas, concepts or processes. The environmental lens might shed light on big ideas such as climate change and biodiversity or a physical process such as flooding, the social lens might illuminate ideas of changing tribal culture or the impact of environment destruction on our physical and psychological well-being and the economic/historic lens might raise important questions about why people of the Amazon shouldn't have the kinds of wealth which western cultures have enjoyed for some time. These big ideas and concepts are examples of what Lambert (2016) would call ‘content knowledge’ although they would perhaps be better described as ‘conceptual knowledge’. They are the big ideas that connect different places; they are what prevent geography from being merely isolated examples. Sarah was unsure about geography’s key concepts and rarely spoke of them explicitly but nevertheless, many of the key concepts apparent in the literature (place, space, environment) can be discerned in her practice, though implicitly in the service of seeing or thinking geographically. Third, although not mentioned by Sarah specifically, each big idea or concept in Figure 5.4 could then be supported by even more specific examples of localities, people, cultures and events. Both these last two points relate to what I am calling the balance between general with the particular and to which I will return later. Finally, each lens connects with the other two. For example, economic priorities (e.g. the sale of rainforest) affect environmental changes (deforestation; reduction in biodiversity) which affect tribal communities (loss of habitats, food sources etc). This highlights a further crucial element of ‘thinking geographically’: an understanding of how the human and physical world interact and the disposition to think relationally.

I will now focus in more detail on two of these aspects, physical and human interaction and relational thinking with particular reference to the general and the particular.

i. Physical and human interaction

In section 5.6.1, I identified three characteristics of geography’s core knowledge that emerged from the case study. I left the last of these - the interaction of the physical and human world – to this section as it more properly belongs in a consideration of inferential ‘know how’ knowledge than of propositional ‘knowledge that’. Sarah’s answer to my question about how geography tackles the topic of ‘rocks’ differently from science in the second lesson of sequence one is a useful starting point:

> ‘For us, the things we’re looking at - rates of erosion - is really important. What comes later is it can have an impact on flooding, have an impact on coastal erosion. Therefore it has an impact on people, and with the geology map of the UK, I think it’s also about what is the pattern of geology across the UK. There was a homework task that I’m probably going to set next week, which is: what economic value do those rocks have for us as humans? (GI3/2)’

Here, Sarah related the physical geography topic of rocks quite explicitly to humans. In a later interview, Sarah explained that whilst sequence one was ‘leaning on the physical’, the fourth lesson focused on the interaction of physical and human geography (how farming shapes the landscape and how the landscape and climate shape farming): ‘and I think that’s important’. (GI4/4)

The ALCAB report of 2014 identified ‘The interface between human and physical geography’ as ‘one of the unique features of geography’ (p. 6). Sarah’s second sequence was all about this interface and the way that human behaviours are having a profound effect on the physical world in ways that, in turn, will shape the lives they lead. In her first interview she explained in more detail why connecting the human and physical world together is such an important feature in geography:

> I think what geography really does is it puts the human and the physical together. So what I say to them is; in economics you might study India’s economy. In science you might be looking at the rock cycle, but in geography we would be really interested in how both those worlds kind of marry-up. So I guess climate change is a big one that we’ve taken as a subject, and I think we have taken it probably more than any other subject, and I think that was right, even though they do it in science, because I asked them today. That looks at the interaction between the human and the physical world. Yeah, so when they say to me, why is it so important - I say, it’s partly because you’re looking at the relationship - our interaction with the physical environment. I think there’s something called - I know David did a little thing on this at the GA conference about the Anthropocene, which is like this next stage that the world has gone into, which is that humans have a massively significant impact on the planet. We’re changing. (GI1/8)

Here Sarah uses the term ‘marry up’ to express the connection between human and physical processes and anticipates the second lesson sequence taught a year later in which she talked about the Anthropocene. As well as illustrating how Sarah connects human and physical geography, this is also a good illustration of her adapting her practice to take account of new ideas, in this case an idea that speaks very powerfully about the interaction of humans with their environment.

ii. Relational thinking: the general and the particular

A particular feature of knowledge in geography is the relationship between specific examples (case studies) and ‘generalisable’ knowledge. Like physics, geography has its own ‘big ideas’ but unlike physics, there is a *range* of possible examples that can support the bigger, more abstract concepts:

> In geography we talk about case studies and examples. Case studies you go into a lot more detail. You have to know what we call place specific detail. It used to be just regurgitate it in the exam, but really you should be applying it to a question, so that the question comes alive with real-world knowledge. What we also try and get them to do is name-drop real-world examples. So it would be; well I now know that this place is in this bit of the country and it’s called igneous rocks. So if they get a question that says - I don’t know; what shape of the land does igneous rocks give - or something. They would go, oh for example Giggleswick Scar. Literally, they’ve said two words but it’s so powerful

> as a geographer, because you haven't just done the theory; you've said, and an example of it is this. (GI3/8)

Here, Sarah is talking about the importance of supporting big ideas with examples of specific places – moving from the general to particular. However, it is not only the ability to support abstract ideas with specific examples that is important but also the ability to apply that specific knowledge to other contexts, moving this time from the particular to the general:

> I haven't said that very much, but being able to read something unfamiliar using the knowledge that you've gained from familiar - well, they become familiar as you learn about them. So you learn about Malham Cove, South Downs…the Lake District. So if I then show them a photo of an unknown place, can they apply that knowledge and understanding to a different place? …..So, when we have in exams what we call decision-making exams where they're given an issue - so, say we've studied coast and coastal erosion which will happen, they have a decision-making exam where it's an issue and it'll be coastal erosion and coastal management, but it will be a totally different location they won't have looked at, but they use the knowledge from the location to apply it to the location.
>
> *To analyse the...*
>
> Yeah, and it's the same for earthquakes and volcanoes. So, a volcano happens in a certain - it might be a developing country; they use their knowledge of studying the Nevado del Ruiz in Columbia, and even looking at like Mt Etna and then going, right okay so that was a developed country - that was a developing country - now I'm looking at Montserrat, so let me take what I know about those two places and then apply it here - okay, what's the best management strategy? I would argue that's quite a big thing. (GI4/6)

Here, Sarah is emphasising the importance of being able to apply knowledge learned from one specific content to another. This is a good example of moving from the particular to the general as even though students are still focusing on a particular place (e.g. Montserrat) they are assuming some general characteristics of a process (e.g. volcanos).

The relationship between the general and the particular was especially evident in the first sequence, where specific landscapes of the UK were explored as characteristic examples of more general processes (e.g. Giggleswick Scar). However, the exchange in the second lesson of sequence two in relation to methane emissions and eating more meat is also relevant here:

> Sarah: Next one: 'breeding and rearing cattle for beef increases the amount of methane in the atmosphere.' James, it was you that spoke about that and you did really well. More cattle means more methane. But I am missing something from this box – you can correct me – what do I need to add? Why are we seeing more cattle farming and meat eating?

PA: Is it more industrialisation of whatever, meant that more people moving to cities?

TS: you're halfway there. The reason they move into cities – same reason…

PA: more people

TS: yes, more people, more people to feed. But why are they eating meat?

PA: protein?

TS: yes, protein. But think about China which you did in Y8 – we definitely mentioned this when we did deforestation. People eat more meat when they generally have more….?

PA: money

TS: yes, eating meat is a sign of wealth. People are becoming more wealthy despite there still being lots of poverty. And then actually, really developed societies become vegetarians and vegans – I have a theory that everything goes back to the beginning. So in China, more meat eating. Not so much in India because of their religion. So you need to spot the bits of information that are missing.

(GL2/2/4)

The big idea of the lesson was that humans are accelerating the rate of global warming beyond what we might expect to occur naturally. They are doing this through the increased emissions of greenhouse gasses. One specific example of human behaviour that is contributing to the problem is the consumption of more meat. One specific example of where this is happening is in China, where meat eating is regarded as a sign of increasing wealth. This is connected to the more general theme of emerging economies and even the growing chasm between rich and poor. The outcome of these trends is more cattle being bred which in turn creates more methane in the atmosphere. This back and forth between the general and the particular in this exchange, where many connections are made, lasts only a minute or so and is a good example of how particular examples in geography can connect with much bigger ideas.

The students I interviewed suggested that part of the value of geography was helping them to spot connections across particular examples and cited two specific examples. One was a connection between China and Africa: 'it's one of the only countries trading with countries in Africa – others haven't because of corruption in the government.' The other was India: 'If someone didn't study geography they'd be, for example - India's population is growing very fast – they'd say so what, what's that got to do with me, I live in the UK. If you learn geography you learn that it doesn't just have an effect on that country but it has an affect on the whole world and you personally as well.' In answer to my question about the kinds of skills geography helps you develop, one student answered 'to think across places - how one place affects another'. This seemed to me to be an excellent example of relational thinking and the ability to move between the general and the particular.

iii. 'Reading' the landscape

Another way in which Sarah wants her students to see the world around them geographically is in a very literal, physical way – by interpreting their landscapes. The starter activity of the first sequence, where Sarah showed students an image of the Lake District with the question 'where's the geography?' is a good example of this. The first sequence as a whole encouraged students to 'read' landscapes, not just through images but in the students' own lives, too. For example in lesson four, Sarah talked about soil creep as an example of slow mass movement due to weathering:

> Soil creep – not a terribly exciting name. That's what's happening in the picture – can you see the rippling effect. Soil is creeping down the hill – gravity is still working – materials are still moving down – but it's creeping about, creeping down. Look at this picture (of the fence) – I love this one because it is really good evidence of soil creep. You might have seen this loads of times driving down country lanes – and you might have thought that fence has gone a bit wonky. But it's actually a physical process called soil creep. You can impress your family and friends by saying – that's a nice bit of soil creep over there – it actually has a term, not just that the fence is a bit wobbly and a sheep has knocked it over – often see trees come down as well. (GL1/1/3-4)

This is not the only time Sarah suggested that the knowledge she is teaching them could be used in their everyday lives – a point I will return to when I explore how she makes geography relevant to her students – but it was a specific example of how students can 'read' something so ordinary about the landscape they might visit with their family. Interestingly, one of the students I interviewed (who was taught the first sequence) spoke, unprompted, about soil creep: 'I found soil creep quite interesting – that something so slow could have such an impact'.

In the final lesson of the first sequence, Sarah was very explicit about 'reading a landscape' with her students:

> This is a river – it looks tiny – it's now flowing in a U shaped valley. A glacier caused this – it's not there anymore. These rivers are known as misfits – a bit sad – but they odd, doesn't look right because so tiny. (Reads more). Can you see how green it is – why – the river carries fertile silt which is why farmland is often found near rivers? Next lesson you could say it's a U shaped valley, I know that river is a misfit and it is green because the river overflows and deposits fertile material. **Lots of people wouldn't read the landscape like you are going to read it.** You will have an understanding of why the landscape looks like this if you are lucky enough to go on holiday somewhere as beautiful as this. (GL1/1/6, my emphases)

By saying that 'lots of people wouldn't read the landscape like you', Sarah is emphasising how geographers see the world in particular ways.

5.6.3 Procedural 'know how': evidence and skills

In this section I will consider the other dimension of Winch's 'know how' knowledge, practical or procedural know how relating to how knowledge is created and verified.

i. Evidence

Underlying most of Sarah's lessons was the question 'how do we know'?

> *So, it's not about, 'I'm going to tell you how it is' - it's actually about, 'and here's the proof'?*
>
> I think that's a very important geography thing, because to just say developing countries are closing the gap with developed countries, in terms of progress or life expectancy. So, let's look at some numbers and some data, and I really tried to do that in today's lesson actually….**So there is evidence for this in the world** (GI2/3)

The evidence she used to answer the question 'how do we know?' varied quite significantly across all eight lessons as summarised in Figure 5.6.

Although Sarah suggested that visual images – which dominated in Sequence One – were an example of evidence, they were often – though not always - used illustratively rather than as some sort of 'proof' (e.g. see lesson one in Figure 5.6). Maps in Sequence One were a useful aid and using them an important geographical skill and the final lesson in the same sequence ended with some data about agricultural activity in the South Downs. None of this evidence was critiqued as it was mainly illustration of geological features rather than the presentation of opinion. In the second sequence more data was used and there were some hints at the limits of evidence.

Figure 5.6 Examples of the evidence used by Sarah across each sequence

	Lesson	Types of evidence used
Sequence 1 – the landscape of the UK	One	Visual images of real places – Lake District, Malham Cove, Giggleswick Scar, Dartmoor, a V shaped valley - using photographs or film
	Two	Visual images of a V shaped valley, a U shaped valley, geological cross section diagram of Wharfedale (see Figure 5.5), map showing rock distribution in the UK
	Three	Maps showing key physical features of the UK, bird's eye view of relief and geology alongside a cross-section, GIS (geographical information systems)
	Four	Photographs of mass movement (landslide and soil creep), cross section diagram to show how soil creep works, photograph of a misfit river in a U shaped valley, Photographs of the Lake District, The Weald and the South Downs, map of the South Downs, pie chart showing types of agriculture in the South Downs, photograph showing examples of diversification in the South Downs (vineyards, farm shop etc)
Sequence 2 – climate change	One	Photo of people drilling ice cores, graph showing CO2 levels, diagram of a tree ring, photographs of glaciers retreating
	Two	Photos showing five ways that humans increase the rate of climate change, data about greenhouse gas emissions in the form of a pie chart
	Three	Pictures showing four impacts of climate change, predictions about temperature rises, students packs of information for independent research
	Four	Six pictures showing different responses to climate change

The first lesson of sequence two was based around the fact that we only have records of temperature changes since 1850 – so how do we know that the speed of climate change is faster today than historically? The following class discussion in the first lesson of the second sequence is worth quoting in full because of the way Sarah asked the students to speculate on ways we might be able to measure average global temperatures before 1850.

TQ: What do you think is the main source of evidence about whether the climate is warming?

PA: average global temperature

TA: Correct – that's what we need. But we only have data after 1850.

TQ: What about before 1850?

PA: Perhaps water levels – ice melting?

TE: Nice- ice melting rates

TQ: Anywhere in particular?

SA: The Arctic

TQ: Hang onto that point. How could we look at ice amounts changing?

PA: water levels (unclear)

TE: ok, thinking about, not necessarily land but …water stored as a solid as opposed to a liquid – based on temperature.

TQ: another way to measure ice that's changed?

PQ: Is snow a solid?

TA: yeah, it's water that's…. One more? I'm not going to tell you.

PA: this is just a thought but we could test changes in the climate by looking at PH levels in the soils?

TA: Hmm, don't know about that, maybe – why?

PA: If soil becomes more acidic then there is usually less water.

TE: nice idea, sounds like a really good research project.

PA: relationship with population density (unclear)?

TE: Ok, we need to pull ourselves back to this (slide 3, first bullet) - no temperature records before 1850 – but how can we look? Recap of what we've said so far – 1. Whether ice has melted or not (more melted than before) and 2. Ice and gas composition. Less sure about soil composition.

PA: could we talk to people about whether things have changed?

TA: not to people before 1850 but what other ways might we find about people in the past?

PA: diaries

TA: yes, diaries, pictures etc,

TQ: is there any other way to look at temperature records before 1850?

PA: look at atmosphere, build-up of gasses

TE; ok, that's along the same lines

PA: erosion patterns way back

TQ: does this have an impact on temperature?

PA: link to sea levels

PA: also – what kinds of animals there were and how they have adapted

TE: Ok, you have done really well. We'll look at three ways of finding out about temperatures before 1850 - vegetation, ice coverage and CO2 levels. We've thought about vegetation a bit – connected with animals- ice coverage (exactly what you said, well done) and CO2 levels which are connected to temperature. Lesson GL2/1/3-4

Not only did this exchange set up the rest of the lesson where these and other ways of measuring temperature before 1850 were explored, but Sarah emphasised that scientists don't make things up – they may need to be creative in finding answers but there is evidence out there to be found. She finished the exchange with this: 'the bottom line is – how do we know these things? We will come back to why there are different highs and lows but how do we know this information in the first place?'

I was also interested in the extent to which Sarah encouraged the students to use evidence in critical ways. I had been told by the geography teacher in the pilot study that evaluation of evidence is generally an area left until A Level geography but Sarah explained that the new GCSE specifications place more emphasis on the reliability and accuracy of data (e.g. GI5/37). There were occasions when Sarah touched briefly on the limitations of evidence in the second sequence, for example by acknowledging how quickly data about greenhouse gas emissions is changing ('I'll be interested to look at data in five years' time' – GL2/2/9) or how any estimates about future temperature rises are speculative ('people don't really know what's going to happen' – L2/3/3).

Figure 5.7   Two examples of students questioning evidence

Example one (GI2/6-7)

Would they ever question a graph, say and the assumptions underpinning that?

Yeah, that's a really good question. I think they trust us to just give them data that's correct, but we do, especially in the development of it - it should be interesting because I didn't think that would be a good one for you to see necessarily but if you show development by - it's things like if you show CO_2 emissions by country - so we did this with India - by country, it looks like China is the biggest emitter of CO_2, but if you show it by per person it's still the United States.

That I think is a classic thing that you need to flag up to them, and they would not necessarily - they could leave your lesson going, oh China is the biggest emitter of CO_2 - that's terrible - God, someone needs to stop china emitting CO_2. Okay, yeah we do, but on the flip side of that, but what are America per person? Actually it's more complicated than that. I think actually human geography can be harder for that, because it depends what factors and what variables that you have a little look at.

Example two (GI2/7)

Is there a point at which - I don't know - say A-Level, that you would expect students to be actively looking for that [looking at data/evidence from different angles]?

We're teaching from a young age in Year 7 that they should question in geography, because it is a bit like enquiry and asking questions. We used to have a lesson that was all about asking questions, and they all had to have a picture and ask like six questions about a picture; what's the climate like here? Then obviously the next state is, well how do you know from what you can see? I was just thinking about evidence as well then; you know the classic shot of looking at the pyramids from one direction - looks like it's in the middle of the dessert - if you look at the pyramids in Cairo from the other direction it's like right on the edge of Cairo. So, the sorts of things - and I would imagine in history you might do similar, it's like, okay it kind of depends how you look at things. Things might look different from different perspectives.

She also touched on reliability once ('If we have time we will think about which way to measure temperature might be the most reliable?' GL2/1/7). In general, however, questioning where the evidence comes from or how far it is useful or reliable was not a major or explicit feature of the lessons. This may not always be the case however - in answer to my question 'how far…do you get kids questioning the evidence?' Sarah responded 'here, loads' (GI2/6) and provided some good examples of where this is done (Figure 5.7). However, it was not a prominent feature of the particular lessons I observed. When I asked the students if they ever questioned the data in geography they answered 'yes and no' though they were able to provide a good example – 'There was a piece of data from China or North Korea and we couldn't completely trust it because they are not allowed to speak out so it could be unreliable or biased.' Overall, in keeping with the general literature about geography education I have read, a critical approach to using evidence was not an extensive feature of Sarah's practice but it was more significant than in my pilot study and more significant than some of the literature implies (e.g. Firth, 2011).

iv. Geographical skills

There are some specific skills that geographers need to develop and that Sarah was very mindful of in both the interviews and in her lessons. These included map skills, reading satellite images, analysing data for trends and anomalies and engaging in fieldwork (identifying questions, data generation, data analysis). Sarah also wanted to encourage her students to use precise terminology so that they can express themselves like geographers. I saw evidence of all these skills except fieldwork in the sequences I observed.

5.6.4 Progression

As we have seen, Sarah was very articulate about what it means to 'see the world like a geographer'. Interestingly, however, Sarah found it difficult to articulate how progress in 'thinking geographically' can be tracked across key stages three and four. Instead, when discussing progression, she emphasized what students will *know* and be *able to do*, rather than *how they will think*. I have included a lengthy quotation below from the first interview, together with my question, to illustrate this important point:

> *When you're doing your tracking of pupil progress across Key Stage 3 and I'm sure then into Key Stage 4 and beyond, what is it that gives you the evidence that a kid's getting better at geography? What sorts of things specifically are they getting better at?*
>
> I don't know that we actually do it that way. Actually we did. At Key Stage 3 - because obviously when you talk about GCSE and A-Level, they judge how we assess. So we put in different exam questions. So, in actual fact that's their - I think Key Stage 3 is the real - if you want to see how a department really does it, look at their Key Stage 3. So, we came up with this system that we would identify what we thought were geographical skills and then we made sure that in our topics we were tackling those skills. So it could be writing a good PEE [point,

> evidence, explanation] paragraph, and that's the evidence, explaining your points. It could be about decision-making because they often have to deal with quite a lot of sustainable decision-making. So we made sure we put that in there. It could be annotating diagrams, because that's important for geography. ….In terms of assessing the content we put [in] some - what we call sometimes content checkers…. we just quickly check their knowledge … and then we assessed their skills in the assessments, but also when they do the skill they have to use knowledge anyway. So in living in cities the skill is being able to annotate diagrams, that those diagrams are based on cities, and sustainability. ….Now ideally…the way I wanted it to be - my vision, was that in the different years they would return to decision-making, annotating - and so you should be able to see progression, because they have five topics in each. It's just too hard to track. (GI1/12-13)

Many of the ways of assessing progress at key stage three that Sarah refers to here focus on generic skills such as writing a 'PEE' paragraph (also common in history in English lessons) or decision making. The emphasis is on these generic types of skills or on knowledge retention, but less about ways of thinking. Sarah did later provide examples of what an ongoing focus on writing PEE paragraphs or annotating diagrams might look like over time in geography and it is possible to see, within the task of annotation for example, that Sarah is connecting the practical skill of annotation with the ability to think like a geographer:

> So; drawing a climate graph, interpreting a climate graph, or annotating a picture of our city and then making those annotations geographical. So that's the whole thing; the lesson is, we don't just want you to tell us what's in the picture - we want you tell what's in the picture geographically. So it's using geographical language. (GI1/14)

She goes on to highlight that students should in theory respond differently to the same picture in different subjects: a geographer will see it one way, an artist will see it another way. This is an important dimension of thinking geographically, but it is not clear how *far* the skill of annotation can reveal the extent of 'thinking like a geographer'.

This is not a criticism of Sarah who is unusually well informed as a geography teacher; a clear articulation of what it means to get better at thinking geographically is work in progress for the whole geography education community, as noted in section 5.3. Taylor (2013) has observed, for example, how various recommendations regarding progression models in geography are essentially generic (for example they refer to increasing depth and breadth and a wider range of skills) and could apply to subjects other than geography. Assessing knowledge and skills is easier to do and concrete evidence of progress in these areas is arguably easier to find than progression in the way students are thinking. It is interesting, however, to compare Sarah's articulation of progress with Tom's, which referred more often to ways of thinking. I will return to this difference in chapter 7. For now, however, I will restrict myself to one further comment.

In chapter 2, I briefly considered whether there is a connection between the epistemic ascent (Winch, 2013) available in a school subject and the closeness of its relationship with the parent discipline. Whilst full treatment of this question is beyond the scope of this thesis, it is worth considering here what epistemic ascent might look like in geography, the extent to which Sarah's students might be expected to achieve it and how far this relates to geography's status as a field rather than a form of knowledge. As Chapter Two explored, epistemic ascent was described by Winch (ibid.) as progression in the two forms of 'know how' knowledge: inferential and procedural. Inferential know how refers to a student knowing when and how to make inferences from potentially isolated pieces of knowledge by drawing on a wider conceptual framework. An example of this in Sarah's lessons was, for example, in the first lesson of sequence one when Sarah talked about tectonic processes and how they shaped the Pennines. Her point – that the landscape of the Pennines has not always looked as it does today – only properly made sense if students understood that the earth's crust is formed of plates which have moved considerably in the past and still move today (causing earthquakes). This was a necessary part of students' wider conceptual framework from which they needed to draw in order to understand *why* landscapes change over time. A further example in the second sequence related to global warming and an important conceptual framework relating to time. The key idea in the first two lessons was that a unique acceleration of global warming is currently occurring. In order for students to understand this inference, they also needed to understand the following:

i. That the climate has changed in the past
ii. That it is changing much more rapidly now than previously
iii. That we can connect these changes scientifically to greenhouse gas emissions

The conceptual framework here is complex: students needed to understand concepts such as timescales, climate, types of human activity and scientific enquiry. This is a good example of the different conceptual frameworks from which geography draws - in this case, history, science and possibly anthropology – and provides a good example of how inferential 'know how' can be a feature of progression in geography.

In terms of procedural know-how, Sarah emphasized the connections between knowledge claims and the evidence that warrants them and demonstrated how we come to know geography. However, examples of students being encouraged to question the quality of evidence were quite isolated. Similarly, whilst Sarah wants her students to see the world from different perspectives, there was limited evidence that she explores the impact of people's perspectives on the opinions they form about the world. In other words, Sarah does not appear to regularly ask her students to explore the role of the 'knower' and to consider how the perspectives of the 'knower' (whether it be the students themselves or others) influence the conclusions they draw. The extent to which this limits students' procedural 'know how' is difficult to gauge in this brief exploration. In Chapter Two I explained that procedural know how as conceptualised by Winch (2013) involves knowing how knowledge in a subject is managed and created and therefore advanced. Winch does not explicitly include a metacognitive awareness here of who creates knowledge and how this affects the quality of that knowledge but Firth (2011) argues that geography students should be much more aware of this as a dimension of their progression as geographers. It is interesting in this context that in ALCAB's (2014) recommendations, the panel of mainly academic geographers did mention the impact of individuals' perspectives on their interaction with geography, but it was not a prominent feature and indeed felt like an afterthought towards the end:

> An understanding of the ways in which differences in values, attitudes and circumstances impact on an understanding of people-environment relations and developing the knowledge and ability to engage with these questions as citizens in the 21st century. (p. 10)

To conclude, the way Sarah conceptualised what progression in geography might look like in practice reflected some of the wider challenges facing geography educators. She was more comfortable talking about students knowing more and what students can practically do than identifying ways of which ways of thinking might develop. This may partly result from her focus on the holistic aim of 'seeing the world like a geographer' rather than on specific concepts and partly from the absence of a developed conceptual framework in geography education which could support a model of progression. Little of this is therefore surprising, despite Sarah's considerable expertise and skills as a teacher, given the broader debates and challenges that currently exist in geography education. Given that geography in universities is highly diverse and highly specialised, it is unlikely that answers to these challenges can easily be found from within the academic discipline itself. The answers in school are more likely to come from within the school geography community itself.

5.7 Knowers: who are the *learners* and what are their needs?

A significant influence on Sarah's practice were the students she teaches. In this section I explore this influence in three ways. First, Sarah wants her students to feel a sense of awe and wonder about the world, its beauty and its significance. Second, she wants to make geography relevant to students' lives and to contribute to their understanding of current moral issues. Finally, Sarah takes account of students' maturity in what she choses to teach them and when.

5.7.1 Awe and wonder

Sarah emphasised the beauty of places throughout sequence one and she wanted to take them there virtually so they could appreciate the range and beauty of the UK landscapes. Asked why she started the sequence with an image of the Lake District, Sarah responds:

> Okay, so the picture; I just look in Google Images for something that I think looks nice. I think I just put UK landscapes in, and obviously hundreds come up. I do go through a thought process, and I often say this to them; **I want them to submerge themselves in that place, and I want them to try and imagine they're there….**So, in my head I was like, right **I want it to have a little bit of a wow factor** if possible - it does need to be in the UK - upland and lowland - it's got forest areas/non-forest areas - there is evidence of human and physical evidence in this picture. (GI3/2, my emphases)

Sarah referred to students imagining they are actually at places and she achieved this in her lessons by using many arresting images and explicitly emphasising the places' beauty: her phrase 'these places are beautiful' in the first lesson of sequence one was an example out of many. At one point Sarah projected a still from a Harry Potter movie filmed at Malham Cove. Harry and Hermione are standing next to each other and Sarah inserted a speech bubble from Harry saying 'Wow! This is awesome – I wonder how it was formed?'

Sarah's decision to stick with the order of lessons in sequence one recommended by the GCSE specification was influenced by her wanting the lessons to have a 'wow factor'. She had considered swapping lessons one and two around and starting with geology but decided against it: 'maybe they [GCSE awarding body] did it so you could wow them with the landscapes at the start' (GI4/1).

In the second sequence the 'awe and wonder' here potentially lies in a more negative sense in the catastrophic effect humans are having on the planet which certainly grabs students' attention. But Sarah is careful to avoid a sensationalist approach that she suggested was common when it was first taught and she tries not to overwhelm students with a sense of foreboding and hopelessness. This is why she always ends the sequence with a more positive outlook – examples of what technological innovations could be developed to mitigate the worst effects of global warming or to adapt to its consequences.

5.7.2 Relevance and morality

Sarah frequently referred to events happening at the time of her lessons, including, in sequence two, powdered rhino horn, the Facebook campaign about plastic straws, Clock 23 and a David Attenborough documentary about plastic in the sea which many students had watched. Sarah believes that it is the job of geography teachers to be up-to-date in their subject knowledge which includes recent academic research and events reported on the news. The latter in particular may contribute directly to lesson or it may be a case of raising awareness:

> …in terms of day to day; I'll know that there was an earthquake in New Zealand and I'll just say to the kids, oh you should keep an eye on that. We don't have time to always teach the topical stuff, but I think just flagging up to them that things have happened is important. (GI1/4)

Sarah also wants to offer practical help to her students. In the first sequence she talked to students about why buying a property too near cliffs could be a mistake; in another lesson, she teaches students what to do in an earthquake 'and I actually think that's really useful' (GI1/9). She suggests that seeing the world geographically is empowering: 'I always say this to them: when you're next on holiday with your mum and dad, or whoever it is, you can go, oh look that's soil creep over there' (GI4/5). It matters to Sarah that she is giving her students a tangible way of looking at their world, be at a local, national or global level, that takes them beyond the knowledge of 'armchair geographers':

> because they can watch, I mean David Attenborough's Blue Planet, is bringing up all sorts of bits. It had a whole chunk on carbon sinks in oceans, which is amazing, and obviously it's very accurate, but it's a small component and I would argue that you need to understand the bigger picture. (GI5/3)

The students I interviewed explained that 'geography is about the future'. They also emphasise the contribution of geography to understanding your environment: 'You should know where you live'; 'it [geography] makes me more aware of where I'm living'; 'If I go to the countryside I will understand what's around me – I'd take it in'.

The students were also aware of some of the moral issues at stake in geography: ‘sometimes – when you’re learning about climate change – it makes you feel that the world is doomed – for example by 2050 half of Bangladesh will be under water. But it also makes you feel more obliged to help the world – to make a difference.’ Sarah also talked about the moral dimension of our treatment of the environment:

> I would argue there is a moral, as a teacher, so if I was teaching my tutor groups sometimes I show them the little bit on plastic from Blue Planet, just because I’m like, actually I am a teacher and you are young people, your heads are full of social media, actually let’s just stop a minute
>
> *mmmm*
>
> This ocean’s very beautiful and it’s being destroyed. So it’s a bit cheesy but I mean I, that’s probably one of the reasons why I was a teacher in the first place. (GI5/13)

She is especially interested in the Anthropocene, ‘but I don’t want to overdo it’ (GI5/20). She treads a careful path between wanting her students to take the issues seriously but not feeling that it is solely their responsibility to fix them (see also Morgan, 2012).

Another example of a moral issue that Sarah is aware of relates to the developing world. I have already touched on this in the example of deforestation in the Amazon – shouldn’t people there ‘have their moment’ of prosperity comparable to that of the western world even if that destroys much of their habitat? Shouldn’t the Chinese be able to eat more meat as the west has done for years even if that is increasing methane emissions? And who is hit the hardest by climate change – the most vulnerable in developing countries:

> the climate change refugees one is a good example of that so when the lesson that you didn’t see was about um solutions and climate change refugees is like a solution, but it’s only cause they have to move out of the way cause if they don’t move out of the way they’re going to be in a drought stricken area that can’t provide any food. So it’s adaptation, but it’s not very nice adaptation. And we talk about that a little bit. (GI5/20)

These are important and difficult questions with a strong moral dimension. This dimension is not evident in all geography lessons – for example they were less obvious in the first sequence than the second - but for Sarah and for the students I interviewed, it was an important one.

5.7.4 Maturity

In terms of specific areas of geography that students find challenging, Sarah suggests that physical geography is harder but admits that this may be because she finds it harder having specialised in human geography at university. The students I interviewed all preferred human geography to physical geography and highlighted ‘rocks’, ‘flow line maps’ and ‘maths’ as the hardest elements of the subjects Specifically, Sarah thinks that geological time is hard to understand and that this is one reason to teach climate change at year 9 and not before. However, the level of maturity is not generally a factor in deciding what to teach when according to Sarah with one further exception being China which is taught in Y9 partly because of the one baby rule: ‘China and the one child policy we wouldn’t do until year nine cause it’s actually quite a sensitive subject cause you have to mention about baby girls and stuff like that’ (GI5/23).

I have already mentioned Sarah’s awareness that climate change is a topic that can be daunting to young people: ‘I don’t want you to go around thinking that you’re carrying the weight of everything on your shoulders’ (GI5/8). During the student interview, there was reference to lessons on climate change sometimes making you feel that ‘the world is doomed’ but when asked whether they felt positive or negative about the future they responded ‘positive and negative – you can’t really predict it fully – some things may be bad and some things may be good.’ They were clear that they were influenced by their geography lessons in their views about this. Sarah’s awareness of the impact of lessons such as the second sequence was illustrated at the end of the second lesson:

> But I don’t want you to go away feeling it’s all doom and gloom – because we’ve made so many amazing advances in things like medicine and transport – surely we can do something to counteract some of the problems we’ve created. (GL2/2/10)

5.8 Knowing: what does the *learning* look like?

This section outlines particular features of the teaching strategies that Sarah deployed in the two sequences. Two of these strategies will be familiar from the previous chapter; the third is a more distinctive feature of Sarah’s practice.

5.8.1 The role of dialogue and scaffolding

There was a strong role for dialogue in the lessons, though not to the extent of history and physics. In the first sequence, about a quarter of the time was spent engaged in dialogue, mainly whole class question and answer but also some paired discussion between students. This was less time compared with the second sequence and reflected the pressure Sarah felt under to ‘cover’ the material set out in the specification. In the second sequence, almost half the lesson time was spent engaging in either dialogue between Sarah and students (28.5 per cent of the lesson time) or between students themselves (18 per cent of lesson time).

In all of Sarah's lessons there was a mixture of her 'teaching from the front' and explaining things to students, some copying from slides, some whole class discussion and opportunities for students to engage in activities by themselves or in pairs or small groups. In terms of ensuring that the subject is accessible, Sarah mainly focused in interviews on the amount of substantive knowledge now required at GCSE. She is very worried about the speed she has to go (for example in sequence one) and whether the lower attainers will keep up. Helping students to structure and organise the knowledge is a key part of the first sequence and Sarah uses many techniques to do this including structured worksheets, green pen tasks (where she provides correct information and the students correct their work in green pen), lots of reassurance (for example in sequence one when she talks about 'intelligent guesswork' and reassures students that they should just have a go) and ensuring a variety of tasks and opportunities to revisit:

> It's empowering. I also think it's means - it's a bit cheesy, but as a teacher it means you've got a belief in them that they're going to be able to do something. I think that's really important that every single time - come on - you can do this - you're going to know something - don't worry. Also, it's about risk-taking. It's about, it doesn't matter what you write in that box - you're going to write the right answer in green - it doesn't matter at all - let's just take a risk and go for it. (GI3/7)

The visual starters that Sarah has in both sequences are deliberately chosen to make lessons more accessible: 'I like to have something on the board for them when they come in so in that sense it's very practical, it's visual, every child can do that.' (GI5/25).

5.8.2 Assessment

Assessment was a major influence in the first sequence as Sarah taught a new GCSE specification for the first time:

> In the specification there are four lessons which introduce them to physical landscapes in the UK. So, because this isn't Key Stage 3, I'm literally following the spec. So the aim of this lesson was to do the lesson that the specification tells me to do, which you can have a look at it. So it's 4.1a. Okay, so very simply; this is a nice neat four lessons. The enquiry lesson is; why does the physical landscape of the UK vary from place to place? It's broken down for me with knowledge and skills. So in this sense I have just done what I've been told. (GI3/1)

There are interesting implications here for the notion of Sarah as a 'curriculum maker' but I would argue that by enacting a curriculum in lessons, she is still 'making it' because of the all the decisions she still makes. However, the difference between the two sequences does suggest a spectrum of curriculum making. In Section 5.6.1 I outlined Sarah's concerns about the amount of knowledge that students are now required to cover at GCSE, despite her commitment to a knowledge rich curriculum and it was clear in the first sequence that this had an effect on her teaching which left her unsure how much the students would remember.

As with the physics sequence, teaching at GCSE also made Sarah very aware of the demands of the examination and she shared two sample GCSE exam questions with the students (lessons two and four). She was aware that students would need to be familiar with case studies:

> Case studies you go into a lot more detail. You have to know what we call place specific detail. It used to be just regurgitate it in the exam, but really you should be applying it to a question, so that the question comes alive with real-world knowledge. What we also try and get them to do is name-drop real-world examples. GI3/8

As with Robert and Tom, Sarah did not offer any serious criticism of the specification and examination at GCSE in terms of it being 'bad geography'; she was simply aware that it was a rush to cover everything and that students needed to have an eye on how examiners would want them to answer questions about the material they were studying.

Assessment at key stage three was undergoing some revision when I visited with the aim to assess progress more systematically. Sarah did not imply that this was a constraint on her practice but as I have already mentioned, the way she described this assessment did not match the sophistication of her thinking about school geography. This is almost certainly not unique to geography and Sarah was more open about assessment in general than either Tom (history) or Robert (geography) so it would be a mistake to read too much into this, but as I suggested earlier, this does connect with the literature and the debates within the geography education world about the challenge of describing – and measuring – progression in geography.

5.8.3 Visual images

So far, I have identified two aspects of 'knowing' that informs Sarah's practice. There is a third aspect that is particular to geography that I would like to identify, that of the role of visual images. Brooks (2017) notes that the use of visual images in geography classrooms has been a preoccupation of students writing dissertations for master's course in geography education and the frequency and quality of the images Sarah used was striking (see Figure 5.3). These images were mainly photographs of places or examples of specific processes (such as landslides) but they also included maps. I have already noted Sarah's use of images to enable students to travel virtually to places and submerge themselves there – and to appreciate the awe and wonder of these places. But they were also a very practical teaching resource, communicating the idea of soil creep, for example, or drilling arctic ice cores.

Maps were an important feature of the first sequence and were used frequently, especially in the first and third lessons as Sarah ensured that they had secure knowledge of place locations.

5.9 Summary

Analysing Sarah's practice and reflections revealed the complexity of geography which emerged as a huge exercise in synthesis in which multiple influences are brought together. These include:

- Marrying human and physical geography
- Balancing the general and the particular and encouraging spatial connections
- Drawing on multiple disciplines and therefore multiple perspectives (e.g. science, economics, anthropology)

Underpinning these in Sarah's practice are geographical skills, geographical terminology and a desire to provide evidence to support claims about the physical and human world. The very fact that I needed to observe two sequences illustrated geography's complexity.

Many of Sarah's reflections mirrored or were influenced by the current debates in geography education, including a desire to avoid sensationalism (Standish, 2009) and a determination that her students will see the world as geographers and 'think geographically' (Lambert, 2016, Jackson, 2006). The difficulty of translating this thoughtful and sophisticated set of aims into a model of progression also reflected broader debates about what getting better at geography entails (e.g. see Biddulph and Lambert, 2017).

What was evident to me during my interactions with Sarah was the enormous contribution geography makes to students' understanding of their world and the way that the subject's potential is sometimes compromised by the demands of external and internal assessment. The students were hugely enthused by geography, though having chosen to study the subject at GCSE they are not necessarily typical. Nevertheless they were powerful advocates for a subject which, they suggested, was about 'what's going to happen in the future'.

Chapter 6 History

In this chapter I start by exploring what kind of knowledge history is before providing a brief overview of history education. I then explore the nature of school history specifically, its relationship with disciplinary history and ways in which students find it challenging. I end this initial overview with some comments about current debates within history education. I then introduce the case study and explain how I have analysed the data before spending the majority of the chapter outlining my findings.

6.1 What kind of knowledge is history?

As outlined in Chapter Two, Biglan's three dimensions (1973) offer a helpful way to characterise different subject disciplines. According to Biglan's model, history is *soft* (i.e. it has no strong paradigms), *pure* (it is not applied knowledge) and *unconcerned with living things.* Biglan's findings in relation to history are echoed by more recent work by Yates (2017) who provides a series of helpful definitions of history, the first two of which clearly reflect Biglan's model. She argues that history is:

i. Pure and soft, i.e. it is characterised by non-applied purposes which makes it pure but not by paradigm consensus which makes it soft
ii. Horizontal rather than hierarchical knowledge in Bernstein's terms (i.e. it does not build sequentially towards higher levels of abstraction)
iii. Linked to ii above, it attends to specificity and detail rather than promoting models or common themes – 'substance and specificities matter' (p. 49).

Yates is particularly interested in history as the product of social values and identities: whilst she acknowledges the agreed methodology of historians and their common desire to seek for truth through a disciplined use of evidence, history can never be judged 'objectively true'. When historians move beyond isolated facts (such as a date when something happened) towards claims that attempt to make meaning and discern patterns in the past – in other words when they move beyond chronicle and towards history whose literal meaning (in ancient Greece) was 'enquiry' – then we move beyond a world that can be fully verified. As Tom, the subject of my case study, says, there are no right answers in the backs of school history textbooks. The traces that the past has left us are either too fragmentary or too overwhelming for historians to make use of conclusively. However, the absence of paradigm consensus is as much to do with the 'knower' as the knowledge itself (cf Firth, 2011). Historians cannot escape their place in the world; their preoccupations, their way of interpreting evidence and their values are all a product of their social environment. Thus, even those historians who resist a relativist view of knowledge (such as Evans, 1997) cannot deny that what they do is an inescapably social activity. Ormond (2014), in setting out a case for history as powerful knowledge by claiming that the rigorous use of evidence turns it into a quasi-scientific endeavour, is on an impossible mission in her claim that history gets close enough to objective truth to align itself with hierarchical knowledge structures.

6.2 History as a school subject

The recontextualization of disciplines into school subjects is, as I have suggested in chapter 2, an important dimension of my research. Not only am I interested in the extent to which teachers 'know' their subject and the discipline from which it derives, I am also interested in the extent to which they understand the recontextualization process and are able to draw on this to inform and shape their teaching goals. In this section, I provide a brief overview of the development of school history before considering more directly the connection between academic and school history. Finally, I turn to the most important dimension of recontextualization, the students, to consider what concepts they find especially difficult when studying history.

6.2.1 Historical context

> 'there is a 'crucial distinction between knowing the past and thinking historically' (Slater 1989)

It is generally accepted that for much of the twentieth century, school history could be chiefly characterised as the teaching of accepted narratives without much attention to how those narratives were formed (Sylvester, 1994). In 1968, Mary Price wrote an influential article entitled 'History in danger?' which suggested that history in schools could go the same way as Latin and become a niche subject, existing only in grammar and private schools. Such warnings, coupled with government funding given to schools' council projects across a range of subjects in the 1970s, were instrumental in the emergence of the 'new history' movement in England. The 'new history' movement emphasised history as both a body *and form* of knowledge and found ways to make this explicit to young people through curricular devices such as second order concepts (Counsell, 2011) and enquiry-based methods (e.g. Riley, 2000). This brought 'an epistemic tradition to a pedagogic site' (Counsell, 2011, p.202) and in doing so anticipated a Future 3 curriculum (see pp. 37-38 of this thesis) where children learn about the past but also understand *how* we know about that past and what the *limits* to 'knowing' it are. Without this metahistorical dimension – without the 'systematic instruction in the methodologies and vocabulary of the discipline' – school history can become a ‘sentimental affair where the past is to be admired or scorned (rather than analysed)’ (Sheehan, 2013, p.70). This way of thinking about history and the past – analytically, critically and aware of the provisionality of the knowledge created – became known as ‘historical thinking’.

Thus, what emerged out of the work of the Schools History Project (SHP) was a conception of history comprising concepts at two levels: first order concepts which operate at the level of substantive knowledge such as revolution, empire and monarchy and second order or structural knowledge which focuses on ‘history as a form of knowing’ (Chapman, 2016, p. 327) and includes concepts such as change, causation, evidence and empathy. Collectively these second order concepts provide a way to ‘think historically’ about the past rather than confining it to folklore, the heritage industry or single narratives. The relationship between first and second order concepts was conceived as symbiotic: neither is more important than the other, nor does one precede the other because they depend on each other for meaning. Chapman (ibid.) describes it as follows:

> The ‘second-order’ is not secondary – in the sense of being a mere supplement to ‘primary’ factual knowledge. It is better understood as *meta*historical knowledge and understanding – as knowledge and understanding *about* historical knowledge and understanding. Second-order knowledge and understanding is fundamental to the development of substantive knowledge in history above the level of isolated or aggregated ‘facts’: it helps both *to form* substantive knowledge (assisting in knowledge building) and gives substantive knowledge *form* (assisting in organizing and structuring substantive knowledge). (p. 328)

To return to Winch’s (2013) point (see p. 34), when he suggests that history curricula are overly ambitious by inviting pupils to identify questions to investigate, it is important to make clear that the aim of history in schools is not to create ‘mini-historians’. There is, however, reasonably common acceptance amongst history educators that students can draw on first and second order knowledge in order to assess claims and develop arguments and explanations through a process of enquiry. There is no expectation that the outcomes of such enquiries will be new or original; pupils can only carry out a rudimentary historical investigation and draw in relatively crude ways on the processes used by historians. But in encouraging them to ‘read like historians’ or to ‘think like historians’, we are using ‘like’ in terms of analogy, not identity (Chapman, 2016).

6.2.2 The relationship between school history and academic history

As knowledge producers, academic historians draw on the ‘epistemic rules’ of history which are deconstructed in schools through the second order concepts. These concepts[9] would not be alien to historians: they draw on them in their work. Indeed, in Yates et al's research in Australia, university historians and school history teachers did share some notion of what gives history its distinctive quality, citing working with evidence reaching critical judgements and so forth (2017). But the extent to which historians think about these sorts of concepts in isolation and consider what it means to get better at, say, analysing change, is less likely. They have no need to do so because they *are* the means of producing historical knowledge: they do what the second order concepts collectively describe. Thus, the second order concepts exist in schools as a curricular device, indeed 'the most efficient device we have for defining the structure of the discipline in curricular terms' (Counsell, 2011, p. 217). They are one of the principal means by which history is recontextualised in schools although they are themselves a construct and open to change. The fact that Canadian history educators have identified the 'big six' second order concepts that do not map precisely onto the English ones and indeed in one case – the 'ethical dimension' - departs dramatically from them is a good demonstration of this (Seixas and Morton, 2012).

6.2.3 Student understanding of history

There is growing evidence that student preconceptions play a significant role in shaping what students learn in their lessons (see, for example, Donovan and Bransford, 2005). In history, students will arrive with their own understanding about 'the way the world works and how people are likely to behave' (Lee, 2005, p. 31) and it is also perfectly possible that they will arrive already knowing something about the topic to be taught. History is everywhere and students, like adults, are 'consumers' of the past, able to access history through the television, film, family histories, heritage sites and so forth (Phillips, 1998b). Failing to engage with these preconceptions can result in students failing to connect what they know outside the classroom with what they learn inside, leading to alternative 'versions' or even a rejection of what is learnt in school (see, for example, Epstein, 2009 and Barton & McCully, 2005).

There is a rich seam of work on student understanding of history.[10] I have provided examples of the kinds of misconceptions students may hold in Figure 6.1.

[9] Currently consisting of (in England) change, cause, evidence, significance, interpretations and similarity and difference

[10] See Lee, 2005 & 2014 and Kitson et al, 2011

Figure 6.1 Student misunderstandings in history

Types of understanding important to thinking historically	**Examples of student misconceptions**
That history is constructed from imperfect evidence	The truth is out there, it's just a question of finding it. Teachers withhold this truth to make us work harder.
That people in the past were not like us	People in the past didn't have the sorts of things we have now because they were stupid.
That change (and continuity) happens in irregular patterns.	Change must mean progress because history has been one long march to now.
That all history is constructed: it is an interpretation.	All accounts of the past produced after the event cannot be trusted – you had to be there to know what happened.

These potential misconceptions are likely to severely impede the progress students can make in historical thinking and thus opportunities to diagnose and address them play an important role in school history.

6.3 Current debates about school history

The substantive knowledge taught in history classrooms in England is currently receiving more attention than in recent years. To some extent, this has been a consequence of Young's work (2008) which was received enthusiastically by history educators despairing of a generic trend in schools resulting in combined humanities programmes, a one-size-fits-all mode of progression within Bloom's Taxonomy and 'empty' skills-based curricula (see Counsell, 2017b). The other major influence has been political as a new Coalition government in 2010 appointed a neo-traditionalist, Michael Gove, as Secretary of State for Education. Gove (2010) emphasised the role of substantive knowledge in general and in history, a national narrative which was dominated by British history, outlined in extensive detail in the initial draft of a new national curriculum (Burn, 2015). This renewed attention on substantive knowledge has focused primarily on two things: the amount of knowledge young people should learn and the type of knowledge it should be (with an emphasis on chronology, narrative and a 'canon' – see, for example, Murray, 2017; Gove, 2010). The new GCSE course in history contains more content than the previous version and some schools are opting for 'knowledge rich' history curricula at all stages which emphasise substantive knowledge building.

This renewed interest has met with mixed reactions including a reassertion of the definition of school history as the interplay between first *and second* order knowledge. In other words, whilst no one is suggesting that substantive knowledge does not matter, some are emphasising that's history's unique contribution lies not just in knowledge accumulation but in the kinds of special historical thinking such knowledge enables (Cain and Chapman, 2014). Neo-traditionalist Gove may claim a commitment to specialist subject knowledge but he sees school history *only* as the acquisition of a body of knowledge about which you think in *generic* kinds of ways as the following quotation from Gove demonstrates:

> It is only when knowledge is secure in the long-term memory that it can be summoned up effortlessly and the working memory can be freed to deal with new and challenging tasks... the more people know about any subject domain the easier it is for them to store and utilise new information creatively... critical thinking skills - such as... interrogating sources in history - depend on extensive background knowledge - about what... might be suspicious omissions in a contemporary account of events. (Gove, 2013, as quoted in Cain and Chapman, 2014, p. 112-113)

What Gove fails to acknowledge here is that a study of history in school requires a distinctive *way of thinking* as well as a body of knowledge if it is to reflect what academic historians actually do. The risk of an agenda which fails to acknowledge the role of such specialised disciplinary thinking whilst simultaneously arguing for copious amounts of substantive knowledge is a drift towards an F1 curriculum.

A parallel debate concerns *what* history to teach and how to support students to build frameworks and big pictures of knowledge that they can turn to in order to navigate and explain the present (and future). The most well-known of these at the time of writing, but not developed in practice as yet, is the model advanced by Howson and Shemilt (2011) who proposed four 'meta' frameworks each focusing on a different aspect of humanity including modes of production and culture and praxis. Others, such as Hawkey (2014) have argued that history should draw on big pictures in order to tackle 'wicked problems' such as climate change. In Figure 2.2, I have suggested a series of prompt questions which could support teachers in making content choices and which might provide the beginnings of an answer to the question 'what is history powerful for?'

6.4 Introduction to the case study

In this section I provide details about my case study, including biographical information about Tom and background information about his department and school before outlining the data I collected and an outline of the lesson sequence I observed.

6.4.1 Tom and his department

Tom studied history and politics at Queen Mary University where he focused mainly on modern (post 1789) European history, although he did learn some Latin American history as part of the politics course. Since then he has developed a particular interest in modern Asian history. After graduating, he pursued a career in politics, working for an MP for three years before a 'crisis of identity' led him to seek another career. He considered teaching but did not want to follow the path of both of his parents and opted instead to train briefly as a clinical psychologist. However, by his late twenties he 'couldn't resist any longer' and did a PGCE in secondary history at the UCL Institute of Education in London. His love of history was palpable throughout the interviews and the way history informs his world view was clear:

> *AK: why have history on the curriculum at all?*
>
> Tom: Well, I mean it comes back to my own life I suppose. My love of history and what I want to pass onto others is it gives us a sense of who we are. The analogy I always use…is when you meet someone new you ask them where did they grow up and it's one of the first things you ask them and immediately you get a handle on somebody or you think you do – you think ah, if they grew up in in the north in the 70s or 80s this must have been their common experience – does it make sense?
>
> *AK: Yeah*
>
> Tom: That's the same for us collectively. If we know where we come from we understand who we are, why we're in the position we're in, so for me personally for instance, my mum and dad were working in Germany so growing up as a child in the 1980s – I was constantly thinking why we are here – why is the British army in Germany? We lived in … a village near Bergen Belsen so that was on our doorstep so from a young age I was inquisitive about the history around me – why is the British army here, why are we frightened of the Russians, what's going on in the Cold War. So the questions that were bigger than your average 6 year old might have and that really inspired my interest. So what I'm getting at is that even though I was conscious of that because I love history, I feel that everyone has those questions, and it's all obviously personal to them so for me teaching history is about satisfying that inquisitiveness that people have in them whether they are conscious of it or not.

This sense of history helping us to orientate ourselves and shaping our identity helps to explain his commitment to making history relevant and meaningful to his students:

> In this school, why do we live in a multicultural community – you know, issues like that, learning in history we understand who we are as a collective, but then also as individual. So that's kind of why I love it and why I want to teach it with students I suppose. If that makes sense.

Tom has mentored several student teachers over a period of about six years which is how I knew him.

Working closely with Tom was Emma who is second in charge of history and has been teaching for three years. She also completed her training at the UCL Institute of Education in London. Tom's department is regarded highly by the school and has had considerable stability in its staff over several years. Recruitment to history GCSE and A Level is strong. At the time of my research, the key stage three scheme of work was chronological, starting with the Norman Conquest in year 7 and ending with an introduction of the Cold War at the end of year 9. The GCSE and A Level courses were both in the process of changing: the A Level course was new that year and the new GCSE was due to start the following autumn.

6.4.2 Tom's school

Tom's school is a larger than average, non-selective mixed comprehensive in London with a student roll of 1656. It converted to academy status in 2011 since when it has opened a primary school which at the time of my research comprised of Reception and key stage one classes. It has a sixth form college onsite which is the result of collaboration between local schools. In 2016, 16.9 per cent of its intake was eligible for free school meals (14.3 per cent was the national average in England in the same year). One third of its students are White British. The other largest ethnic groups represented are Black African and Black Caribbean. The proportion of students with English as an Additional Language is above average. It was last visited by Ofsted for a full inspection in 2014 where it gained outstanding across all categories.

6.4.3 Generation of data

I observed Tom teach four lessons in June-July 2016 to a high attaining year 8 set of 27 students. I also interviewed him on four separate occasions for a total of four and a half hours. The interviews followed the pattern set out in chapter 3 with a slight change in the fourth interview in which I asked detailed questions about lesson three as well as more general questions about the sequence as a whole. The third interview focused on the first lesson of the sequence.

I also interviewed Emma who is second in charge of history for 30 minutes and a student from the Year 8 class I had observed for 20 minutes. The student interview was not ideal as I wanted to interview a small group but unfortunately this did not happen due to mixed communications and logistical challenges on the day.

Alongside the interviews and observations I collected documentation where available. Primarily this included the resources and slides from the lessons, the Sixth Form prospectus which included a page on history (Appendix 19) and the key stage 3 schemes of work (see Appendix 20 for an extract).

6.4.4 Overview of the lesson sequence

The sequence came at the end of a unit on 'Black Peoples of the Americas' in which the class had already been taught about the trans-Atlantic slave trade. The four-lesson sequence I observed finished the unit by exploring what happened to ex-slaves after emancipation. The question that shaped the overall sequence in the mind of Tom but which was not explicitly explored with students at the end was 'What was the legacy of slavery?' Note that Tom planned the sequence from scratch because of the freedom at key stage three to teach pretty much anything you want. It was also approaching the end of term and there was no assessment connected to the topic so Tom was particularly free to take the topic in the direction he wanted.

The first lesson began with the Emancipation Proclamation in 1863 and whether life improved for the ex-slaves afterwards, with the conclusion that in many ways they did not. The second lesson moved onto the early 1900s and compared four African American people and organisations wanting to bring about change in different ways. The third lesson briefly explored the impact of WWII on the struggle for equal rights before focusing on Rosa Parks and the bus boycott. In the fourth and final lesson, students looked at the Civil rights movement through the prism of two popular songs from the 1960s before reflecting on some big questions relating to the unit as a whole. See Appendix Eight for a more detailed summary.

In terms of substantive (first order) knowledge, Tom took a chronological approach and provided knowledge through a combination of direct teacher instruction, sources, information packs and PowerPoint slides. The chief second order conceptual focus in the sequence was impact (an aspect of significance), but change, evidence, causation, empathy and perspectives were also present as additional foci.

6.5 Thematic analysis of the data

The data for history was thematically analysed under the three broad categories of knowledge, knowers and knowing (see Chapter 3 and Hoadley, 2011) and Winch's (2013) distinction between inferential and procedural forms of 'know that' knowledge (see chapter 2). Within these broad categories, as with the other two subjects, I coded the history data inductively (see Appendix 21 for an early draft of the history codes and Figure 6.2 below for the final version). It is worth noting that history was the first subject I analysed thematically and hence there was some early clarification needed and some later back and forth between subjects as I subsequently analysed geography and physics. For history, a number of clear themes emerged (the role of narrative, conceptual complexity, dimensions of a good historian, maturity, morality and assessment) whilst others required much greater refinement. For example, within the first category of 'knowledge', 'depth and breadth' was a code initially before I combined it with 'narrative frameworks' and 'big pictures'.

Figure 6.2 The categories and themes used to code the data in history

Knowledge: *What* is to be taught?
Propositional knowledge ('know that'): core knowledge, entitlement and chronology Inferential 'know how': narratives, big pictures and conceptual complexity Procedural 'know how': perspective recognition and 'being a good historian' Progression
Knowers: Who are the *learners* and what are their needs?
Maturity Morality Meaning and engagement
Knowing: What does the *learning* look like?
Influence of a constructivist theory of learning, especially dialogue Assessment

The theme of ‘progression’ was not initially included as I felt the concept was addressed within the other themes, but having identified it as an important theme in its own right in my analysis of geography and physics and influenced by my rereading of Winch’s (op. cit.) work on epistemic ascent, it seemed justifiable to include it and to revisit and recode the data accordingly. ‘Personal development’ was briefly a theme under the second broad category of ‘knowers’ but I made the decision to subsume this within the categories of morality and maturity. A final theme within this category, ‘cultural and intellectual artefacts’, was removed as the data to support it was, on reflection, too sparse. Finally, the earliest attempt to code the final broad category of ‘knowing’ was unsatisfactory, probably reflecting my less secure understanding of Hoadley’s (op. cit.) meaning. There were five codes in this category initially: the influence of constructivism, simple to complex, assessment, everyday ‘portals’ and oracy and dialogue. However, I realised that many of these themes were extensions of a constructivist pedagogy and hence I was able to subsume most of these into a single code.

6.6 Knowledge: *what* is being taught?

My coding for this section was heavily influenced by Winch’s (2013) development of the work of Hirst (1965) which I explored in detail in chapter 2. I originally analysed the data according to Hirst’s first two forms of knowledge, propositional and procedural, giving them roughly equal weight and in effect using them as proxies for the first and second order types of knowledge in history. However, this felt like an artificial separation and Winch’s distinction between inferential and practical ‘know how’ provided a much better alternative. I still have a section below on propositional ‘know that’ knowledge but it is relatively short as I have restricted this to ‘stand-alone’ knowledge – in effect, ‘lists’ of topics to be taught. The actual *process* of helping students understand and apply substantive knowledge to their thinking is now explored as inferential ‘know how’ knowledge. The final part of this section moves onto procedural ‘know how’ knowledge and examines how Tom and his department set out to provide insight into the epistemology of history and the light this sheds into the way knowledge is generated within the discipline.

6.6.1 Propositional knowledge (‘know that’): core knowledge, student entitlement and chronology

i. Core knowledge and student entitlement

Discussions about what history students should learn are commonplace amongst politicians and the media (Phillips, 1998a). Typically, many history teachers are reluctant to identify a canon of knowledge that all children should learn about but they may mention a small number of topics that children have an *entitlement* to know (Husbands et al, 2003). Both Tom and Emma reflected this tendency. Although Tom isn't entirely confident that students remember the factual knowledge they learn in lessons in detail and he shied away from specifying a lengthy list of topics that students should learn, he does believe that there are things that students *should* all know about:

> 'We decided we'd steer away from Germany there [at GCSE], but again that then puts pressure on our Key Stage 3 curriculum because we all agree that actually to understand the modern world and understand modern Europe especially, you do need to know about Nazi Germany and so on. So in actual fact, that's another thing that we've got to think about with our Key Stage 3: what are the things that we really believe must be taught, and where do they fit in? So Nazi Germany is something I think - okay we don't want to over-do it, but we can't not do it either.' (HI2/14)

Emma similarly believes there are things all students should learn though she too only identifies one such topic: 'you can't send a key stage three pupil out without knowing about the Holocaust'.

Choosing what to include in a history curriculum is challenging because of the sheer amount of history to choose from and choices are inevitably influenced by aims. This is certainly one area where history in the academy can offer little assistance - there is no collective agreement on what should feature on either under-graduate or school history curricula and not even an agreement on a common 'core': 'the discipline itself does not have an agreed foundational position on what is the core content of history as the object of study' (Yates et al, 2017, p. 49). As a 'soft', 'horizontal' form of knowledge, there are no compulsory building blocks in terms of substantive knowledge. You can become an expert about guerrilla warfare during the Vietnam War, for example, without knowing anything about warfare in the middle ages. In this context, it is unsurprising that history teachers often emphasise procedural over substantive knowledge when discussing the purpose of history education (Husbands et al, 2003). It is easier to agree on historical ways of thinking than on specific topics to teach. The mistake would be to assume that substantive knowledge therefore doesn't matter to teachers. Teachers can often provide developed rationales for the specific topic choices they make even if they are reluctant to specify what others should teach (e.g. see Husbands et al, 2003 and Yates and Millar, 2016).

Tom exemplified this in his rationale for teaching about the experiences of African Americans after emancipation: he was very clear and committed about his reasons for teaching it (as described below) but he didn't therefore assume that everyone should teach it. As a head of department he was also thinking hard about the history curriculum of the school as a whole and what it is important for students to know:

> I do think that knowing something of what happened is also important. The problem is of course – there is a political dimension to that – how do you choose – and that is difficult but it's also the nature of what is it that they want to learn about that. For instance one of my frustrations that I want to address as hod [head of department] is I want us to focus much more on a sort of backdrop to the multicultural community we are – I would like us to do more modern history – perhaps it's a personal interest – be interesting for students here to know about the partition of India, Windrush, so for me I do want them to know about that. Do I care if they know if Windrush was 1946 or 1948 – not really. But I do want them to know what Windrush was and the significance of it. In terms of the knowledge I do want them to know certain things. But it's more the significance of them than the actual ins and outs of dates, names, I don't really care if one of my kids knows the date of the arrival of the Windrush but I do want them to know what it was and why it was important so I do think it's important for them to have knowledge. For me, the important thing is the significance rather than the ins and outs that you could google. (HI1/7)

Here, Tom clearly stated that it matters to him that students know things about the past, not in terms of precise factual details such as dates, but in terms of what happened and what the significance of it was. To draw out the significance of events (or people or trends) or indeed to explain why things happened or how things have been interpreted, students usually need some wider contextual knowledge and a sense of chronology; in this sense whilst a modern military historian may not need to know about medieval warfare, there will be things she or he *does* need to know about beyond the immediate context of, say, Vietnam. Again, this is not fixed and there is no agreed way to sequence such knowledge, but to use the example of Tom's lessons, in order to make sense of the legacy of slavery on African Americans in the late nineteenth and early to mid-twentieth century, there is a 'core' of information students will need which relates to a. the pre-emancipation period and b. the post emancipation period. It is hard to imagine teaching this series of lessons without students knowing something about slavery, what it was, when it started, why it existed, when and why it ended. Post emancipation, it would be equally hard to imagine not teaching them about the Jim Crow laws and the Civil rights Movement. In that sense, then, whilst history does not have 'core' substantive knowledge in the way physics does, once a topic has been selected, there is a degree of specific 'core' knowledge associated with it. It would be wrong to push this too far, however. In choosing to teach this specific topic, Tom still had many decisions left to make about what substantive knowledge to teach and in what depth to teach it, including:

- how early to start chronologically (he starts with the post emancipation era because the previous unit had already explored the trans-Atlantic slave trade in detail)
- when to stop (he chooses1968)
- who to cover in detail (Rosa Parks)
- who to mention in passing (Martin Luther King)
- what to cover in outline (the immediate post emancipation era in lesson 1; the 1960s Civil rights Movement in lesson 4)
- what to cover in depth (individuals and movements in the early twentieth century in lesson 2; Rosa Parks in lesson 3)

No lists of substantive knowledge provided by the government (in the form of national curricula) or by awarding bodies (in the form of examination specifications) can make all these decisions for the teacher and the National Curriculum in particular does not try. Even the examination specifications - which teachers can take literally and only teach what is listed there - do not preclude teachers from adding material that provide extra detail or context. These decisions are down to the individual teacher and relate to their particular goals.

ii. Chronology

It is worth commenting on one final point here which is Tom's decision to teach the topic chronologically. Whilst the reasons for doing so relate to inferential know how (and will be developed below), the fact that he believes this to be important is an aspect of what history *is*. It is perfectly possible *not* to teach the whole history curriculum chronologically but *within* a topic, having a sense of the chronological framework is essential because history is a study of time: of changes over time, of specific moments in time, of the differences between times. In relation to Tom's comments above about revising the curriculum in his school and introducing a new focus on Windrush, he slightly contradicts himself by saying that 'dates and things, yes, important they have a chronological understanding and it was the second half of the twentieth century'. Students need to know what happened in what order and when: without this history loses meaning. This is evident in the way Tom taught his lesson sequence.

6.6.2 Inferential ‘knowledge that’: narratives, big pictures and conceptual complexity

In this section I will start by exploring how narrative frameworks *within* topics shape Tom’s practice before moving onto ways in which he conceptualises bigger pictures *across* topics*.*

i. Narrative frameworks

A narrative framework enables students to understand what happened and when in chronological order. For Tom, providing a reasonably complete narrative of the experience of Black people in the US between c1865-c1965 was important: ‘I felt I needed to provide them with some kind of narrative and chronological framework to explain the legacy post-slavery’ (HI4/1) and ‘That was my overarching aim from these lessons….to be able to give them a sort of chronological framework’ (HI4/11). A narrative thread can be seen clearly in every lesson, sometimes provided by Tom verbally to the students with accompanying images on slides and sometimes through student activities. In lessons one and four, the aim was to provide a narrative overview whilst in lessons two and three, Tom chose specific individuals and moments as the primary focus, finding ways to help students connect the smaller and bigger stories with the overall narrative framework. A good example of this was in lesson three in which, although the primary focus was a study of Rosa Parks and the Montgomery Bus Boycott, Tom spent the first 25 minutes of the lesson exploring changes around the time of the Second World War in order to connect the previous lesson (four individuals’ attempts to promote change between 1900-1930) with this one. Using a series of images, Tom established ways in which the Black community was influenced during and after the Second World War. For example there were Black soldiers fighting in the US army against racists in Germany; radio helped to spread messages; the levels of education of the Black community were rising; more travel within the US meant that many Black people living in the South saw a better life in cities such as Chicago and New York. This information provided a bridge between the previous lessons and the actions of Rosa Parks and the emergence of the Civil rights Movement in lesson three.

Not all of Tom’s attempts to ‘fill in the gaps’ were so lengthy. In lesson two, he spent about eight minutes explaining the situation for ex-slaves in 1900 and outlining key factual information such as the Jim Crow laws, education and voting statistics, the Ku Klux Klan and lynching. Again, this picked up roughly where the previous lesson ended - in the immediate post-emancipation era – and provided context and meaning for the main focus of the lesson which aimed 'to understand the different methods undertaken by Black people to improve their position in the early twentieth century.' (HL2/1)

It is important to note, however, that the narrative framework Tom used was his own construction (with the caveat that it would be unthinkable to exclude certain things as noted the previous section). Since the nineteenth century, historians (at least in democratic countries) have moved away from single stories or single narrative frameworks: '[history] claims no core objective foundational account of the world, or of a country, that the curriculum can use as its touchstone (although some stories can be ruled out and shown as open to correction)' (Yates, 2017, p. 51).[11] Tom was conscious of the decisions he made about what to put in and what to leave out of his particular narrative framework and conscious, too, about avoiding a 'single story' of the past. A recurring theme in the interviews was his aim to avoid a 'victim story' where Black people are seen as having no agency: 'It's partly …. about it not becoming the story of black people's oppression. Of course that is a major part of it, but I don't want that to be a victim history. Of course there are a lot of ways in which they were victims. Of course, but I want there to be some sort of resolution beyond that' (HI2/7). An example of this within the sequence came in lesson four in a discussion about a James Brown song:

> TQ: So the key question – is this about rights? Is it about fighting for rights or changing the way we live, changing people's views? It's all well and good on paper having some rights but got to make this happen. Lot of people though Obama being president meant this had happened – black people have rights put into action.
>
> PA: some people feeling ashamed to be black but needed to be proud
>
> TE: Love that - was there a sense of black people as victims? James Brown saying that we're proud and good – no need to be victims. (HL4/5)

Not wanting the topic to be a 'victim story' is not the only single story Tom wanted to avoid:

> I think I've also got a duty to represent the idea that actually this is as much about …the trans-Atlantic slave trade is about white people oppressed the black people, but as much as anything that was about capital and circumstance as well as race. Of course race is part of it, but white were not the only people who did this; I feel I need to explain that is the case; it wasn't just white people involved in this situation, and that not all white people are like this. (HI2/8)

[11] Note that Yates is writing in an Australian context where the issues around history curricula are similar to England. In some countries, school history curricula *are* built quite deliberately around a 'foundational account', albeit one that would not have legitimacy beyond its national borders.

So just as Tom wanted to avoid a story of Black people as victims, he also wanted to avoid a story of White people as only perpetrators. This is a good demonstration of the complexity behind the choices history teachers make about where their narrative frameworks begin and end and what they should include. Tom would ideally have liked to go further in his narrative and examine the concept of legacy in more modern terms, for example by including Haiti which was the first Caribbean slave colony to gain independence but which remains one of the poorest today. The only reason he did not do this was one of time; the narrative framework was shaped not only by his aims but also by pragmatic considerations.

A further dimension of Tom's narrative framework was what he chose to cover in depth. When explaining why he chose to focus on Rosa Parks in lesson 3, Tom drew both on his overarching aims and his knowledge of what was possible to achieve with the class in the time available:

> So my idea was to think immediate, think medium-term, think long-term. So I decided I'd have to do something on Civil rights. I decided against trying to do too much. I think to try and give them a picture I'd have to pick out an event or an idea, and focus in on that rather than try and give an overview. It's so difficult, isn't it? What do you select? You can see from today's lesson [lesson four] that I tried to give an overview, and it became a sort of race-through, and I don't think that's ever so effective. So I decided I'd look at an event or a person. Initially I thought Martin Luther King, but then I Figured, actually there'll be other opportunities for them to look at Martin Luther King, and I really felt that actually it's good to look at a woman, to be blunt about it. So I wanted them to see a female historical figure. (HI4/1)

Here, Tom weighed up the advantages and disadvantages of overview lessons where students learn about a sequence of events over time. He favours opportunities for students to explore something in depth, though it is worth noting that in the sequence, two of his lessons provide what might be termed 'overviews' and two focused on a more specific person/moment (lesson 3) or groups of people (lesson 2). This blend of overview and depth is notoriously difficult to get right in history, both within and across topics, and is a significant feature of the choices teachers like Tom make when they decide what should go into the narrative frameworks they teach. Again, there was a pragmatic consideration here: Tom considered asking students to compare Rosa Parks with Linda Brown in lesson three as both could be considered examples of 'test cases' but concluded that on this occasion, it would have been very difficult for students to understand what a test case is and how this set a precedent: 'they just didn't have that sort of framework to fit it into the contextual understanding.' (HI4/2).

What is especially interesting about Tom's reasoning in this section is how much it echoes Winch's arguments about inferential know how knowledge. Knowing when and how to make connections between concepts is at the very root of Tom's practice, as are the times when he recognised that students will lack a particular conceptual framework needed to make sense of something. Sometimes he made connections between concepts, people and events explicit; at others he provided the opportunities for the students to make them and less often, he assumed that students can and will make them automatically (for example the concept of rights which I explore later).

ii. Big pictures

> 'What has not been attempted in Britain is to teach pupils how to handle the past as a whole. In consequence, few fifteen year olds are able to map the past; even fewer can offer a coherent narrative; and virtually none can conceive of anything more subtle than a single 'best' narrative' (Shemilt, 2000, p. 86).
>
> 'Shemilt likens pupils in history classrooms to children who have never watched a cinematic film but are expected to understand a particular film from brief and disconnected trailer clips – that they can understand each clip but not the film's narrative and its purpose, or 'the bigger picture'. (Kitson et al, 2011, p. 113)

Linked to narrative frameworks but refocusing away from individual topics and towards a whole curriculum is the issue of big pictures. As the quotations above suggest and as mentioned earlier in this chapter, this has become an area of interest and debate in recent years. Tom saw the students' ability to see the bigger picture as an important part of their progression in history:

> 'the other thing that's important is getting better at drawing parallels….that's a sign that someone is getting better at history. I recently marked a Y8 assessment … and quite a few of them unprompted by me - one of the questions was about causes of the civil war – quite a few of them mentioned about the star chamber and how this brought about arbitrary justice – some of them said it runs contrary to magna carta. That means – that conceptual jumping from one topic to another – that's getting getter at history….being able to see the bigger picture and be able to compare and contrast.' (HI1/5)

There were two occasions when Tom encouraged students to make connections across periods in lesson one. Once was during a discussion of legacy when Tom explained that they had come across legacy before when looking at Henry VIII and Edward VI. The other was in a discussion about what 'normal' means in educational terms and why what is 'normal' today has not always been so by reference to the Industrial Revolution and the lesson they had on children working in factories (normal at the time, not at all normal for England today).

In a later interview, when discussing his curriculum choices at key stage 3, Tom outlined possible plans to organise topics into themes such as migration (year 8) or war (year 9). The topics would remain roughly the same and they would still be taught in a broadly chronological framework ‘but the silver thread that links them all together would be so much more apparent’ (HI2/13). Tom wanted his students to see the ‘bigger picture’ because otherwise ‘I don’t think they always understand how it [topics] relates to each other’ (HI2/15). The implication here is that he wants students’ big picture understanding to be more than a sum of the different parts of history they have studied and that progression in history consists partly in students making connections across topics which could be easier if topics were bound together in some way through overarching themes. This raises interesting ideas in relation to Bernstein’s horizontal and hierarchical knowledge structures. History is generally characterised as having a horizontal knowledge structure: it is not necessary to have learnt about x in order to understand y and the goal is not towards greater abstraction. This is why it is possible to study an A Level in history without having studied it at GCSE and why the positioning of the whole unit on Black Peoples of the Americas at the end of Year 8 was not a critical decision in terms of accessing the content. It could have been positioned elsewhere and students could still have accessed it. Similarly, within the topic, it would be possible to teach the four-lesson sequence on post-emancipation without a previous sequence on slavery and still access it. However it would seem likely that the meaning students made of the unit as a whole and the sequence in particular did relate to the big picture understanding they were able to situate it in. In this sense, then, it might be possible to argue that sequencing does matter in history, even if there is no single ‘correct’ way to do it.

iii. Conceptual complexity

Tom was juggling first and second order concepts continually throughout the sequence. Examples of first order concepts included legacy, slavery, emancipation, civil rights, equality, freedom, education and protest. I am going to take one of these concepts, rights, and track the way Tom uses it through the sequence. Figure 6.3 summarises how often the concept was referred to in each lesson. I have also included ‘equal/equality’ for comparison.

Figure 6.3 References to two substantive concepts across the sequence

Lesson	How often ‘rights’ referred to	How often ‘equal/ ‘equality’ referred to
One	1	6
Two	2	10
Three	11	5
Four	18	0

In lesson one, the focus was on contrasting what *could* have changed after emancipation to the benefit of freed slaves and what *did* happen. In response to a picture projected onto the whiteboard (Figure 6.4), students were set the following task: ‘in no more than 10 words, can you explain what kind of vision of the future this depicts for freed slaves’. Tom recorded a number of words on the board during the ensuing class discussion: prosperous, free, safe, equal, freedom, normal, change, **rights**, respect and equality. This was the first mention of the word ‘rights’ and it was not discussed further at this point.

Figure 6.4 Image used at the start of lesson one

During the first half of lesson two, Tom began by asking students which priority out of a possible four (security, opportunities, prosperity and equality) they would have focused on at the beginning on the twentieth century as an African American. His point was that it was difficult to decide at the time (as it was for the students in the lesson) and different individuals and groups had different priorities. Tom concluded the class discussion as follows:

> The point is that it was the same for people at the time – there was a debate – what should we focus on. Many wanted a focus on **rights** they deserved; others wanted a focus on pay. In the short-term term, a focus on prosperity. Of course equality but short-term first. (HL2/2)

This was Tom's first unprompted reference to 'rights' in the sequence. Later in the same lesson, Tom used the concept again, this time during a discussion about lynching:

> TQ - Now this is an awful thing to think about, lynching. Who knows what this is?
>
> PA – black people being hanged.
>
> TS – yes, black people taken from their homes in the middle of the night by a mob of white people to somewhere public and hanged from a tree. Usually – this would happen to someone who was 'uppity' – what does that mean?
>
> PA – someone high up in society?
>
> TS – maybe, idea of high up – I can see where you got that but it wasn't so much that actually. Anything else?
>
> PA – happy
>
> TS – not happy
>
> PA – confident?
>
> TS – yes, that's a good way of putting it – someone who's trying to make themselves better – other people would say they have ideas above themselves. You're getting above yourself. You're an uppity black man – don't come here and tell me what your **rights** are, how much you should be earning – people considered uppity were often those that were lynched. (Reads from slide) 'Nearly 3000 hanged between 1885-1917'. (HL2/3-4)

We can see that Tom used the concept of rights when paraphrasing the possible response of someone involved in the lynching of African Americans after emancipation. On both occasions that the concept of 'rights' was invoked in the second lesson, it was associated with action. In the first example, Tom used rights in the context of African Americans focusing on the 'rights they deserved', rights they were going to take action of some kind to achieve. In the second example, Tom demonstrated a possible reaction to this: by wanting their rights, black people were getting above themselves.

In lesson three, the concept of rights was referred to more frequently. The lesson began with picture clues about the impact of the Second World War on the African American community and in the class discussion that followed, a student volunteered the word ‘rights’ for the first time in the sequence and suggested that better communications (such as the radio) helped people to ‘spread their rights’[12]. As the discussion developed, the concept of Black American soldiers deserving their rights because they fought for freedom in the war is established. It is noticeable how the concept of ‘rights’ is again coupled with the language of action by Tom during the lesson: ‘people **standing up for rights’**; ‘I’ve fought for freedom, this is the right time for us to **get our rights’**; ‘New desire to increase their equality and **win their rights’**; ‘a member of main organisation **fighting for rights’**; why a **drive to get** equality and **rights** (HL3, my emphases). Verbs such as ‘standing up’, ‘fighting’, drive’ all suggest positive action.

In the final lesson, the concept of rights was invoked 18 times, mainly in connection with the narrative of the civil rights movement and legislation of 1965. Tom then played a James Brown track (Say it Loud) which conveyed the message that gaining legal rights to vote was not enough for those who wanted fair treatment by the police, better access to jobs and a good wage. Tom ended the class discussion about the song by saying this:

> So the key question – is this about rights? Is it about fighting for rights or changing the way we live, changing people’s views? It’s all well and good on paper having some rights but got to make this happen.
>
> Lots of people thought Obama being president meant this had happened – that black people will have rights put into action (HL4/5)

Here, Tom raised questions about whether (legal) rights are enough if people’s views haven’t changed, or the way they live their lives. This was a profound message which Tom didn’t have time to fully explore but it was a subtle reframing of the idea of rights which up to that point had been seen as the major goal to fight for. James Brown’s message – that Black people needed to feel proud – hinted at something deeper in the struggle for equality.

This analysis of Tom’s use of the concept of ‘rights’ is intended to demonstrate the complexity of first order concepts embedded within substantive knowledge. Tom does not explicitly define rights – he assumes that students understand the term (unlike many

[12] This may have been influenced by Tom having written ‘civil rights’ on the board at the beginning of the lesson when he briefly explained what the lesson was about.

other terms which he *does* explicitly define such as legacy). However he uses the concept as shorthand to help convey one of his overall goals – that Black people were not simply victims of racism and inequality but were actively searching and fighting for their rights in various ways. At the beginning of the sequence there was a bigger emphasis on the concept of equality than on rights as Tom established the context of the lessons: that following emancipation, Black people hoped to achieve greater equality but this was not forthcoming. In lesson three, the idea that this situation was not simply accepted by the Black community began to dominate and by the fourth lesson, the idea of fighting for rights was well established before Tom problematised it at the end by suggesting that changing attitudes was perhaps more important. This is just one of the substantive, first order concepts that played an important role in the sequence and helped to provide a conceptual framework.

Alongside first order concepts, Tom was also working with a number of second order concepts. The overarching question which Tom had in his mind when planning this sequence was around the legacy of slavery. This relates to the second order concepts of both 'consequences' and 'significance', which in this context examines how profound and long-lasting the consequences were. However, the concept of change and continuity was also a major influence, especially in the first lesson. The following extract demonstrates the way Tom moved between at least two second order concepts in a single lesson:

> 'Change, definitely. I think yes, and no; change was definitely the key thing that I wanted to focus on in this particular lesson, but the bigger question that we're thinking about is, well what was the legacy of this thing? So I think it was necessarily to talk about consequences for them to – without them even necessarily being conscious of it - also thinking longer term of, well what came about as a result of this. So yeah, definitely change was the concept I really wanted to have at the heart of the lesson, but consequence is something that maybe I wanted to bring in an awareness, even if it wasn't necessarily the sort of main focus.' (HI3/1)

Here, Tom explains that Lesson One focused on change (did life for ex-slaves get better?) but also anticipated legacy (and significance) by introducing the consequences of emancipation, i.e. that African Americans were disappointed by the lack of change. Juggling these two concepts of change and consequences was a feature of the sequence as a whole. The learning objective for the first lesson was 'to consider to what extent did life change for ex slaves after the Emancipation Proclamation' (HL1/1) and Tom explored whether change in this case automatically meant progress: 'We can see there is a view that life for Black people would get miraculously better once they were no longer slaves…[but] is that true? How did life *actually* change – did it suddenly get rosy…? I'm not so sure' (HL1/3). Tom later explained in an interview that he wanted to challenge the idea that 'change equates to progress and change is necessarily good…I wanted to go beyond just the idea of change itself and start to think about the nature of change and whether it was positive or negative.' (HI3/2). Believing change to always herald progress is a common misconception in history (see Figure 6.1) and Tom was tackling that explicitly in the first lesson. In the second half of the main activity, after categorising information about the lives of ex-slaves into four themes, students had to decide where on a spectrum of 'change' and 'continuity' they would place themselves physically for each theme. However, although the first lesson therefore focused on change, by the end of the sequence the emphasis had shifted onto the 'legacy' question with a more obvious focus on both consequences and significance. Towards the end of the final lesson, two of the questions for students to discuss were, first, 'Is the Black Peoples of the Americas Unit a 'victim' story? and second, 'Do you think this unit is important to study?' which is a classic 'significance' type of question because it requires students to consider why it is significant enough to even be on the curriculum.

Although change and legacy/significance were the underpinning conceptual ideas at work in the sequence, they were not the only ones. In an illuminating extract during interview four – which I will quote here at some length – Tom explains how he decided on the second order conceptual focus in lesson three:

> 'originally I was going to do about what was the significance of Rosa Parks, but then I came to the conclusion, actually *they wouldn't have enough contextual knowledge to be able to sort of say what really resonated about her* - why was she remembered - what was the impact? It felt to me like they needed to know more about Civil rights to understand the chain of events and so on. So that was the original plan. Then my second thought was that actually I know from previous lessons that I've taught, with Rosa Parks both in Year 8 and also when we do Civil rights with GCSE students, that it's always been a bit of a sticking point about whether it mattered or not that she was a member of the NAACP already, and whether she was just a sort of innocent bystander. She still was of course, but some students have always found that to a reason to be outraged, like they'd been sold a lie. Other students had come to a completely different conclusion which is that it makes it even more heroic. So I was kind of interested in that notion. So actually, what I initially set out to do was look for different interpretations. That was my original idea; I could introduce them to the narrative, and then we'd look at different interpretations and build something around that. I wasn't quite sure but that was the basic idea. So I did a bit of reading myself, and it wasn't clear. *I couldn't find too clear cut interpretations - particularly ones that would work for Year 8*, but in doing that I did Google literally Rosa Parks interpretations, and one of the things that came up was the National Archives of America. They did have two slightly different interpretations of her, and the significance of her, and it was kind of interesting, but actually in the process of doing that I then saw these other

> pieces of primary evidence to go with it, and I thought, *actually that would make for a more interesting lesson*, and *we would arrive at that discussion about did it matter about her back-story and so on*. (HI4/1-2, my emphases)

Here, Tom took me through his decision making process about which second order concept would provide the best lens through which students could learn about Rosa Parks. He started with the concept of significance before realising that in order to answer this question, students would need to know more about the Civil rights Movement than could be achieved in the lessons available. This demonstrates the symbiotic relationship between first order (substantive) and second order knowledge: the second order concepts will influence the amount and type of first order knowledge that students need just as the first order knowledge itself may suggest obvious second order concepts to focus on. For example, the decision to teach about why there was a revolution in France makes a primary focus on causation most likely and in order to enable students to answer this well and identify long as well as short term causes, the first order knowledge taught will need to go back a long time before 1789. In the case of Tom, he understood that to make a judgement about someone's significance you need to know something about what they did, what the long-term consequences of their actions were, whether that person's impact was greater than his or her contemporaries and so forth[13]. Having rejected significance, he recalled that the potential tension between the 'mythical' version of events concerning Rosa Parks and the reality had previously led to some students feeing they had been told a lie in other classes. Tom chose to focus on that tension, initially through the lens of historical interpretations which would encourage students to explore the differences between, and reasons for, different interpretations of historical people or events some time later. However, the interpretations he found were not clear-cut enough or accessible for Year 8 and in the end, Tom found primary evidence (the original police report and Rosa's court affidavit) online which he combined with a short biography in order to give students the task of deciding what version of events was most correct. This enabled him to plan an 'interesting lesson' which 'would [still] arrive at that discussion about did it matter about her back-story' (HI4/2). Thus, the second order concept he eventually chose as a chief focus was evidence with a secondary focus on interpretations. Students used their analysis of the evidence to create a better account of Rosa Park's actions than the one in the textbook and along the way developed their understanding about the relationship between evidence and interpretations.

[13] Emma made a similar point in explaining why both first and second order knowledge matters: 'you need to know what happened in order to develop skills and in order for them to have the confidence to do the know-how'.

I have chosen to dwell on this moment in the interview because it exemplifies what I term ‘conceptual complexity’. Unusually compared with other subjects, historical second order concepts are not linked to specific periods and events. Concepts such as ‘cause and consequence’ and ‘evidence’ can be used as lenses through which *any* topic may be viewed. Tom is clear that for him, the topic comes first, *then* he decides which concepts will work best: ‘I guess really I don’t often go into a topic and think, well these are the skills or concepts I want to look at – how can I fit them in? It tends to be the other way round’ (HI2/910. Thus, there is a choice for the teacher in terms of the second order conceptual foci. In the sequence as a whole, there were at least five second order concepts at work, each bringing its own demands and particular way of thinking about the past, whether that be about thinking of history as something historians construct (evidence, interpretations), or analysing patterns and causal relations in the past (change and continuity and some cause and consequence) or about making judgements about the significance of the past in relation to impact, even on today.

6.6.3 Procedural ‘knowledge that’: perspective recognition and ‘being a good historian’

i. Perspective recognition

Encouraging his students to view the past from different perspectives was an important feature of Tom’s practice. I will return to this later when I analyse the influence of students’ maturity on Tom’s practice but it is important to include it here as a dimension of what Tom believes the process of studying history to involve. Wanting students to understand post emancipation America from the perspective of African Americans was a strong feature of the whole sequence. Tom was frequently asking questions such as, in lesson three: ‘See if you can think of any reason why these people decided that now was the time to fight for equality’ (HL3/1). I have already suggested in Figure 6.1 that empathy and appreciation of different perspectives can be challenging for young people and in this sequence, they were being asked to understand the perspective of adults in a very particular situation.

Alongside the general requirement to understand different perspectives in these lessons, Tom was also more explicit on a number of occasions:

> ‘Are we looking from the perspective of white people to ex-slaves – back to the enquiry question – this is from the freed slaves’ point of view.’ (HL1/3)
>
> It’s not really about what we think. But I wanted to get you into the mindset of people at the time and understand different options. (HL2/2)

> Why would James Brown think that black people needed to be able to say I'm black and I'm proud? (HL4/4)

The second quotation in particular is an example of Tom encouraging some metacognitive reflection about perspectives and using a popular pedagogical technique– giving students an opportunity to 'feel' an emotion that can then be related back to someone in the past – to help. In this example, Tom wanted students to feel a lack of certainly about which aim they would have prioritised in the early twentieth century in the struggle for a better life in order to help them to appreciate the difficulties people had at the time.

ii. Being a 'good historian'

I have already written about Tom's awareness of over-simplified narratives and this influenced not only Tom's choice of what to teach but also how he presented the past to the students. In lesson three, he deliberately set out to undermine an accepted narrative about Rosa Parks and challenge a myth that has developed around her actions. Students, after examining primary material relating to the bus boycott, had to rewrite a narrative account from a textbook where certain features were missing:

> 'in doing that they would have had conflict within themselves about what they should and shouldn't include in the narrative. So I wanted them to be aware that in future when we encounter narratives, that whoever has written it has had to go through a similar process. So I want them to have a conscious awareness of that; talking about the fact that we want them to accept textbooks and so on, but still want them to have that sort of healthy scepticism. So I suppose that's one thing that they could have an insight into how this has emerged. (HI4/8)

At the end of lesson three about Rosa Parks, Tom is quite explicit about what good historians do and this is not the only occasion he does so (see Figure 6.5). Most of the time, however, he nudges his students to think in historically mature and reasoned ways without spelling out that this is what he is doing: 'I do feel that with the how to be a good historian they don't necessarily have to articulate it. It kind of seeps into them, and I do find myself doing that a lot.' (HI3/14)

Figure 6.5 Examples of explicit references to 'being a good historian' in the sequence

Lesson	Examples of explicit references to 'being a good historian'
One	Tom has on the board an exam-style question: 'Emancipation brought immediate change to the lives of ex-slaves in the USA. Life was better'. To what extent do you agree with this interpretation?

	The following exchange follows: SA: I agree – better but not everyone had agreed with it so things were not likely to be all good. TQ: Careful, you're getting ahead if yourself – **good historians need to look at the evidence.** How far do we agree? What did Craig do that's good in history? SA: Agreed and disagreed TQ: What's the b-word? SA: Balance
Three	TQ: Now in the last couple of lessons, when we've looked at what happened to black people after slavery ended and what people did – my feeling is that you're all good historians who have made good progress but you have committed a cardinal sin. What is it? SA – we've believed in the textbooks TQ – is that a bad thing? SA – we've accepted it TS – You've accepted it at face value. TQ – what would a good historian do? SA – question reliability.
Four	The final key question for students to debate at the very end of the sequence 'What have we learnt about being historians from this unit?' Tom explains that he wants them to think about 'what it means to be a good historian – anything you've done to consider what it means to be a good historian.'

The next section will consider what Tom thinks it means to get better at history but from these examples, we can conclude that the way evidence is used and critiqued is a major component.

6.6.4 Progression

This section has so far included many references to Tom's teaching goals and I will argue that implicit within these is a model of progression. Here, I will summarise what this model looks like.

Tom is interested in propositional, knowledge that, only in so far as it enables students to think in particular ways. He wants students to understand the significance of this knowledge and to be able to draw meaning from it by locating it in a bigger context. Making connections within topics, across topics and between the past and the present are all important to him. Knowing more history therefore has to be part of what it means to get better at history, but as isolated information it is not enough. It is only by locating within wider knowledge and within a broader conceptual framework that it becomes meaningful. Thus, one can extrapolate from this that knowing more and knowing how to make these sorts of connections is at the heart of progression. Part of this process of meaning-making is shaped not only by first order knowledge but second order knowledge too – by using the conceptual frameworks of significance, change and consequence, the substantive knowledge is moulded in particular ways. This is, I would argue, what Winch (2013) characterises as inferential know how: progression in learning occurs as students become more aware of when and how to make inferences from the knowledge they are learning. This includes an awareness of why oversimplification is not helpful: Tom’s goal – made explicit to students - to avoid a story of Black Americans as victims is a good example of an inference he wishes to avoid by exploring the complexities of the past and avoiding generalisations.

Alongside this inferential know how is clear evidence of Winch’s procedural know how in Tom’s teaching, although in practice the lines between the two types of know how knowledge are blurred. Tom wants his students to appreciate the importance of recognising different perspectives in the past; perspectives that are different from ours and different from each other’s. The implication is that the more students can achieve this and indeed have a disposition to do it, the better they will be at history. Underpinning all of this is an understanding of what history *is*. Tom wants his students to understand that history is constructed from evidence, that this evidence can be unreliable or misleading and the interpretations that emerge from the evidence are themselves open to question. This point is made clearly in the third lesson about Rosa Parks when Tom encourages the students to critique a textbook account. Again, we can therefore conclude that the more sophisticated an understanding students have of history’s distinctive epistemology and the more skilfully they analyse and critique evidence and interpretations themselves, the more progression they have made. Put together, this combination of inferential and procedural know how enables students to get better at history. What was striking about the data was the extent to which Tom articulates this quite explicitly and sets out to achieve it quite deliberately in his practice.

6.7 Knowers: who are the *learners* and what are their needs?

In this section, I consider how the students' needs influenced Tom's practice, both in what he chose to teach and how he chose to teach it.

6.7.1 Morality

There was a moral dimension to the lesson sequence with notions of injustice, equality, victimhood *and* Black empowerment running throughout. I have already explored Tom's concern not to present the whole unit from slavery onwards as either a 'victim story' or a story in which white people are all oppressors. It was clear from the interviews that he does not set out to provide explicit moral guidance to the students but does believe that they will draw out the moral implications from topics themselves if taught well. He is also happy to share his views with the students - 'they know my moral views on things' (HI1/8) – so long as it doesn't become a case of him telling the students 'what a good person is…it's not for me to decide' (HI1/8). Nevertheless, it is clear that the moral dimension of topics is an important issue to Tom and there are times when he will go the extra mile to provide opportunities for students to think for themselves about moral issues:

> 'When Nelson Mandela died I stayed up most of the night to do lessons for the following day because I knew they would come in and want to know about it and inevitably there's a moral angle to it. I am a left liberal person. History teacher cliché in that way and it probably comes through by osmosis but it's not something I try to lead them to as such.' (HI1/8)

Similarly, with reference to the third lesson on Rosa Parks, Tom talked about the 'moral significance of it, which was the sort of biography thing' which ran alongside 'the actual narrative of what actually happened' (HI4/6).

6.7.2 Maturity

Knowing what the students could and could not handle because of their age was a factor in Tom's teaching and decision-making. One of the hardest things about teaching history for him is that 'perhaps they are at the age in life when their life experience isn't sufficient to be able to understand the significance of some things.' (HI1/9). The example he provides to support this is life expectancy growing from 30s to late 40s during the Industrial Revolution and students not understanding how significant this was – 'to them, that's just older people but for people our age that's a massive difference' (HI1/9). I have already discussed why Tom felt that the students did not know enough to be able to judge Rosa Parks' significance. In the first interview he suggested a further reason why students might struggle with this focus:

> 'for them the difficulty they have in understanding history is why things might be such a big deal or why an achievement of somebody is so massive because they are still of the age when they think anyone could do anything if they put their mind to it. So actually, to see the achievement of somebody who does something important is quite hard to get across to someone.' (HI1/9)

This is not just a case of knowing insufficient history, Tom goes on to suggest, it is also a case of having insufficient life experience. History requires students to engage in perspective recognition (i.e. understanding the perspective of people in the past) and see things in the past as others saw or experienced them, but often this requires students to think as adults rather than as children:

> it's about life experience as well. Some of them in there will have quite clear experience of what it's like to not be able to afford to eat very well, whereas some of them won't have a clue about what that would be like. So some kind of contextual awareness of these issues - it's quite hard for students of their age - they haven't experienced it - well what does that actually mean - just how important is that? Some of them will make a presumption, well everybody can afford food. So maybe that sort of awareness is - not through any fault of their own, but it's perhaps lacking, and restricts the opportunity to sort of go into that perception about what's better or not (HI3/20).

As we saw earlier (see p. 206), in lesson one, Tom used this understanding of students' limited life experiences to question one student's use of the word 'normal' in the phrase 'they [ex-slaves as depicted in a picture from the time] are free people living normal lives with rights'. Tom asked, 'What's a normal life?' to which the student answered 'having a family, education jobs'. Tom responded with 'Why normal – what's your normal? Did everyone think it was normal – did everyone go to school…not sure that normal is the right word' (HL1/4). He was trying to move the student away from an assumption that their own life sets the benchmark for 'normal' and can be used to measure how far the past was and was not 'normal'.

6.7.3 Meaning and engagement

Making history meaningful on a personal level to the students they teach is important to Tom and Emma (who was going to oversee changes to the key stage 3 curriculum the following year) and they set out to do this in a number of ways. First, they select topics to teach that reflect the gender and ethnicity of the students. The choice of Rosa Parks in lesson three of the sequence and Elizabeth I as a module at GCSE were explained on the grounds that they were both women and there aren't enough women in the history curriculum. In terms of ethnicity, Emma, talking about her plans for key stage three, wants to choose topics that 'reflect our kids' because an issue is that they don't feel the history they learn applies to them: 'they are always learning about other peoples' narratives'. Tom echoed this in the second interview:

> 'We are a very multicultural school and it feels like, for me anyway, students sit in our classes and think, well this is predominantly white history, but they give us a black unit in Year 8 and they give us Civil rights in GCSE; what about if I'm a Latin American or an Asian student? What is there for me here? What if I'm Polish? The only time we ever almost mention Poland is they were invaded and the Holocaust took place there. So it's a lot to think about in that kind of regard.' (HI2/8)

The ethnic make-up of the school is very diverse with a high proportion of black students. In the class I observed, two-thirds of the students were black and Tom does think about this: 'I know that they will be going home and talking about it [the sequence]. I'm pretty sure they didn't go home and talk about the agricultural revolution' (HI2/5). Tom tries to discuss this quite explicitly with the students in lesson four when he asks them if it is especially important to study the Black Peoples unit in this kind of school or whether that doesn't make a difference. The student I interviewed, Jack (a mixed-race student), was clearly interested in this question: in his interview he argued that the Black Peoples unit was more important to study than some others because he goes 'to a school in London, one of the most multi-cultural cities in the world'.

The second way Tom tries to make history meaningful to the students is through local connections. One example was that when teaching about the Industrial Revolution, Tom talks about new houses nearby called 'The Dairy' because that is where there was a dairy farm which disappeared commuter lines from London were built. This links with a third approach, linking the past with the present. Emma, when teaching about the Crusades, asked students to compare them to a more recent religious conflict in order to tease out and challenge stereotypes. Tom, when explaining why he believed history is important, drew on his own background growing up as a young British boy in Germany when his interest in history was piqued by wanting to know what Bergen Belsen (round the corner from where he lived) was or why the British army was stationed in Germany or why everyone was scared of the Russians. In the fourth lesson of the sequence, he referenced President Obama in relation to the civil rights movement in the US.

Fourth, meaning also derives from application and how will these young people be able to *use* their history after they have left school. Tom would like to think that if they watch a film 'in a few years' time and it refers to the civil rights movement or Black Power, they've got this awareness'. Emma, in a similar vein, saw the value of school history as helping pupils to engage with it 'on their own' after they leave school, even if they stop learning it at the end of Y9. For example, they will be able to say 'oh, that's why it's different now and have the skills to look at things critically.' Tom was also interested in transferable skills and ways of thinking. In answer to my question 'why do you think they need to be good historians?' he answered:

> 'well, they don't necessarily, do they?' What they do need, he argues, are universal skills, or life skills: 'being able to make your own decisions - being able to be a critical thinker - being able to articulate and express yourself and justify yourself. These are useful life skills, regardless of if they want to be a good historian or not. So I buy into the idea that these are tools that they're going to find useful in life. I'm not oblivious to the idea that I'm not just teaching them history. I'm an adult who has an influence over their development.' (HI3/15)

Tom is committed to helping his students to know about the past and to think about that past in historical ways but the value of this lies partly in the ways this helps young people to think more broadly about the world and the choices they make within in. For Tom, this is where the broader meaning of history for young people is found.

Underlying much of this section on how history is made meaningful to young people is an assumption that more meaningful history lessons will also be more engaging. Throughout the interviews there were relatively few explicit references to engaging students. This might reflect my questions, but I am more inclined to identify two other reasons. One is that discussions about meaning were probably used as a proxy for engagement. By helping students to make personal meaning out of their study of history, they are more likely to be engaged, so the choice of topic and the way this is made to relate to their lives are likely to contribute to engagement. Yates makes a similar point about the Australian history teachers in her study whose selection of topics to teach are influenced greatly by the potential for engagement: 'as they saw it, if students are not engaged in what they study, the activity here is not actually teaching history, but merely transmitting messages or items to be learnt…' (Yates, 2017, p. 56). The second possible reason is that as experienced and highly effectively teachers, having to work hard to engage students is not as much of a preoccupation for Tom and Emma as it is for teachers in their early years whose concerns about behaviour management and keeping students on task are probably more acute.

6.8 Knowing: what does the *learning* look like?

In this section I consider two key influences on what the learning in Tom's practice looks like: one broad theme of constructivism and one narrower but influential theme of assessment.

6.8.1 Influences of a constructivist theory of learning

There were three particular influences of a constructivist theory of learning (see p 242) that were especially apparent in the data: a desire for students to find things out for themselves, particular approaches to scaffolding (especially in terms of starting simple and becoming more complex) and a central role for dialogue.

i. Desire for students to find things out for themselves

Tom stated towards the end of the last interview that ‘I want them [the students] to be able to be the ones who take control of the learning as much as possible.’ (4/19). There are examples of this in every lesson of the sequence - for example, students making their own inferences from source material, students finding out information for themselves and students engaging in a ‘Socratic’ (i.e. argumentative but cooperative) discussion (see Appendix Eight for a fuller summary).

However, Tom acknowledged a tension between wanting them to ‘discover as much as they can for themselves’ and the need to sometimes ‘provide the information’ (HI2/9). For Tom, much of this comes down to time:

> Well, I feel like my role particularly with a group like this is to facilitate them. I want them to discover as much as they can for themselves. That’s not always easy. Sometimes you have to provide the information. So, for instance so the first lesson they get that information sheet …. just the constraints of time - it would have been quite nice to gather all that information and then analyse it. So as much as possible I do think that it’s important that there’s a sense of self-discovery. (HI2/9)

Whilst this quotation suggests that Tom would like to have facilitated the learning of the Year 8 class more than he was able to, it is important to emphasise that Tom was not suggesting that ‘teaching from the front’ was always a negative practice. It would be a mistake to draw unhelpful dichotomies here such as ‘progressive’ and ‘traditional’ (see Chapman and Cain, 2014) because Tom’s practice defied these simplifications. Although he felt he did not facilitate enough and that there was too much teaching from the front, the reality was that almost all of this consisted of verbal interactions with the students where he would direct questions at them to make them think harder. The information he did provide (on slides, verbally and on worksheets) was essential to enable the students to think in the ways that they did. What especially frustrated Tom, however, was a lack of time in which students could really explore and digest that information. The lessons in the school last for 50 minutes, not much time to find out, digest, analyse and debate information.

ii. Approaches to scaffolding, especially in terms of starting simple and becoming more complex

A second constructivist influence could be seen in Tom's use of scaffolding to support students' learning and especially in his favoured approach of moving the students from simple to more complex understandings or to put it another way, from 'familiar' to 'strange' knowledge. Tom achieved this in three ways. First, he started each lesson with a recap of the previous one. Second, he drew on students' historical knowledge from beyond the sequence which may have been learnt in history or in other subjects or outside school. Third, he drew on students' general knowledge beyond history. An example of the last two of these was the way he used the image in lesson one (see Figure 6.4). During the discussion about the image, students drew on both the previous lesson sequence on the trans-Atlantic slave trade and on their wider knowledge (such as that an olive branch represents peace). They also drew on their general, 'everyday' knowledge, for example that a woman dressed in white might be an angel and that a man on the ground underneath a horse is frightened and being bullied. These 'familiar' symbols and images were used to introduce a new or 'strange' concept: that people hoped or assumed that life would get better for ex-slaves following emancipation but in fact this was not what happened.

This example illustrates what Dowling refers to as everyday 'portals to the esoteric' (Dowling 1998, quoted in Hoadley, 2011, p.155). Whilst the knowledge Tom drew on in these examples are not all what we might term 'everyday', it was about utilising knowledge that students brought with them into the classroom in order provide a route into more complex thinking. In this sense, the 'everyday' or prior knowledge was an important pedagogical device but not an end in itself.

iii. A central role for dialogue.

Vygotsky argued that dialogue in a social context played a crucial role in learning (Moll, 2014) and the amount of dialogue in these lessons varied from 40 per cent to 66 per cent of the lessons. This does not include time when Tom was talking to students without asking questions; it solely refers to instances when Tom was in dialogue with pupils in a whole class discussion or when students were in dialogue with each other, either in pairs or in groups. Over the sequence as a whole, there were 120 exchanges between Tom and members of the class in whole class discussions and 59 per cent of the time was spent on some form of discussion activity. In a sequence where Tom felt under considerable time pressure, discussion was not seen as optional. During the second interview, Tom explained why, in the first lesson, he asked pupils to decide where to stand on a human continuum in pairs rather than on their own:

> So. the first lesson… they had to move as pairs. I wanted them to do that deliberately because I wanted them to take on board the notion that it's important to at least consider other points of view, rather than just steadfastly have your idea, and this is what I'm sticking to. Often I find that students will do that. They'll come up with an idea and then they'll feel that what they have to do is defend that idea rather than review the idea, if you see what I mean. They feel almost like they're under attack if you suggest anything different. So that's why I wanted them to work as a pair there, so that they'd be forced to actually debate and consider a different possibility. (HI2/10)

It is interesting that Tom took a highly generic pedagogic strategy, pair discussion, and defended it in history specific ways. He wanted the students to consider different arguments and different options about where to stand on the continuum because there were no absolutes here. The issue – how far aspects of Black people's lives changes after emancipation and how far it was for better or worse – was not one where categorical answers were available. There were answers that were less defensible based on the available evidence (it would, for example, be untenable to stand at the 'everything changed, it was all for the better' end of the continuum for each category) but it was far from clear where on the line represented the 'truth' as truth had no meaning in this context. Although the students did not get into this debate very deeply due to a lack of time, the answer was complicated by the fact that it would depend exactly when and where in the US you were referring to. The historian's task of making generalisations is usually a fraught one (because of the complexity of people and events in the past) and this is precisely why historical interpretations are open to question. It is in this context that forcing students to consider other points of view makes perfect sense in history.

6.8.2 Assessment

If an F1 curriculum (Young and Muller, 2010) can be criticised on the grounds that it over emphasises accumulation of fixed, canonical knowledge and an F2 curriculum (ibid.) can be criticised on the grounds that it over-emphasises the way students learn at the expense of what they learn, current practices in schools might be criticised for only valuing what is taught if it can be measured in ways that generate 'tracking' data: 'we end up valuing what is measured rather than that we engage in measurement of what we value' (Biesta, 2009, p.43). Many teachers – including those in my research – fight valiantly against this trend but inevitably, the pressure of accountability and the need to demonstrate progress on a regular basis influences what they do.

Within the sequence itself, the influence was not as obvious as I expected, though as Tom explained, this was because it was at the very end of the school year and the lessons did not therefore lead to a formal assessment. Consequently, he had more freedom to adapt and change what he as doing as he went along. If I had seen him teach the English Civil War to the same group, it would have been different:

> So, if you take something like the English Civil War, which I did with this group just before Christmas, there was lots of chronological interesting stuff. They were interested in topics that came out of it in discussion points, but also then I was conscious that we were working towards an essay that I was going to get them to write, and as much as I enjoyed the idea they might be interested [and] as much as I enjoyed the idea that we could develop wider skills out of it, I was also consciously thinking, right well how is this going to feed into their preparation for their essay? It's not only important for them to make progress as far as they and their parents and people see it; it's also - if the pressure on me to be able to demonstrate to other people that they've made progress, and on a sequence of lessons like we've just done now, I'm confident they have in my own mind, but there's nothing tangible there. (HI4/17)

This quotation conveys the pressure that Tom feels to demonstrate student progress, a pressure placed on him by senior school leaders (who themselves feel the need to demonstrate progress to external bodies such as Ofsted). In the example above, this pressure has resulted in Tom cutting short moments in lessons where students were engaged which were not central to the assessment at the end. This runs counter to the points made in the previous section about meaning and engagement and suggests a tension between how Tom wants to teach and is sometimes forced to teach.

There were two instances in the lesson sequence where Tom used GCSE 'exam-style' questions. He explained that, by introducing these kinds of skills at key stage 3, it can become 'second nature and they almost don't have to think about it. It becomes routine and it takes the pressure off me.' (HI3/13). Nevertheless, whilst Tom doesn't see a huge conflict between anticipating GCSE and knowing what good historians do, he would rather not have GCSE as the reason to do things in particular ways:

> it doesn't fill me with a great deal of satisfaction, to be honest with you. I want them to be able to arrive at that, because that's what good historians do, rather than because that's what examiners are going to give you ticks for - if that makes sense. (HI3/13)

6.10 Summary

One of the features that recurred in my interviews with Tom were a series of tensions that Tom experiences in his daily practice. These tensions are summarised in Figure 6.6.

Figure 6.6 Tensions that Tom experiences

What Tom would like to do	*What Tom feels he has to do*
Allow students to find things out for themselves more	Tell students things because he doesn't have enough time otherwise
Teach more history (e.g. non British history, more thematic history)	Make hard choices because there is too much history he would like to teach and limited lesson time available
Let student responses and interests shape lessons	Cover the content required for assessment purposes

The second of these and to some extent the first is the result of history's scope and complexity and the challenge of doing that justice in single short lessons across a limited number of years within formal schooling. Tom is juggling a set of complex aims in his practice, balancing conceptual complexity with substantive knowledge building. He seeks to build narratives which he implicitly and explicitly asks his students to challenge by foregrounding the nature of knowledge construction in history. Underpinning these aspects of knowledge building and choices of what to teach are moral principles and values and a desire to help students understand their world.

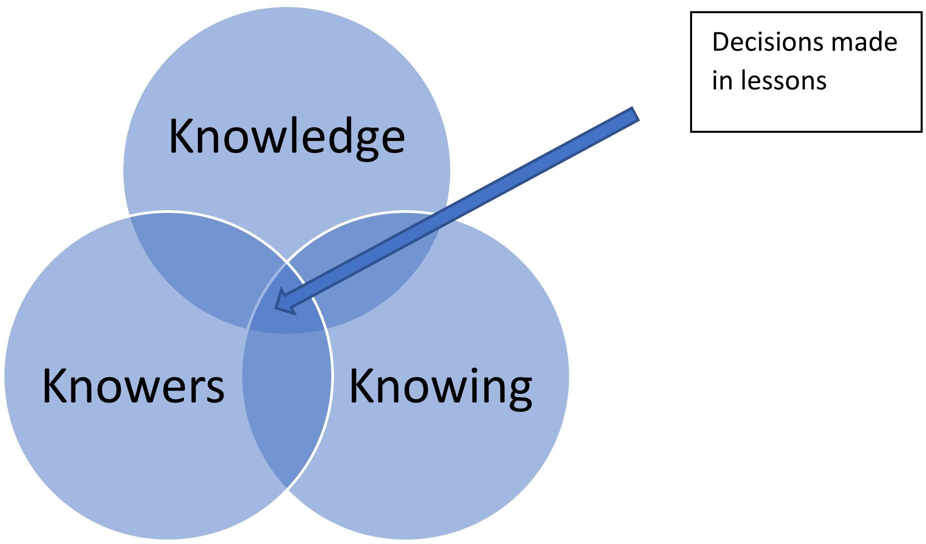
Of all the teachers I observed and interviewed, Tom best exemplifies an attempt to realise an 'F3' curriculum (Young and Muller, 2010). This is not because Tom is a 'better teacher' but, I would suggest, because of two, connected factors. First, history as a school subject and history as a discipline are not as far removed from one another as geography and even physics. The fact that a current trend in history education is to bring examples of 'real' historians' work into the classroom from key stage three is testament to that. Second, the history education community has been remarkably consistent in its adoption of 'new history' which started in the 1970s and gained momentum with the launch of GCSEs in 1988 and especially with the introduction of the national curriculum in 1991. The clear conceptual framework of history's second order concepts which deconstruct what historians do and how they think and the emergence of enquiry as the means to marry concepts and content has proved enormously successful. That is not to say that all teachers understand this well enough, nor that history is therefore as well taught everywhere as it is in Tom's school. But Tom can draw on this strong recontextualising tradition in his practice.

Some of Tom's preoccupations reflect current debates within history education, such as the need to teach more diverse histories and the value of providing 'big picture' knowledge to students. The last tension in Figure 6.6 relates to a more unwelcome preoccupation, that of assessment. Despite the success of ‘new history’ and new ways to define progression, assessment remains a problem. This is partly because of its overbearing presence in English schools (Biesta, 2009) and partly because school history has struggled to align its vision of progression with national curriculum levels (Luff, 2016) and their replacement.

Chapter 7 Cross-subject analysis

The role of this chapter is to bring together my analyses of the three case studies in order to explore the similarities and differences between them. My primary goal is to explore the extent to which teachers of different subjects, each derived from a different discipline and comprising a different knowledge structure, bring distinctive knowledge and understanding to their practice. This includes the extent to which they are agents in the recontextualization process and how their role in this process might differ. It also includes the extent to which they conceptualise progression differently and the impact this has on their notions of sequencing within the curriculum as well as how the subject shapes the way the relationship between knowledge, knower and knowing is manifested in their teaching. I will continue to use Hoadley's (2011) 'knowledge, knower and knowing' framework in the first half of the chapter to ensure continuity from the previous three chapters. It is important to note that whilst the framework provides a helpful means of analysing teachers' knowledge and practice, it does not do justice to the connections between each category. In Figure 7.1, I have rearranged the categories of 'knowledge, knower and knowing' into a Venn diagram to illustrate how each category interconnects, with all three coming together in the decisions teachers make in lessons. That is not to conflate the three however: as I will argue, following Hoadley (ibid.), it is important that each remains conceptually distinct, even if in practice they merge. I will explore aspects of this interconnectedness towards the end of the chapter when I explore recontextualization in practice.

Figure 7.1 The interconnectedness between the analytic categories of 'knowledge', 'knower' and 'knowing'



In pulling the different threads together in this chapter, I have drawn extensively on the literature referred to in Chapter 2, especially Bernstein (1999, 2000), Klafki (1995) and Hoadley (2011), and also on work I had not read previously, especially Muller (2006), Deng (2007) and Doyle (2017).

7.1 Knowledge

As I explained in Chapter 3, my choice of subjects was determined partly by wanting different knowledge types. Figure 2.1, drawing on Biglan's (1973) three dimensions, illustrates the differences in knowledge structure across the three subjects, with physics categorised as 'hard' (i.e. strongly hierarchical), history as 'soft' (i.e. strongly horizontal) and geography drawing from across the continuum. I share Muller's (2006) interest in how far should and can the knowledge structures of a discipline determine progression models within school subjects and I extend this interest to consider the impact of different knowledge structures on teachers' aims and the moment by moment decisions they make in the classroom.

7.1.1 How did the teachers define core (substantive) knowledge?

Robert (physics) identified very specific concepts that students needed to understand before they could move on, at lesson, sequence, topic and subject levels. For example, he wanted students to understand the concepts of 'pitch' and 'amplitude' before he moved onto more quantitative ideas about measuring the speed of sound. This 'core' knowledge was often copied into exercise books and associated with specific terminology which Robert would repeat (such as particles) and emphasise. The core terminology of physics also referred to procedural and mathematical knowledge, two further dimensions of the core knowledge of physics. Robert's understanding and practice of physics aligned well with Bernstein's (1999) concept of hierarchical knowledge, with reasonably strong verticality (progress is achieved through theory integration) and grammaticality (the capacity of a theory to progress through 'worldly corroboration' (Muller, 2006, p. 14)). However, it is interesting to note that verticality is not absolute throughout Robert's practice; not every topic builds on another and hence his sequencing of topics is not identical to practice elsewhere (i.e. in my pilot data). Nevertheless, there are core ideas – such as particles and energy – that track across all topics and which need to be understood in order to progress.

Tom (history) had a very different view of core knowledge. Whilst Robert takes the core substantive content of physics courses for granted, Tom cannot easily do this because of history's horizontal structure (Bernstein, op. cit.) and is reluctant to specify core substantive knowledge that all students must learn beyond arguing that students need to understand the significance of what they learn. However, it was clear from Tom's practice and interviews that once a topic has been chosen – in this case the lives of ex-slaves after emancipation – there are things that students have to know. For example, it would not be possible to teach the topic up to the 1960s and not mention the civil rights movement in the US and figures such as Martin Luther King and Malcolm X. This is not enough to claim verticality within such topics (unlike in mathematics which, although a horizontal subject in Bernstein's terms, nevertheless displays weak verticality *within* its discrete languages - Muller, 2006). History does not have 'discrete languages' which constrain thinking: it introduces new language in new topics (for example emancipation and civil rights here) but this language is not bounded and there are usually other terms that can be used. Even with regard to history's second order concepts, whilst there is helpful terminology to describe, for example, causation (necessary and sufficient causes, catalysts, triggers), this language is in common usage. Nevertheless, whilst history is a good example of a horizontal knowledge structure, it is possible to argue that within individual topics there is a small 'core' of substantive knowledge. Hence, whilst Tom was reluctant to specify what substantive knowledge all students must learn in history, knowledge building within the topics he chose was a central part of his practice.

Sarah (geography) was similarly committed to building substantive knowledge and emphasised this most explicitly out of the three case studies. She was also much happier to provide a list of core topics that she believes all students are entitled to learn about than Tom, though these were at the level of big ideas rather than specific topics. This list (see p.164) suggests that she sees geography's purpose as contributing to big ideas such as 'sustainability' and 'population' whereas Tom (and Emma) both identified specific topics such as the Holocaust and Nazi Germany as topics all students should learn about. Whilst the reasons for studying these are related to understanding the modern world and understanding what humans are capable of, it was not those ideas, per se, that Tom and Emma emphasised. This may relate to geography's more obvious role in explaining the modern world whereas in history it is more implicit. Like Tom, however, whilst Sarah emphasised the need for students to understand places and processes, she could not pin down core knowledge any further and include specific places because there is such an array to choose from. In this sense, geography does sit within horizontal knowledge structures. However, in physical geography, there is a stronger sense of verticality, as understanding rock types and glacial processes, for example, require a discrete language. Helping students to understand specialist terminology was more important to Sarah than it was even to Robert and she went as far as to say that this terminology *is* geographical knowledge. It is not surprising that geography demonstrates aspects of both hierarchical and horizontal knowledge given its status as a field rather than a form of knowledge (White, 2012) and this has implications for the way Sarah defines progression in geography which I will return to later in this section.

7.1.2 How important was inferential 'know how' knowledge (Winch, 2013) in the teachers' practice?

It was striking in all three teachers' practice how far they related single lesson decisions to bigger conceptual ideas. Figure 7.2 summarises three specific examples of this. In physics, a singular concept (sounds are caused by vibrating particles) connected with bigger ideas (everything is made of particles). In history, a substantive, first order concept (life for ex-slaves did not get better) connected with other substantive concepts (what was a slave) in order to shed light on bigger, second order ideas such as change (not all change is progress) and significance (how long lasting was the legacy of slavery and is it still felt today). In geography, a specific concept (power stations are the biggest generators of greenhouse gas emissions) connected with bigger ideas about the interaction of the human and physical worlds (humans are accelerating climate change).

Figure 7.2: Inferential know how in practice: three examples of how singular concepts connect inferentially with bigger conceptual frameworks.

	One concept introduced during sequence	*What other concepts this concept connected with/built on*	*How this concept related to the conceptual aims of the sequence*	*How the conceptual aims of the sequence relate to the conceptual framework of the subject (the 'big ideas')*
Physics	That sound is caused by vibrating particles (e.g. tuning forks).	That everything (gasses, liquids and solids) are made up of particles which constantly move.	Sounds become louder if particles are moved further apart and higher if particles are moved more quickly. Sound cannot travel in a vacuum.	When particles are moving, energy is being transferred between them, known as energy transfer.

History	Life for ex-slaves did not on the whole get better after emancipation.	What was a slave. What a slave's life was like. What was emancipation.	The legacy of slavery was enduring; change did not mean progress for all ex-slaves; African Americans had to fight for their rights.	Change does not always mean progress. Understanding the past helps us to understand the present.
Geography	The highest greenhouse gas emissions are generated by power stations.	What is a greenhouse gas. Why is it connected to global warming. What is a power station.	That humans are increasing the speed of climate change. That we are living in a new era, the Anthropocene. That there are ways we can adapt or mitigate the effects.	That people interact with the natural world to create effects.

Whilst each teacher set out to build conceptual frameworks differently, the clarity of the bigger ideas of each subject, related closely to overall aims, was evident in the decision making of all of them and was, I suggest, a significant feature of their expertise. In physics, the conceptual framework was mainly built sequentially; it was necessary for students to understand x before they could understand y, with the ultimate aim of greater abstraction and fewer (conflated) concepts. Robert wants his students to understand that everything is connected in physics and underpinned by a few big ideas and that the explanations of phenomena in one context can work in others. The opposite is true of Tom's conceptual framework in history which *expands* as students progress. Tom wants his students to understand some 'big pictures' of the past but these proliferate as students progress and are able to make more connections between them. Whilst these connections – both in terms of a substantive narrative (what happened) and conceptual framework (why did it happen, what changed, how does it connect with today) – can generate some overarching conclusions (why do wars happen, does change affect everyone equally), it is vital in history that the *particular* dimensions of specific topics are preserved. Thus, Tom wants his students to understand more first and second order concepts, not in order to conflate them (as in physics) but so there are more connections they can make. Sarah, meanwhile, had a clear sense of wanting her students to see the world like a geographer, drawing on multiple disciplines (such as geology, economics, politics, anthropology) to enable them to see the world from different perspectives. Doing so can shed light on two of geography's underpinning concepts: that the physical and human worlds interact in important ways and that particular examples illuminate more general ideas. Sarah did not connect these ideas to specific concepts explicitly but they implicitly relate to concepts such as place, space and environment. If the core principle underpinning the conceptual structure of physics is *greater abstraction* and the core principle underpinning the conceptual structure of history is *increasing complexity*, then the core principle underpinning geography's conceptual structure might be described as *synthesis* as different perspectives and interactions are brought together in the analysis of specific places and processes. I will return to these ideas in section 7.1.5 in relation to progression.

7.1.3 How important was procedural 'know how' knowledge (Winch, 2013) in the teachers' practice?

During my analysis of the teachers' practice, two dimensions of 'procedural know how' were evident:

i. How do we know what we know?
ii. What is the status of what we know i.e. how far should we trust the claims that are made?

In chapter 2 I used the term 'epistemic insight' to describe these two dimensions (Billingsley and Hardman, 2017). The extent to which the teachers paid attention to both dimensions varied across subjects. The first dimension was most clearly evident in physics and history. One of the key aims for Robert (physics) was to help his students develop the skills of a good physicist by carrying out observations of phenomena using models such as tuning forks, slinkies and oscilloscopes in order to draw conclusions. The second half of the sequence focused mainly on the quantitative dimension of physics: how to measure wavelengths and calculate the speed of sound. The physics sequence I observed therefore had the strongest element of 'how do we know' and provided an opportunity for students to carry out an experiment to calculate the speed of sound for themselves. The history sequence also had a reasonably strong focus on 'how do we know', with numerous encounters with historical source material (contemporary images, photographs, songs, court proceedings) interspersed with information collated by Tom from various sources including textbooks. In lesson three, students had the opportunity to critique a textbook account of Rosa Parks using primary source material and write a new account, thus working like historians in a rudimentary way, and throughout the sequence Tom referred to the skills of a 'good historian'. In both physics and history, students were therefore not only given opportunities to understand how we know what we know but also to work like scientists and historians. As Winch (2013) emphasises, this is pre-figurative practice in the sense that knowing how knowledge is managed and created, whilst important, is not the same as actually being able to do it 'like experts', but nevertheless, Robert and Tom provided opportunities for students to develop an understanding of what physicists and historians do, or have done, to create knowledge.

In geography, Sarah provided many *illustrations* of what we know in geography, such as images, maps and data. However, there was less emphasis on how such knowledge is actually generated. An exception was in the first lesson of the second sequence when she explained how we know that global warming is speeding up at an unusually fast rate and explored a series of techniques used to measure temperature before records began in 1850. However, this lesson did not focus on what *geographers* do but rather on what scientists are doing and overall in both sequences there was limited emphasis on what it means to 'work like geographers'. This is partly because it is difficult to be clear what this is. Fieldwork is an important component of school geography and enables students to collect data for themselves but it doesn't represent what professional geographers actually do. Whilst being a 'good physicist' involves observation of phenomena, control of variables, repeating experiments and so on and being a 'good historian' involves, for example, looking at as much evidence as possible in a balanced way and acknowledging the existence of different perspectives in the past, I was left wondering what the definition of a 'good geographer' is. I will argue in the next section that Sarah's definition of good geographical 'skills' have more in common with school geography than with the practice of geography as a discipline and have quite generic characteristics.

In terms of the second dimension of procedural know how - how to assess the validity of claims - the picture was more mixed. Tom's lesson on Rosa Parks came closest to an explicit focus on whether a claim (found in a textbook) should be trusted or not. In physics, Robert asked students to assess the validity of their own data following the speed of sound experiment and he personally talked very fluently about the limits of truth in physics but there was little evidence in the sequence or in the interviews that he addresses this meta cognitive reflection about the limits of truth in physics explicitly with his students. In the geography sequence, there was limited explicit focus on how we judge the validity of claims though Sarah provided a small number of examples outside the two sequences where she does encourage students to consider this.

Overall, I was interested that approaches to 'how do we know' were more prevalent than an explicit focus on the value of claims. The two are not unconnected – understanding how we know things is a necessary precursor to understanding the grounds on which we might regard a claim as valid– but such connections were not generally evident. This is perhaps surprising because these subjects offer only a representation of the world: the way geographers define 'development' is subject to change; the way historians explain the outbreak of the First World War is subject to change and even the way physicists explain energy transfer – or at least the models they use to do so – is subject to change. The relative absence of this dimension in Robert and Sarah's practice may be in part because I only observed a small number of lessons but in the interviews it was not a major feature either. This has implications for the realisation of an 'Future 3' curriculum scenario (Young and Muller, 2010) in their classrooms which would include helping students to understand the limits of the knowledge they encounter and how knowledge claims are warranted.

It is interesting that this dimension is more strongly established in Tom's practice than in the other two and I would suggest that this goes back to the emergence of 'new history' in the 1970s and the deliberate attempt to represent history as a form as well as a body of knowledge. The distinctive epistemology of history as a discipline (as opposed, for example, to geography, which borrows from a number of other disciplines) strongly influenced the changes in school history. However, whilst this 'new history' has become increasingly embedded in curricula documents including examination specifications, in physics, it is a different story where attempts to shift the emphasis of the curriculum onto the nature of science (NOS) have been less sustained. In geography, a metacognitive focus on how knowledge claims are warranted appears to have been a less prominent feature in its curriculum development altogether. These differences suggest a different pattern of recontextualization across subjects and are likely to relate to the different paths curriculum development have taken and the relationship between school subject and academic discipline. It may also, as a final point, relate to the challenges of teaching where teachers juggle the need to foster an engagement with their subject, an understanding of substantive ideas within a conceptual framework and a sense of how knowledge is created. Bringing these three dimensions together well is already a challenging task: emphasising a further dimension of 'know how' knowledge which explores the limits of what we really know or can be sure of may be neither feasible nor desirable with all students. Even in the somewhat rarified context of Robert's school, for example, he felt this was 'going a bit too far'.

7.1.4 How did the teachers define progression in their subject?

Winch (2013) argues that it is only through a bringing together of the two types of 'know how' knowledge (inferential and procedural) that epistemic ascent can be achieved. The previous sections have explored the teachers' understanding of both types of knowledge in relation to their subjects. For Robert, getting better at physics involves understanding more sophisticated concepts, linking and conflating these concepts, being able to apply this understanding across diverse contexts, understanding increasing advanced mathematics and developing more sophisticated and independent approaches to designing, executing and evaluating experiments. Thus, Robert identifies knowing more (core knowledge), knowing how to connect this knowledge together (conceptual, inferential knowledge) and knowing how the knowledge is created (epistemic knowledge) as the three components of getting better at physics. They collectively describe what it means to 'think like a physicist'.

Tom's conceptualisation of progression is not dissimilar in that he identifies 'knowing more' as a precursor to being able to make more substantive and conceptual connections across bigger 'pictures' of the past whilst also emphasising the importance of understanding that historians work with evidence to create interpretations and need to understand the different perspectives of the past. Collectively, this represents Tom's understanding of 'thinking historically.' Unlike Robert, however, his approach to sequencing knowledge is quite different. Whilst there is no definitive order in which to teach physics topics, Robert does argue that teaching certain topics in a particular order 'makes sense' and that to do otherwise would compromise student understanding. He also argues in favour of revisiting topics so that underlying principles can be fully understood before they are taken further. Thus, students in his school may learn about sound waves three times (as in the case of some of the students I interviewed), each time revisiting key understandings before taking them on a little further, in the case of the specific sequence I observed, to more quantitative work. History is different in this regard. Whilst the sense a student makes of Tom's sequence does depend to some extent on understanding the previous topic, it would in theory be possible to teach his sequence as a 'stand-alone' topic with only a cursory reference to pre-emancipation slavery. The relationship between topics in history is not mutually dependent (it is not necessary to learn x before y) although that does not preclude a relationship and indeed recent work in history education has urged teachers to see the curriculum as the progression model, sequencing topics in order that connections are planned for in order to deepen students' understanding (e.g. Counsell, 2017a). Nevertheless, the sequencing of topics in history – and by Tom - is more arbitrary and dependent on teachers' judgements about what ordering will make the most sense compared with the sequencing in Robert's department. One example of this is the decision by history teachers to teach chronologically or not. Whilst the key stage three curriculum at Tom's school was taught chronologically, there were plans to introduce a 'development study' in year seven which would span many hundreds of years and which would be followed by a depth study which would move the students back in time again. The decision, therefore, to move way from strict chronological teaching (which is disrupted at key stage four in any case) is entirely possible; it does not preclude students developing a sense of chronology. In other words, there are many potential ways to sequence learning in history whereas in physics, though there are choices, these are more limited because of its more hierarchical structure. Another difference between the two subjects is Tom's decision – in keeping with most history departments – not to revisit topics, but rather to revisit the second order concepts. This is because a failure to fully grasp, say, the different interpretations of the Indian mutiny of 1857 will not prohibit a subsequent attempt to grasp different interpretations of the Cold War, unlike physics where a failure to grasp what causes sounds to travel will inhibit an understanding of how and why we can measure its speed.

Sarah's understanding of progression is less similar in that when asked in an interview to characterise progression in geography, her answer – that it consists of knowing more substantive knowledge and being able to demonstrate 'skills' such as writing a good paragraph or annotating diagrams - did not fully align with her practice and the aims she set out elsewhere in interviews. In contrast to Robert and Tom, Sarah did not articulate what it means to get better at *thinking* in her subject, focusing instead on what students will *know* and be able to *do*. As we saw in Chapter 5, this does not do justice to the richness of Sarah's theorising about thinking geographically and 'wearing geography goggles'. This may be because in her answer to my explicit question about what it means to get better at geography, she defaulted to ways the department has developed to assess it. It is arguably easier to devise ways to measure knowledge acquisition and skills than it is to measure increasingly sophisticated ways of thinking. It may also be because geography is still developing a language to articulate what getting better at 'thinking geographically' means because it is currently framed as much as a disposition (which you have or not) as a cognitive achievement and is not fully related to geography's 'big ideas' or concepts (which Sarah was unsure of). Certainly, there is confusion in the geography education currently about what progression might look like (Biddulph and Lambert, 2017).

Sarah's difficulties may also relate to geography's arguably less secure relationship with its parent discipline than history and physics as outlined in Chapter 5. Deng, 2007, argues that 'The disciplinary component [of a school subject] concerns the inclusion of the structure of the academic discipline as a facet of curriculum content. There needs to be a progressive representation of the structure of the academic discipline in light of different psychological stages of the learner' (p.286)[14]. This may be more difficult to achieve in some subjects than in others. Muller (2006) is similarly interested in the relationship between the knowledge structure of a discipline and the way progression is conceptualised in school subjects, though less certain whether the relationship is always possible or evident. There is, he suggests, more likelihood of a stronger relationship between hierarchically structured disciplines and the way progression is conceptualised in their related school subjects than in horizontal subjects and this seems plausible although Tom does borrow from the discipline quite extensively in the way he conceptualises progression in history. First, his emphasis on procedural know how knowledge is based on the practice of history by academic historians (such as the use of evidence) and second, the other second order concepts (such as causation or change), though an invention of the school subject, attempt to deconstruct the different ways historians think and what history actually is (i.e. an interpretation). However, any model of progression in school history, though connected to what historians do and how they think, cannot derive in any direct way from the discipline because progression can only be expressed conceptually and not by specifying content. By contrast, progression in school physics can be defined in terms of core substantive knowledge- building within a conceptual framework, borrowing heavily from the discipline even though the knowledge is largely Newtonian and not reflective of what academic physicists actually do. The concepts and practices introduced to students in Robert's school are an attempt to introduce students to the basic underpinning concepts that are necessary to understand before progressing onto advanced physics and the methodology practised by his students is not entirely divorced from what physicists do. In geography, however, the connection to the parent discipline is less obvious because geography in universities is fragmented, drawing on multiple disciplines with different epistemologies. It is possible that this more tenuous connection makes it harder for school geography to define progression because, for example, a 'good geographer' in universities may display very different skills depending on whether they lean more towards physical or human geography. As Muller (op. cit.) writes, 'is geography closer to physics than to biology…and how would we know?'

[14] It is worth noting in this context that Deng's own background is in physics.

The fall-back position when defining progress in school subjects becomes too difficult, Muller suggests, is to 'shift the focus from the knowledge itself to the knower-actors, from a knowledge approach to a knower approach' (p. 24). This involves distilling from what teachers do the level of cognitive demand in a subject. This runs the risk of taking us down an F2 road (see p. 36) where generic skills such as those outlined in Bloom's Taxonomy are taken as proxies for progression in individual subjects. The problem is then that the specific 'evaluative criteria' (Bernstein, 2000) of each subject is thereby concealed. My conclusion regarding the three teachers in my research is that they all had a strong sense of what they want their subjects to enable students to do or how to think, but that Robert and Tom were able to articulate this more clearly in terms of progression than Sarah (though Robert was in the strongest position to be able to *measure* progression). The recontextualization field of geography education has not focused on students' conceptual understanding in the same way as comparable fields in history and physics and the discipline of geography itself is an imperfect guide given the 'chasm' between 'those that teach in school and those that teach in universities' (Goudie and Spooner, 1993, p. 338).

7.2 Knowers

Hoadley's description of South African post-Apartheid curriculum reform, implemented in 2005 and outlined in chapters two and three, was an effective warning of the consequences of privileging 'knowers' (students) and 'knowing' (ways of learning) over 'knowledge' in curriculum construction, with a weakening of conceptual subject specific frameworks and privileging of 'everyday' knowledge. However, whilst Hoadley was critical of this curriculum, she nevertheless recognised that 'If any act of curriculum construction is to decide what knowledge is of most worth to its citizens, then a consideration of knowledge *and knower* is crucial (ibid., p156, my emphases). In this section I want to explore how and how far the 'knowers' that the teachers were teaching influenced their practice. There is inevitably much overlap with 'knowing' here but I have decided to retain Hoadley's three categories because the choice of a pedagogic approach is not only in response to students' needs but is also influenced by what is fashionable at any given point and therefore merits separate treatment.

It is important to note that none of the three teachers in my research privileged the knowers (or the knowing) over the knowledge they taught. They are working in a very different context to post-Apartheid South Africa, and the curricula they work with (in the form of the National Curriculum and examination specifications) specifies what is to be taught by subject and pay attention (even if in limited ways) to subjects' conceptual structure. Whilst an important role of the teacher is to make that curriculum meaningful and accessible to their students, I was never in any doubt that curricular considerations were of fundamental importance. Choosing what to teach (as well as how) was influenced by the students but the aims underpinning particular topics were profoundly informed by subject specific concerns, conceptual structures and a desire to induct young people into particular ways of thinking. In other words, a concern about the 'knowers' did not eclipse a focus on the knowledge.

7.2.1 How far and in what ways were the teachers influenced by the students they taught?

All three teachers were committed to and adept at making their subject accessible to students. I will address specific issues related to their pedagogical choices in the next section, but it is important to note here that the teachers understood that making the learning accessible was a key part of their role. For Robert, the most significant aspect of this was in diagnosing and addressing students' 'sticky misconceptions' through extensive interactions with students individually, in small groups and as a whole class. He was able to draw on his experience to anticipate the most common misconceptions and had a number of different approaches he could draw on to remedy these. Addressing student misconceptions was not such a significant feature of Tom and Sarah's practice but there were instances where each did identify some. Tom, for example, identified the misconception that 'going to school' was normal in the past and Sarah quite deliberately drew attention to the fact that transport fumes are not one of the biggest sources of greenhouse gas emissions. Anticipating mis- or preconceptions in specific subject areas is an important dimension of Shulman's PCK (pedagogical content knowledge) (1986) and was a dimension of the three teachers' expertise.

Another common strategy used by all three teachers to make their subject accessible was in moving students from the familiar to the strange, with the familiar being either something in their everyday lives or something they had previously learnt. Robert, for example, started lesson one with a film clip about an owl and lesson two with a clip about surfing, whilst Sarah began her sequence on the physical landscape of Britain with a photograph of the Lake District and the question 'where's the geography?' The familiar to strange approach was not just an example of making the subject accessible but also meaningful by relating it to students' real worlds. We saw in Chapter Four how Robert emphasises real world applications of physics knowledge as a way to 'sell' the subject to prospective A Level students. Similarly, one of the ways that Sarah makes geography meaningful and relevant to her students is by, first, connecting the issues they study in school to current debates, news items and TV documentaries and second, by connecting geography to students' immediate, local worlds. In both physics and geography there is the possibility of applying knowledge in immediately practical ways, for example by explaining to a parent why their hearing has got worse as they have aged (physics) or examining why the fence on the edge of a field is leaning over (geography). Immediate applications of history were less visible in Tom's practice but nevertheless, he is motivated strongly by wanting students to understand what is going on in the world as a whole (e.g. teaching them about Nelson Mandela the day after he died) and understand their diverse local community (by choosing to teach about migration to Britain).

The maturity of students was also an influence on the teachers' decisions. In physics, this was mainly a case of whether the students knew and understood enough to engage in more advanced study but in history and geography it was also connected to their emotional maturity. In history, Tom was mindful of the amount of life experience students have and whether they are mature enough to fully understand different perspectives or be able to judge the significance of a person or event in time. This is not just a case of knowing more (though this is part of it); it is also about understanding, for example, what it might be like to have your life expectancy increased by ten years. For Sarah, the emotional maturity of students was less significant but was a factor in choosing when to teach about the one child policy in China, for example.

The 'knowers' therefore influenced the teachers' practice in terms of creating access and meaning, although manifestations of these influences differed in type and extent across subjects. The *emotional* maturity of students, however, was only apparent as an influence in history and geography.

7.2.2 How far were the teachers influenced by students as members of a wider society?

In chapters four to six, I regarded knowers as synonymous with individual students. My re-reading of Klafki (1995), however, has led me to acknowledge that 'knowers' represent both the individual students we teach and the wider society to which they belong. In my data analysis, both definitions of 'knowers' are implicit but here, I would like to distinguish those aspects which pertain more specifically to this notion of a wider society: morality, respect, values, identity, understanding (the present) and a critical engagement with the world. In most of these themes, the history and geography I encountered have particularly significant roles to play. Both Sarah and Tom saw their subjects as a way to explain the present world: for example in history, explaining the historical roots of the cultural and ethnic diversity of Britain and in geography, explaining why rainforests in the Amazon are disappearing. Indeed, a significant rationale for geography's existence on the curriculum is its attempts to explain the modern world. This connects with the third question that Klafki (ibid.) believes a teacher should ask 'in the preliminary phase of instructional preparation' (p. 22): 'What constitutes the topic's significance for the children's future?' (p. 24). Geography is in a strong position here, given that the grounds for content choice by Sarah were – beyond meeting GCSE specification – shaped by the current and future worlds of our young people.

Connected to the theme of explaining and understanding the present was the theme of morality and a sense of the values that underpin Tom and Sarah's practice. For Tom, teaching about the lives of African Americans after emancipation was infused with ideas such as injustice, equality and victimhood and whilst he does not aim to teach about morality explicitly, there was a strong moral dimension to the sequence. Similarly, it would be hard to imagine that Emma - who teaches with Tom and who cited the Holocaust as the only topic she felt all students should learn – could teach the Holocaust outside a moral framework. Moral issues also featured in Sarah's interviews, for example when she described the debates she conducts with students about deforestation in the Amazon and reasons why the local people 'shouldn't have their moment' and experience the wealth developed countries have been enjoying for years. In cultivating 'awe and wonder' about our planet, Sarah is also encouraging students to respect it and preserve its natural beauty and resources, a further reflection of Sarah's values and her aim to help students understand and appreciate planet earth. Helping students to understand their identities as Londoners, Britons and as human beings also played a part in history and geography, with Tom openly asking his students whether it was more important to learn about Black civil rights in south London than somewhere less diverse and Sarah going out of her way to celebrate the richness and variation of Britain's landscapes.

Finally, all three teachers encouraged students to demand reliable information to varying degrees, whether it was through a critical evaluation of experiment data (physics), a rejection of a textbook account of Rosa Parks (history) or an examination of the evidence that humans are accelerating climate change (geography). Sarah's concern about 'armchair geographers' who think they are experts because they have seen something on the television echoes concerns raised by social realists who emphasise the value of the best knowledge available at a given time as opposed to the everyday knowledge that students bring with them. Providing access to this robust knowledge and encouraging them to think in different ways is empowering for young people, creating ‘alternatives’ (Young and Muller, 2010) for the future. None of the teachers spoke explicitly about their own subject in this way but it was evident that all three provide distinctive and helpful ways to think about the world, ways that could shape the decisions that young people make in the future, using the particular knowledge they have learnt at school as an important resource.

7.3 Knowing

In this section, I will compare the pedagogical strategies used by the three teachers with particular reference to the influence of constructivism before exploring how important a role pedagogical considerations played in the teachers’ decision-making.

7.3.1 How similar and different were the pedagogical strategies used to bring about learning across the three subjects?

i. The influence of constructivism

With the exception of the Secondary Strategy in the early 2000s, which was only ever advisory, there have been few attempts in recent years to control pedagogy in English secondary schools. This was not the case in South Africa where ‘a particular theory of learning (constructivism)…[was] transformed into a set of ‘pedagogic techniques’, which bled into the structuring of the curriculum so that knowledge, knowers and knowing all became blended into one’ (Hoadley, 2011, p.155). Figure 7.3 sets out the South African Education Department’s view of the shift from a traditional to a constructivist classroom embedded within curriculum reform.

In this framework, the boundary between curriculum and pedagogy became blurred and a ‘progressive’ pedagogy became an aim in itself, regarded as a way to break free of the repressive, traditional pedagogy of the Apartheid era. Here, a constructivist or progressive pedagogy became aligned with a knowledge-poor curriculum and indeed Moore, drawing on Bernstein’s concept of ‘invisible pedagogies’ (which was effectively a critique of progressive education), has suggested that ‘relativism’ is their ‘natural epistemological reflex’ (2014, p. 180). Certainly, the constructivist emphasis on placing students at the centre of their own learning could be interpreted as encouraging a ‘knowledge-free’ pedagogy where the evaluative criteria is concealed from students. A logical assumption from this - popular in some circles in England currently - would be that teachers who take knowledge seriously teach in very traditional, teacher-led ways which emphasise memorisation, note-making and frequent testing (e.g. Peal, 2014).

Figure 7.3 Attempts to control pedagogy in the South African curriculum, 1997 (Hoadley, p.147)

Table 10.1 Shift from traditional to constructivist classroom

Traditional classroom	*Constructivist classroom*
Curriculum is presented part to whole, with emphasis on basic skills	Curriculum is presented whole to part with emphasis on big concepts
Strict adherence to fixed curriculum is highly valued	Pursuit of learner questions is highly valued
Curricular activities rely heavily on textbooks and workbooks	Curricular activities rely heavily on primary sources of data and manipulative materials
Students are viewed as 'blank slates' onto which information is etched by the teacher	Learners are viewed as thinkers with emerging theories about the world
Teachers generally behave in a didactic manner, disseminating information to students	Educators generally behave in an interactive manner, mediating the environment with learners
Teachers seek the correct answer to validate student learning	Educators seek the learner's points of view in order to understand learners' present conceptions for use in subsequent lessons
Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing	Assessment of learner learning is interwoven with teaching and occurs through educator observations of learners, learner observation of learners at work and through learner exhibitions and portfolios
Students primarily work alone	Learners primarily work in groups

Source: South African Department of Education (2000b: 12).

However, this traditionalist-progressive polarity does not reflect the practice of the three teachers in my research who move along a *spectrum* of teacher-led and pupil-centred approaches in their pedagogic practice. Their practice suggested that it is neither an either/or situation nor one that is *necessarily* associated with a particular concept of knowledge. In other words, the three teachers, whilst teaching a curriculum rich in substantive and disciplinary knowledge, drew on pedagogical approaches from across the full spectrum of possibilities. These included aspects which reflect the influence of a constructivist theory of knowing.

At the heart of constructivism is the belief that people are active in the construction of meanings when exposed to new knowledge. In other words, they try to find ways to make sense of new information, generally by connecting it with knowledge already learnt or things already experienced. This process occurs – more or less successfully - regardless of pedagogical choices but it has inspired a particular approach which acknowledges the needs of the learner alongside what is to be learnt. At the heart of this pedagogy is a belief that learners can be helped to learn things beyond what they may traditionally have been thought capable of. The work of Vygotsky has been especially influential in the application of constructivism to pedagogy in three particular ways (Moll, 2014). First, by emphasising the role of social interaction and the importance of dialogue in developing understanding; second, by acknowledging the role of the 'more knowledgeable other' (e.g. the teacher) who can guide the learner and third, by the concept of ZPD (Zone of Proximal Development) which is the space within which students can make progress but only when supported by others.

All three teachers used teaching strategies that reflected Vygotsky's theories. First, dialogue played an important role in all the lessons I observed and included whole class discussion, teacher to student interactions and student to student talk. Over half the lesson time in the history and physics sequence and a good proportion of time in the second geography sequence was devoted to interactive dialogue of some kind. Second, all the teachers allowed opportunities for students to find things out for themselves with appropriate support provided in the form of resources, prompt questions, clear instructions, interventions or peer support (i.e. working in pairs or groups). This did not preclude more so-called 'traditional' forms of learning, including – in all subjects – some teacher talk from the front when students were told things or indeed some copying of key information from the board into books (this was particularly the case in the two key stage four sequences I observed so was designed partly for revision purposes later). The technique of moving students from the familiar to the strange as outlined in the previous section is a further example of trying to help students to construct meaning by connecting new knowledge to familiar, already-known knowledge.

These clear influences of a pedagogy influenced by a constructivist theory of knowing and implemented in a knowledge-rich environment has led me to conclude that the problem is not that such a pedagogy excludes knowledge but that its use alongside a curriculum that is knowledge-poor and outcome-driven (as with Curriculum 2005 in South Africa) creates an unholy trinity of factors which leave many students without a basis from which to develop conceptual understanding. In other words, it is not constructivism *per se* that is the problem, but rather the context is which it is adopted. There no doubt exists examples of cross-curricular 'project based' discovery learning in this country which draw on constructivism and where knowledge boundaries are not respected but my point is that this does not imply that we should see this relationship as inevitable.

The other point to make in relation to my data is the striking similarities in pedagogy across the three subjects. As with my pilot data, the overall structure of the lessons (e.g. the use of engaging starter activities, the inventive use of digital resources, the layering of student activity with whole class discussion and teacher exposition) was similar across most of the lessons in all three subjects. The only exceptions were elements of the final two physics lessons (where the students were carrying out the speed of sound experiment for part of lesson three or completing a set of exam questions for part of lesson four) and the third lesson of the second geography sequence (when students spent most of the lesson in a 'market place' activity where shared information gathered in groups). Other than that, the overall structure of the lessons was remarkable similar. It is interesting to note, however, that very generic strategies such as students working together in pairs were chosen for different reasons across subjects. In physics, for example, Robert chose pair work in lesson two (with the slinky demonstrations) to enable students to identify each other's misunderstandings through dialogue. In history, however, Tom chose pair work towards the end of lesson one so that students could see that there were a number of tenable positions one might take in answer to the question he had posed and that this was acceptable as long as the position could be defended. These differences in purposes relate back to the knowledge structure of each subject: in physics, Robert needed to know that students had understood what the slinkies were telling them about longitudinal waves whereas in history, Tom was not interested in a 'correct answer' but rather wanted students to understand that there were multiple possible answers. In geography, pair discussion was not used at all in the first sequence and only rarely in the second sequence; dialogue tended to be conducted mainly at a whole class level.

ii. Assessment

Assessment was the other aspect of 'knowing' emerging from the data of all three teachers, often identified as an often unwelcome influence on their practice. It was not ongoing, 'formative' types of assessment that they talked about (though there was plenty of evidence of this in their classroom practice even if it was not explicitly raised in interviews) but rather summative assessment designed to generate data of some kind which enable students to be 'tracked' and teachers and schools to be held accountable for their progress. Assessment at key stage 3 was mentioned by Tom as a constraint because regular formal assessments cut short valuable learning time. This was a reason why Tom felt liberated in the sequence I observed because there was no formal assessment at the end of it (because it was the end of the school year) and he could take the learning wherever he wanted as the lessons unfolded. Sarah felt less constrained than Tom by assessment at key stage three but her department had spent much time discussing how best to approach it, concluding as I noted earlier in the chapter that substantive knowledge and geographical skills would be assessed rather than the more meta-conceptual goal of thinking geographically.

Two of the sequences I observed (the physics sequence and the first geography sequence) were taught to key stage four (GCSE) classes and the influence of the relevant specifications was very apparent. None of the teachers – including Tom – felt that the GCSEs compromised the integrity of the subject in terms of what they had to teach. However, Robert made references to the ‘chicanery’ of exams and the need to ‘play the game’ so that students wrote answers in ways that would generate the highest marks.   Both Robert and Sarah therefore incorporated practice exam questions into their lessons and gave students advice on exam techniques. Sarah, whilst welcoming the renewed emphasis on knowledge in general, did feel that there was too much knowledge in the new specification and that her students would find it difficult to cope. Robert did not raise this, though his rather different context – teaching in a high achieving private girls’ school – may account for this.

iii. Powerful pedagogies

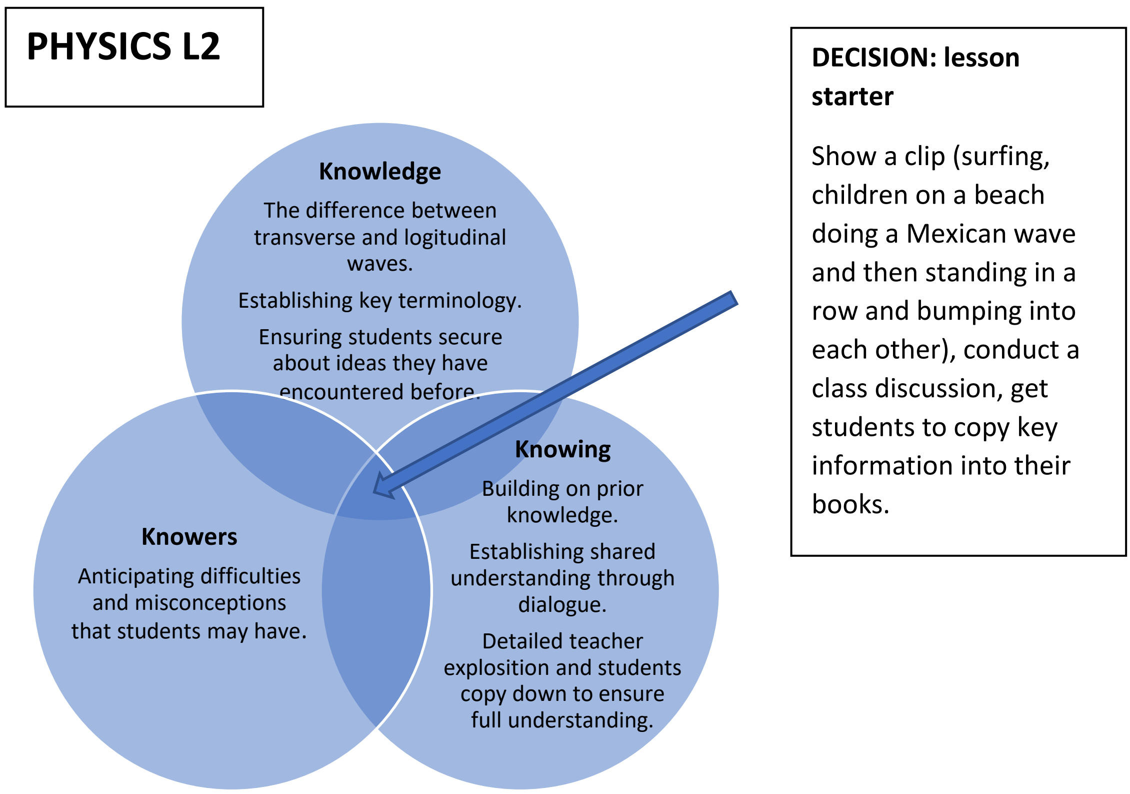
Roberts (2014) argues that knowledge is only *potentially* powerful and that a powerful pedagogy is necessary for the realisation of powerful knowledge in the classroom. Writing in the specific context of geography education, Roberts outlines some of the ways that a powerful pedagogy might enable young people to 'make connections of all kinds: between existing knowledge and new ideas; between different pieces of information; between different concepts' (p. 205). The pedagogies of the three teachers enabled students to make these sorts of connections and in that sense might be termed ‘powerful’. However, I was also interested to explore whether they demonstrated ‘powerful pedagogies’ that were unique to their subject. Physics and geography do have their own specialist pedagogies relating to practical work and two unique themes did emerge from the data, first the theme of experiential learning in physics (relating to Robert’s attempts to let the students experience, say, vibrating particles) and second, the theme of visual images in geography. Sarah continually took students on virtual journeys to places, brought to life by vibrant colour images and films. Visual images were also present in history and physics but their role in Sarah's lessons was especially striking.

However, despite these small differences, my data suggested it that it is not the pedagogy that is particularly specialist across subjects but rather the purpose to which it is put. I will explore this further in the next section.

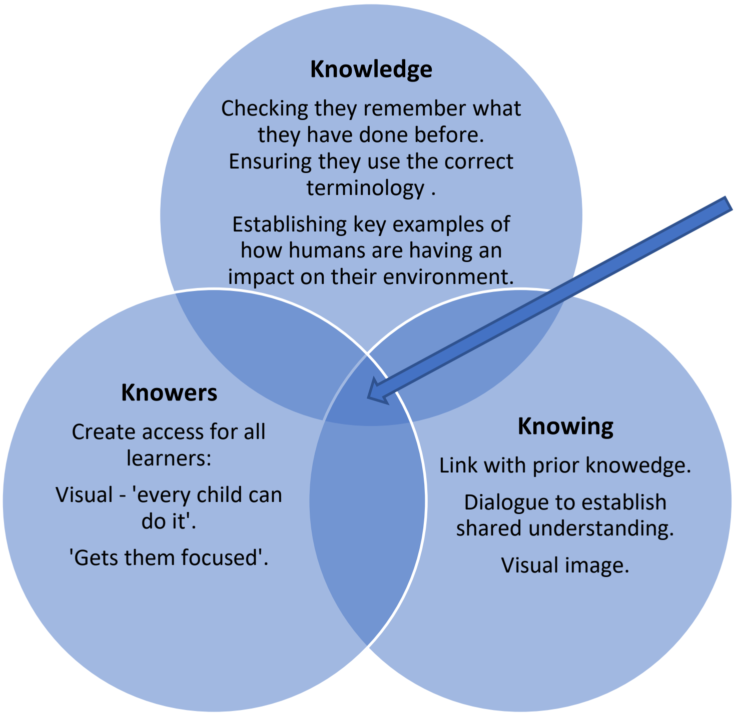
7.3.2 How important were pedagogical considerations in decision making?

Hoadley (2011) demonstrated what can happen when knowers and knowing eclipse knowledge in curriculum planning and hence one of my research questions focused on the balance between knowledge, knowers and knowing in the teachers' practice. In Figure 7.4 below, I have taken the starter activity from one lesson I observed in each subject, which in each case was a visual resource (image or film clip) followed by a whole class discussion with teacher prompts in the form of questions and some form of written response. It shows how the decisions in each case were influenced by the coming together of knowledge, knowers and knowing.

Figure 7.4 How different kinds of knowledge work together in teacher decision making



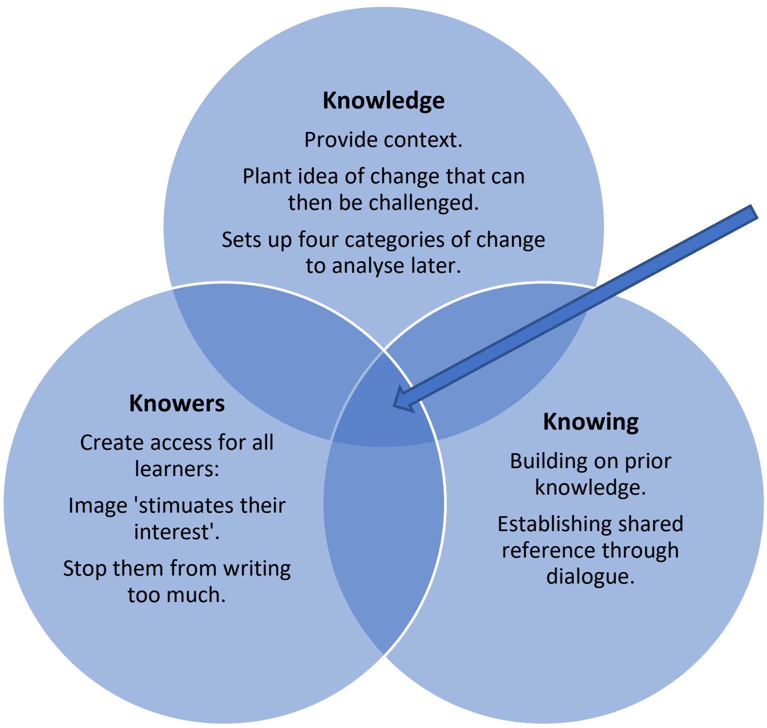
GEOGRAPHY L2/2



DECISION: lesson starter

Slide with five pictures showing how humans affect climate change. Students to write down an idea for each picture. Then whole class discussion about the pictures and written task to summarise that discussion.

HISTORY L1



DECISION: lesson starter

Image of a picture drawn at the time of emancipation showing how lives of ex slaves would change for the better. Students to write ten words to sum up the picture. Whole class discussion where certain words were recorded on the board.

Whilst the three teachers balanced the three dimensions of knowledge, knowing and knowers in their practice, there is no doubt when analysing their lessons that knowledge – core, inferential and procedural - provided the overarching influence for the decision making within the lessons themselves. It was only in the context of *what* the teachers wanted to achieve in knowledge terms that decisions about how to make this meaningful and accessible to their students and how to enact the lesson pedagogically were made. Where Tom and Sarah had considerable choice about what to teach at key stage three, the influence of the knowers became especially pronounced, but in the lessons themselves across all sequences, it was the ‘underlying logic’ (Kitson et al, 2011) of the subject that was most influential.

7.4 Recontextualising

7.4.1 How far did the teachers understand the recontextualization of disciplines into school subjects?

Muller (2006) argued that in ‘strong grammar subjects’ (such as physics), teachers need to ‘stand on the shoulders of giants – in other words, that they can speak with ‘disciplinary grammar’ (p. 26). Shulman similarly assumed that teachers need to know the ‘substance and structure of the academic discipline’ (Deng, 2007, p. 282). Deng, however, questions these assumptions, arguing that what teachers most need to know about is the subject in school, not the parent discipline. There is not space here to explore fully the extent to which school subjects are similar to their parent discipline (although I have made several observations in relation to the three case studies). What is more relevant to consider in the light of my research questions is what the three teachers understood about their discipline, the school subject and the process of recontextualization itself.

Robert, as we have seen on page 124, characterises physics as the triumph of a small number of big ideas. As an experimental physicist, he brings considerable knowledge of advanced physics in a particular area and experience of research. However, he was careful to distinguish between ‘knowing physics as a physics graduate’ and ‘knowing physics in order to teach it’. In Chapter 4, I emphasised that school physics is fundamentally Newtonian and not modern and offers an introduction to the discipline of physics rather than a watered down version of it. I also drew attention to what Robert calls ‘sticky misconceptions’. According to Robert, physics teachers do not need to be at the cutting edge of physics research but they do need to have a very thorough grounding in the underpinning ideas of Newtonian physics in order to diagnose and rectify the misconceptions that occur in schools and there was good evidence of this kind of knowledge in Robert's practice. This distinction between 'knowing physics' and 'knowing school physics' supports Deng's (2001) similar findings.

Robert also talked about the distinctive epistemology of physics, referring to both its scope and its methodology, and as we have seen (p. 131) engaged in sophisticated reflections about the nature of truth in physics in interviews. In this sense, Robert's understanding of physics as a discipline went beyond what he customarily draws on in his practice with his students, at least explicitly, and he was very aware of what it means to be a 'good physicist', a 'good physics teacher' and the difference between the two. He not only understood his discipline epistemologically and conceptually *and* his school subject but also the recontextualization process (Shalem, 2017). He was in a good position to do so having been a member of a group advising the government on the revision of the National Curriculum in the early 2000s which mapped out the science curriculum from early years to A Level around five big ideas: cells, interdependence, particles, forces and energy.

Like Robert, Tom understands the epistemology and conceptual structure of his subject and the way it is recontextualised conceptually into classrooms. In history this is via the second order concepts which provide a conceptual framework to understand what history *is* (through the concepts of evidence and interpretations) and how historians *think* (through the concepts of causation, change and similarity and difference) which Tom has a good understanding of and references in his own practice. As Yates et al (2017) concluded in their research with history and physics teachers, the choices of what they teach are often driven by a strong sense of the discipline as a whole. Not only does Tom understand the discipline of history, he also understands – and helps to shape - the wider aims that connect history to the lives of young people and which help to fill the ideological space opened up as it moves into school (Bernstein, 2000).

Sarah's sense of the discipline of geography is more fragmented as she classes herself primarily as a human geographer and finds the physical geography harder to teach. As I have indicated elsewhere in this chapter, school geography is not as closely connected to the discipline as history or physics and whilst academic geographers can still make important contributions to the development of school geography (e.g. ALCAB, 2014) it is recognised that there is a 'chasm' between the two (Goudie and Spooner 1993). Furthermore, the absence of a unified epistemology – arguably one of the strengths of the subject because of the ways it brings multiple perspectives together – makes it more challenging for Sarah to 'understand' the discipline in the way that Tom and Robert do. Sarah does, however, understand the aims of *school* geography and the way that it navigates a path through the diversity of academic geography, drawing different areas of research together under the unifying theme of human-physical interaction.

Based on my data I believe that Robert and Tom understood their disciplines well and Sarah partially so. All three understood their subjects and they each appeared to understand not only the differences between the discipline and the subject but also something about the recontextualization process and the reasoning behind it. In the next section I will argue that they play an active role in the recontextualization process but it is important to note that they also showed a deep understanding of the recontextualising fields beyond their own practice. Robert, as noted previously, has previously contributed to what Bernstein (2000) would term the ‘Official Recontextualization Field’ when he advised the government on the revised national curriculum for science. As a teacher educator and writer, he has also contributed to Bernstein’s ‘Pedagogic Recontextualising Field’ outside his own school.

Sarah completed her PGCE with Margaret Roberts, an influential figure in geography education and especially geographical enquiry. She has completed a Masters in Geography Education and is an active member of the Geographical Association, for example by attending the annual conference. She is also closely associated with my university’s geography education department, working with many student teachers over the years and attending subject seminars held there. In that sense, then, Sarah, whilst not actively contributing to the recontextualization of geography outside her school, is very familiar with current debates about geography education.

Tom is less obviously engaged in debates about history education outside his school but he completed his PGCE in London with Ros Ashby, a key contributor to our understanding of the ‘new history’ movement and has retained close links with my own university, working with numerous student teachers, one of whom is now his second-in-department. All three teachers are therefore aware of developments and debates beyond curriculums and specifications, enabling them to understand not just their content but also the reasoning behind them and indeed their limitations. Shalem (2017) concluded from her research that all teachers need a foot in three fields: production, recontextualization and reproduction. Whilst it seems unlikely that most teachers will have experience of academic research in their discipline and although the term ‘reproduction’ does not in my view adequately describe what the three teachers in my research do, I do agree with Shalem that knowledge of all three fields is enormously helpful in enabling teachers to understand the reasoning behind the features of the school subject which may be similar and different to the discipline.

When teachers do not have a sense of their subject's conceptual framework which draw on these three fields of knowledge, a curriculum where a knowledge framework is absent becomes deeply problematic as in South Africa (Hoadley, 2011). Indeed, empirical studies in South Africa at the time of Curriculum 2005 'claimed convergence in findings from the research around a number of issues, most importantly around teachers' extremely poor conceptual knowledge' which meant they 'lacked the knowledge base to interpret Curriculum 2005' and ensure progression (ibid., p. 149). In England, many secondary schools are no longer obliged to follow the national curriculum - although GCSE specifications are still heavily prescribed – and we do not yet have any empirical work showing what happens in those schools that radically depart from the national curriculum. One obvious limitation of my research is its focus on expert teachers; by claiming that their expertise is informed by (mainly) strong knowledge in the three fields proposed by Shalem (2017), I make no claim about the knowledge base of teachers in general in this country.

7.4.2 How far did the teachers play an active role in the recontextualization process?

The task of bringing a curriculum to life in classrooms has been characterised, variously, as 'delivery' (Doyle, 2017), 'enactment' (Doyle, ibid.), 'curriculum making' (Lambert & Biddulph, 2015), 'transformation' (Gericke et al, 2018) and making the 'final connection' (Deng, 2007). Each term brings with it a subtly different sense of the teacher's role in this process. Part of the distinction rests on the extent to which teachers are involved in a curricular as opposed to a pedagogic process. Much of the literature suggests that a teacher's role is primarily pedagogic, enacting a curriculum which has been made elsewhere. Young (2010) writes that 'teachers cannot create a curriculum themselves' which, although acknowledging that there are multiple recontextualization agents, contrasts with Lambert and Biddulph's (op. cit.) account of teachers who 'make' a curriculum every time they teach a lesson. Doyle (2017) recounts his own journey from seeing teaching as 'delivery and implementation' to the enactment of a curriculum in which teachers play a more active role. Nevertheless, his view is still that teachers actively transform a curriculum rather than make it:

> Teachers…deal with the particular, so to do the practical work of teaching they must transform whatever curriculum **they encounter** into forms and practices they can use with specific students at a specific time and place. (p. 2424, my emphases).

A problem in the literature is that these discussions about the role of teachers in enacting, shaping or making a curriculum do not fully acknowledge the role of context. In Germany, curricula have historically (since the seventeenth century) been loosely defined at a regional level with the expectation that teachers will shape them according to their own aims and expertise (influenced by the concept of *Bildung* – see p. 56). Klafki (1995) sets out very clearly the key questions he believes a teacher should ask 'in the preliminary phase of instructional preparation (i.e., didactical analysis) in view of the concrete topics/themes proposed by the curriculum or planned by the individual teacher' (p. 22) and these convey a strong sense of teachers as curriculum *makers* who before they can turn their attention to 'methods' must first attend to questions about the purpose and structure of the content they will teach:

> The second step of instructional planning, methods planning, can only proceed from didactic analysis. Methods planning is concerned with the 'how' of teaching, more precisely with the question, which ways can lead to the fruitful encounter between the children and the content (the pedagogical significance and structure of which have been established by didactic analysis) and what can follow for a fruitful encounter between the two to be achieved. (p. 28)

This preliminary phase of Klafki's didactical analysis addresses the following questions:

i. What wider or general sense or reality do these contents exemplify and open up to the learner? What basic phenomenon or fundamental principle, what law, criterion, problem, method, technique or attitude can be grasped by dealing with these contents as 'examples'?
ii. What significance does the content in question or the experience, knowledge, ability or skill to be acquired through this topic already possess in the minds of the children in my class? What significance should it have from a pedagogical point of view?
iii. What constitutes the topic's significance for the children's future?
iv. How is the content structured?
v. What is the body of knowledge which must be retained ('minimum knowledge') if the content determined by these questions is to be considered 'acquired', as a 'vital', 'working' human possession?

(pp. 22-28)

Answering these questions entails more than curriculum implementation and require a particular definition of what Doyle (2017) terms curriculum 'enactment'. Klafki is suggesting that teachers are – or should be – active in the *shaping* or *making* of a curriculum in the classroom in much the same way envisaged by Lambert and Biddulph (2015).

However, elsewhere in the world (i.e. beyond Germany), the relationship between the teacher and the curriculum varies. Deng, writing in Singapore, though emphasising teachers' contribution to the recontextualization process, makes repeated reference to teachers using the 'curriculum materials' which are provided. It is not clear what these materials are, nor whether teachers have to use them, but it is in this context that Deng describes teachers as the 'final connectors' (2007, p. 289). Doyle, writing in the US, describes how the curriculum there is framed simply as inert content, the value of which is assumed. Within England there are variations even within the country, from scripted lesson plans to high teacher autonomy. Across the world, factors such as prescribed textbooks, highly detailed curricula, flexible curricula, and outcomes-led curricula all make a huge difference to the extent to which teachers shape a curriculum. Unfortunately it is not always clear in the literature how far specific contexts influence particular conceptions of teacher agency.

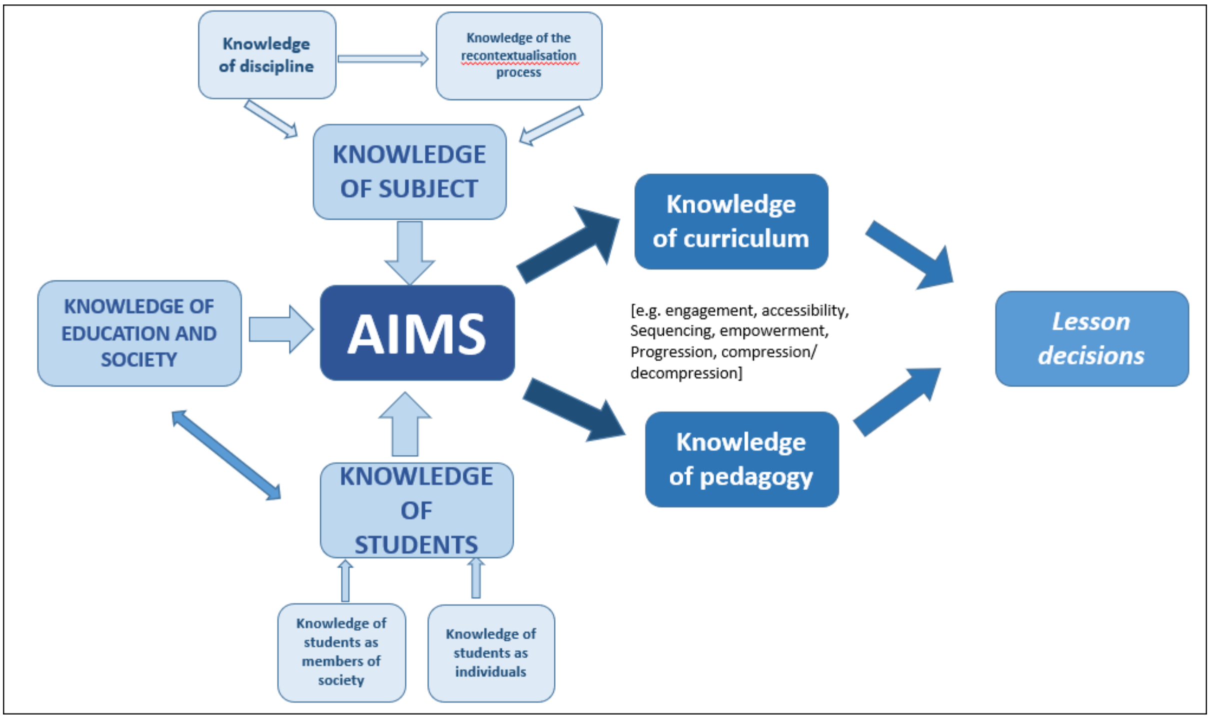
The practice of three teachers in the specific context of London secondary schools in my research strongly suggests that they are actively involved in curriculum making in classrooms and that in practice, curricular and pedagogic decisions are intertwined. It may be useful at this point to revisit the definition of what I mean by curriculum and pedagogy (set out in Chapter Two) which draws from Bernstein (1975): 'Curriculum defines what counts as valid knowledge, pedagogy defines what counts as valid transmission of knowledge' (p. 85). Using this definition, the three teachers in my research are without question actively engaged in recontextualising their subject *in curricular as well as pedagogic* ways. To support this claim, I have attempted to represent the knowledge the teachers drew on and the way this knowledge was manifested in their lesson decision diagrammatically in Figure 7.5. It is a complex diagram but is underpinned by a set of assumptions emerging from the data about the teachers in my research:

i. The aims which inform the teachers' practice are influenced by three factors: the subject, the students and society as a whole. This mirrors the didactic triangle (see page 57).
ii. Knowledge of the subject in school is influenced – to varying degrees – by an understanding of the discipline and the recontextualization process itself which includes knowledge of official curricular material as well as broader debates within the relevant subject community.
iii. Knowledge of society and education means understanding the broader goals of education in order to prepare students to contribute fruitfully to a democratic, information-rich, plural society.
iv. The fundamental aims informing the teachers' practice come first, as in Klafki's didactical analysis (1995), before more practical decisions are made.

v. The enactment (Doyle, 2017) of these aims in classrooms requires practical curricular and pedagogic knowledge. Together this knowledge addresses issues such as the sequencing of learning to support progression and the need to engage learners and make the subject accessible and meaningful.

vi. Curriculum and pedagogy are connected and it is very difficult to define when one ends and another begins.

Figure 7.5: A sequence of teacher knowledge deployment as manifested in lesson decisions



What I have tried to illustrate here is that the three teachers' practice was fundamentally shaped by their knowledge of their subject (which was itself shaped by their knowledge of the discipline to a greater or lesser extent and their understanding of the recontextualistion process) coupled with their knowledge of their students and of broader social and educational goals. Together, these different types of knowledge shaped their overall aims, regardless of any specific curricula (such as GCSE specifications) they were teaching. In other words, these aims and the knowledge that informed them lay at the heart of the teachers' expertise and shaped the more immediate decisions they made in the classroom. The right-hand side of Figure 7.5 identifies two further types of knowledge – knowledge of curriculum and knowledge of pedagogy - which the teachers draw on when they plan and teach lessons. This is deeply practical knowledge about how to teach, to use Klafki's term, 'elemental' knowledge (essential content) so that it creates access to 'fundamental' knowledge, that is, knowledge which provides a deeper level of insight for the learner (see Kruger, 2008). The teachers draw on both curricular and pedagogical knowledge (as defined by Bernstein, 1975) to make this happen in lessons and I found it very difficult to separate the two in any meaningful way. By choosing, for example, to dwell on a particular point in a lesson, teachers are drawing on their pedagogic knowledge (for example, this is engaging the students and they will benefit from more time spent on this) and curricular knowledge (I can bring in another example here because it will extend their knowledge and help them make connections in helpful ways). This type of knowledge is captured partly in Figure 7.5 as ‘compression’ and ‘decompression’ (Muller & Hoadley, 2018) which echoes Klafki’s concepts of ‘elemental’ and ‘fundamental’ knowledge and refers to the way that teachers choose when and how to ‘compress’ and ‘decompress’ complexity. This process, I am suggesting, is both a curricular and a pedagogic one.

Thus, Figure 7.5 separates the underpinning knowledge which informs the teachers’ practice from the specific curricula and pedagogic knowledge that teachers draw on in specific lessons (and which Shulman (1986) refers to as PCK) . Their expertise involves bringing these types of knowledge together successfully in their planning and teaching.

I am going to take one decision made by each teacher in order to illustrate how these were shaped by the teachers’ different types of knowledge and by their active involvement in the recontextualization of their subject. I will move the opposite way along Figure 7.5, starting with the decision and moving backwards through curricular and pedagogic knowledge and ending with aims.

i. Physics

The **decision** I have chosen was to use the surfing clip in Lesson Two, refer back to it throughout the lesson and correct a likely misunderstanding arising from it. The clip showed surfers riding waves and then a group of children on the beach physically modelling a transverse wave (using a Mexican wave) and a longitudinal wave (line of children bumping into each other one after the other).

The **practical curricular and pedagogic knowledge** that underpinned this decision included knowing that:

- students needed to understand the difference between a transverse and a longitudinal wave and that this can be hard to visualise;
- moving from the familiar contexts of beaches, sea and children to the stranger more abstract one of sounds waves will create more access and engagement;

- the clip is most useful placed at the start of the lesson because it will provide a quick reminder to students throughout the lesson of the key features of different waves (including recreating the two demonstrations from the clip themselves);
- the clip introduces knowledge that follows naturally from the first lesson in the sequence and anticipates what students will do during that lesson and beyond;
- the clip does set up a potential misunderstanding - that surfers move forwards because the waves move them forward when in fact it is the tide that moves them - which will need correcting.

Underpinning this knowledge was a **deeper knowledge of the subject and of students** (though less of **wider social and educational goals).** Robert understands the physics of waves very well and he also anticipates the likely misconceptions that students will have. He understands that the analogy of the surfers on the waves might imply that the water waves (the particles) move forwards and carry the suffers (the sound) with them when in fact the water waves move up and down, just as the particles only vibrate, and it is the tide (or energy) that moves the surfers (sound) forwards. Finally, Robert understands that students find experiential learning valuable – being able to see and even better to experience a phenomenon can help to create access.

ii. History

The **decision** I have chosen was to present students with primary source material relating to the prosecution of Rosa Parks in 1955 which they would discuss as a class before using it to piece together an alternative account of what happened in the Montgomery Bus Boycott.

The **practical curricular and pedagogic knowledge** that underpinned this decision included knowing that:

- a specific case study of an individual who was involved in the Civil Rights movement would deepen students' knowledge and complement the overviews provided in lesson one and four;
- this case study would make sense in the context of the lessons before and after – i.e. that the students would know enough to make sense of it and would be able to draw on it subsequently;
- the second order concept of evidence would be accessible to students (because the primary sources were more accessible than subsequent interpretations of Rosa Parks that were first considered) and would engage them;
- the topic would provoke opportunities for discussion and debate.

Underpinning this knowledge was a **deeper knowledge of the subject, of students and of wider social and educational goals.** Tom knows the history of the Civil Rights movement himself very well. He also understands the second order conceptual framework of history as a school subject and how this deconstructs the discipline into a more accessible form. Specifically, he knows what students need to understand about the concept of 'evidence' and how this understanding needs to be balanced with an understanding of the substantive knowledge of 'what happened'. He is sensitive to the needs of students in terms of access and engagement and he understands the broader goals of teaching history, including a sense of moral purpose. He deliberately chooses a woman to show an example of female empowerment and the whole lesson contributes to his awareness of the power of narratives and the need in this sequence to avoid a 'victim story'.

iii. Geography

The **decision** I have chosen was to present complex data about greenhouse gas emissions in Lesson Two of the second sequence about climate change accompanied by lengthy class discussion and a written analysis by students

The **practical curricular and pedagogic knowledge** that underpinned this decision included knowing that:

- students needed to understand why the climate is changing quickly and how this connects with human actions;
- it is helpful for students to see the evidence for the claims being made and analysing data showing the biggest emitters of greenhouse gasses is a good way to do this;
- discussion will help the students to access the data and to identify its significance;
- the data will challenge some of their preconceptions (i.e. that cars are the biggest producers of greenhouse gas emissions);
- students need to develop their skills of analysing and writing about data;
- this activity makes sense within the lesson (it follows an introduction and general discussion about the causes of climate change) and within the sequence (it follows the first lesson looking at the evidence for climate change and is followed by a lesson looking at the impact of climate change).

Underpinning this knowledge was a **deeper knowledge of the subject, of students and of wider social and educational goals.** Sarah is very familiar with the topic herself and keeps up to date with current debates, especially as reported in the media.

She is also keen for students to understand where knowledge comes from and wants to challenge the preconceptions they may have. This is all part of moving them on from 'armchair geography' and equipping them with the precise knowledge to draw on in their daily lives. Sustainability is a topic that Sarah believes all students should learn about (see p.164) because of its importance to the students personally and as members of a wider society and it is a good example of Sarah's understanding of the key geographical idea of the interaction between human and physical worlds. Finally, Sarah understands what students find difficult and how to create access and engagement.

These three examples are intended to demonstrate how specific decisions in these lessons were influenced by quite 'technical' knowledge of how to enact a curriculum which in turn was influenced by a deeper knowledge base about the nature of the subject, the students and wider educational and social goals. I would argue that these teachers are not simply 'implementing' or 'pedagogising' a curriculum, though this is part of what they do. Rather, they are making a curriculum every time they teach a lesson (see Lambert and Biddulph, 2015) and this requires an active role in the recontextualization of their discipline into schools. Shulman's PCK is a very useful summary of the kinds of important knowledge teachers draw on in pedagogising their subject but I feel it underestimates teachers' role in the recontextualization process itself. As Deng (2007) has noted, Shulman assumes that the discipline and the school subject are the same thing. My argument is not only that this is incorrect but that the three teachers in my research are an important part of the recontextualising field.

Chapter 8 Conclusion

In the conclusion I return to my three research questions which are:

1 What kinds of knowledge do expert teachers across three subjects draw on in lesson design and enactment?
2 To what extent and in what ways do expert teachers play an active role in the recontextualization of their discipline into school subjects?
3 How far and in what ways do expert teachers achieve a ‘Future 3’ curriculum scenario?

In responding to these questions, I shall be making connections between them but for clarity, in what follows I address each one separately.

8.1 What kinds of knowledge do expert teachers across three subjects draw on in lesson design and enactment?

My particular interest in this thesis has been in the knowledge that informs teachers’ decision making in planning and teaching lessons across physics, geography and history. Carlson and Daehler (2019) refer to this type of knowledge as ‘enacted PCK’ or ‘ePCK’ (p. 83). They describe ‘enacted PCK’ (based on Shulman’s original conception of pedagogical content knowledge, 1986) as:

> the specific knowledge and skills utilised by an individual teacher in a particular setting, with a particular student or group of students, with a goal for those students to learn a particular concept, collection of concepts, or a particular aspect of the discipline. (p. 83-84).

I have chosen to start this section with this recent reference to Shulman’s conception of teacher knowledge because it remains one of the most influential, certainly in the English speaking world, as is illustrated by the work of Carlson and Daehler and other science educators who since 2012 have worked to refine the model of PCK for science teachers.

Shulman’s concept of PCK is certainly valuable in explaining teachers’ decision making in planning and teaching lessons. In Figure 7.5, which proposes a sequence of teacher knowledge deployment as manifested in lesson decisions, the ‘knowledge of curriculum and pedagogy’ in the middle section essentially consists of PCK. This is the knowledge that the teachers in my research drew on to inform decisions such as how to sequence and structure the learning, what pre- and misconceptions to anticipate and strategies to secure student engagement. In other words, one of the significant knowledge bases of the teachers in my research was PCK. The other two types of knowledge suggested by Shulman – content and curricular knowledge – were also visible in the practice of the teachers, although here, the precise nature of 'content' knowledge becomes more problematic. Although Shulman understood that the content derived from disciplines needs to be transformed 'into a form that high school students can comprehend' (p. 8), he still assumed that the school subject is a simplified version of the academic discipline and that knowing the discipline well is a prerequisite for teaching the subject well. The teachers in my research did not make the same assumption and indeed Robert said quite explicitly in an interview that being a good physicist and being a good physics teacher are not the same, an argument also made by Deng (2001). Bernstein's (2000) concept of recontextualization suggests that the school subject is not just a simplified version of the discipline but a reconceptualised one and the practice of the teachers in my research provided good evidence of this. Robert and Tom had secure understanding of their disciplines which informed their practice; Sarah less so because it is harder to 'know' geography in a holistic sense. However, all three understand and 'know' their subject, suggesting that whilst teachers may benefit from a strong understanding of the discipline, especially in hierarchical subjects such as physics, they also need to understand the discipline as recontextualised into subjects.

Figure 7.5 attempts to illustrate what 'knowing your subject' involved for the three teachers. Certainly, it involved PCK but it also involved understanding some of the aims of their subject which are not dictated by the discipline alone but included the aims of schools, education and society. The didactic triangle, as developed from the work of Klafki (see Gericke et al, 2018 - see also p. 57 of this thesis), captures these influences and recognises the interplay of students, the subject and teachers within the overarching influences of schools and society. For the teachers in my research, the aims which underpinned their practice were profoundly influenced by all three in different ways. This is why I placed these influences at the beginning of the sequence in Figure 7.5. As in Klafki's work on didactical analysis (1995), I believe that these fundamental aims come first and more practical curricula and pedagogic decisions derive from them. It is this dimension of teacher knowledge, evident in the three teachers, that I think Shulman potentially underestimates.

In terms of the subject (or 'content') itself, Shulman drew attention to Schwab's distinction between syntactic and substantive knowledge. In my research, I found it helpful to differentiate knowledge further, drawing on Winch's (2013) two types of 'know how' knowledge. This enabled me to analyse the teachers' understanding of the conceptual structure of their subjects separately from their knowledge of 'content' and to conclude that all three of them were able to draw on their subject's conceptual structures in their decision making but in slightly different ways. As I suggest in Chapter Seven, Robert seeks to reduce concepts by conflating them as students make progress towards greater abstraction, a characteristic of hierarchical knowledge. Tom, by contrast, seeks to increase conceptual complexity: as students learn more and as they mature, they are potentially able to make more conceptual connections and understand different perspectives better. Sarah, however, is working within different paradigms simultaneously. Physical geography demonstrates some characteristics of hierarchical knowledge whilst human geography is more horizontal. Sarah's overall aims are to create a synthesis of different perspectives on the world, with the interaction of human and physical processes at its heart. These kinds of differences are important to understand for two reasons. First, it enriches our understanding of what knowing your subject for the purpose of teaching it looks like and second, it challenges generic approaches to assessment and progression in schools which are applied across subjects and which do not recognise subject specific nuances.

Winch's (ibid.) other type of 'know how' is procedural, similar to Schwab's 'syntactic' knowledge that influenced Shulman. Understanding where knowledge comes from was an aim evident amongst the three teachers, though in practice stronger in physics and history than in geography. Nevertheless, there was an acknowledgement that students are not simply given information; they are also entitled to know where that information comes from. This procedural 'know how', together with inferential 'know how', shaped the three teachers' evaluative criteria (Bernstein, 2000), that is the criteria used to measure progress in learning. As I noted in the literature review on p. 66, Shalem (2017) argues that 'unless the teacher has strong conceptual knowledge of what she teaches, she will struggle to decide what evaluative criteria should count in the topic of the lesson and how to make this explicit for a new acquirer' (p. 185). For the three teachers, this conceptual knowledge was both inferential and procedural and was used to restrict or elaborate recognition codes in their teaching (Bernstein, 2000). In other words, they were able to take certain conceptual understanding for granted whilst choosing to expand on others. Tom exemplified this well in the third lesson of the history sequence when he assumed students' understanding of *why* historians use evidence but chose to elaborate on the challenge of *how* they use it to sometimes create misleading accounts of the past. For Shalem, understanding the 'conceptual base' of a subject requires knowledge of the discipline, the subject *and* the recontextualization process. This last dimension does not explicitly feature in Shulman's categories of teacher knowledge but from my research evidence I would argue that it is a valuable one. However, as I will argue in the next section, part of the reason teachers need to understand the recontextualization process is because they are actively engaged in it themselves.

In conclusion, my contribution to the debate about teacher knowledge, based on my research, is twofold. First, I have identified, in Figure 7.5, two 'levels' of teacher knowledge. The first level relates to the three teachers' aims which were shaped by the interplay between their subject (understood as the discipline recontextualised into a school subject with distinctive evaluative criteria), students and wider social and educational goals. These aims informed the second level of more practical knowledge which share many characteristics with Shulman's PCK and which combine knowledge of both pedagogy and the curriculum which Shulman himself found impossible to separate. Second, analysing the teachers' knowledge about their subject according to Winch's (op. cit.) two types of 'know how' provided a valuable way to compare the similarities and differences between them, especially regarding progression. This could provide a useful common language to use across the whole school curriculum where it can be difficult to establish common ground between subjects.

8.2 To what extent and in what ways do expert teachers play an active role in the recontextualization of their discipline into school subjects?

The teachers in my research all played an active role in the recontextualization process at the level of individual lessons. I have tried, in Figure 7.5 and the text that follows it, to demonstrate how their decisions in lessons were influenced by both short-term practical knowledge about the curriculum and pedagogy and longer term goals relating to the subject, students and education/society. Whilst the extent to which the teachers were genuinely creative in choosing what to teach differed, their role in 'making' a curriculum in lessons was evident. This was even the case in the first geography sequence in which Sarah followed the GCSE specification almost to the letter. Shalem (2017), in her research about teaching from scripted lesson plans, has emphasized that even in that most controlled of environments, teachers need to understand a subject's evaluative criteria to teach well; having a script is not enough. In that first geography sequence, not only did Sarah demonstrate this understanding (ensuring that the evaluative criteria were made evident to students) but her decisions were influenced by her wider understanding of the aims of geography education. Hence her repeated emphasis on the beauty of the landscape implicit in which is a need to respect and protect it.

There was, however, variation in the teachers' involvement in the recontextualization process. Whilst all were engaged in recontextualization at the level of individual lessons, in two of the sequences (physics as well as the first geography sequence) the content was specified by the awarding bodies. In the second geography sequence, the topic – climate change – had been planned collaboratively by the department and the main activity in the third lesson, for example, had been planned by a colleague of Sarah's. The history sequence, however, was planned by Tom from scratch. He designed the resources, chose the big questions and decided which second order concepts he would focus on in particular. His role as a recontextualization agent was thus especially significant. There are two points to make about this. First, teachers are only ever *part* of the recontextualising field and Tom, although creating his own sequence, was nevertheless profoundly influenced by the recontextualization tradition in history education which has seen it transformed as a school subject over the last thirty years. The fact that he included 'GCSE style' questions for students to discuss when he was under no obligation to do so reinforces this point. Second, this variation reminds us of the importance of context. I have indicated elsewhere (see p. 256) that much of the literature about teacher knowledge and teachers' role in the recontextualization process is context specific but does not make this sufficiently clear. Even within a sample of three, the sequences I observed ranged from lessons that were heavily prescribed by an external body to those that were planned from scratch by a teacher who had a free choice of what to teach. Whilst my argument that the teachers were active agents of recontextualization in all the sequences still stands, the extent of their role varied according to the precise nature of each sequence.

My final point in this section relates to the different relationships between the subjects and their 'parent' disciplines as discussed or exemplified by the three teachers. In physics there are ways that Robert leans heavily on the discipline. The big ideas that shape his conceptual framework, the aim for greater abstraction and the insight he provides into the epistemology of physics all derive from the discipline. However, school physics does not mimic academic physics; rather it is an entry point to that world and in that sense, therefore, it is recontextualised quite significantly. The influence of students is a major factor in this process, with many finding the abstract nature of physics challenging, and it was therefore not surprising that Robert was the most concerned out of the three to correct student misconceptions. It also explains why he believes that physics teachers need a different kind of knowledge from physics graduates, knowledge which is simultaneously deeper and simpler, enabling them to diagnose and remedy student errors by relating them back to the fundamental principles of concepts such as force and energy.

The wider influence of society was less apparent as an influence in the recontextualization of physics in Robert's practice than in history. Tom draws on his disciplinary understanding particularly in relation to history's epistemology, i.e. he understands how history is constructed and how all accounts are provisional. But his decisions about what to teach are not shaped by the discipline but by his values and his commitment to helping students understand the world around them. Thus, although both Robert and Tom draw on their understanding of their disciplines, the impact of the discipline on what to teach and the order to teach them is greater in physics than in history.

Finally, geography is a hybrid discipline, drawing from other fields. School geography is neither an 'entry point' to the discipline in the manner of physics, nor a reflection of its distinctive epistemology, as in history. Sarah identifies herself as a human geographer and by her own admission finds physical geography more challenging although she takes steps to ensure she is fully prepared to teach it. More significantly, however, the absence of both a clear and unified epistemology and conceptual structure within the discipline is manifested in Sarah's less developed definition of progression. School geography appears to be less a recontextualised version of the discipline and more a distinctive one in its own right. Given that geography was taught in schools before it existed in universities and became established in the universities (in the early twentieth century) mainly to create a cadre of qualified teachers for state secondary schools, this is perhaps not altogether surprising.

In conclusion, my research suggests that the three teachers do play an active role in the recontextualization process and that this was evident across all the sequences I observed. However, the extent of this recontextualising role varied according to context (i.e. how much choice did they have about content and activities) and subject. This latter point is not only about extent; the three subjects were also recontextualised in different ways with, for example, a bigger role for social influences in history and geography then in physics. I know from the literature that science is not exempt from wider debates about social utility but these were not evident in my case study so again, context is important.

8.3 How far and in what ways do expert teachers achieve a 'Future 3' curriculum scenario?

An F3 curriculum – or more precisely F3 curriculum *thinking* - differs from both F1 and F2 by respecting the boundaries imposed by disciplines, by respecting the knowledge which is created within these boundaries but also by exploring the status of that knowledge and indeed its limits (Young and Muller, 2010). In practice, an F3 curriculum requires an interplay of disciplinary content, concepts and skills, the balance of which will differ across disciplines and subjects. It also requires students to explore how claims in the subject are warranted and the extent to which 'truths' are provisional.

Tom's aims appear to come closest to enacting an F3 curriculum. The content – first order or substantive concepts – is shaped by a wider second order conceptual framework with genuine interplay between the two. The skills Tom seeks to develop such as using primary source material well, carrying out an enquiry and communicating opinions complement and contribute to this conceptual framework. Collectively, this combination of content, concepts and skills represent what it means to 'think historically'. In terms of epistemic insight, Tom wants his students to know where historical knowledge comes from and he wants them to understand that it is provisional and open to revision, which in the sequence I observed, the students tried to do themselves.

Robert also enacts features of an F3 curriculum. I found the difference between concepts and 'big ideas' a little blurred, and the difference therefore between 'overarching concepts' (such as energy) and smaller, more precise concepts (such as amplitude) less distinct than the difference between history's first and second order concepts. Nevertheless, it was very clear how Robert's teaching locates individual areas of content (and concepts) with broader conceptual frameworks. Running alongside this is Robert's attention to how we know things in physics by engaging the students with models and experiments. Collectively, as with history, the interplay of content, concepts and skills defines what Robert called 'thinking like a physicist'. Students do not properly experience how physics knowledge is generated in Robert's classroom any more than students create a piece of genuinely original and rigorous work of history in Tom's but the point is that the students understand that knowledge comes from somewhere and is produced by someone. Robert is less inclined than Tom to explore the limits of scientific knowledge with students however, at least before A Level. This difference between physics and history is likely to reflect the process of recontextualization and the greater, more consistent emphasis on epistemic insight within history education since at least 1991.

The weakest enactment of an F3 curriculum was in geography. Sarah is very strong in her understanding of geographical content and skills, displaying a strong commitment to both in her lessons and in the interviews. She is also very articulate in describing what it means to 'think geographically'. However, unlike Tom and Robert, this does not derive from an overarching conceptual framework and the interplay between content, concepts and skills is somewhat implicit in her practice and not used to define progression (which is mainly restricted to content and skills). This is not a weakness of Sarah's practice, but a feature of school geography's characteristics as a subject giving it a less than clear identity in relation to 'a discipline'. There is clearly an important and perhaps urgent research agenda implied here for the geography education community, one that has long been acknowledged by the community itself (e.g. Lambert and Morgan 2011). This is also evident in the extent to which students in Sarah's lessons engage with how they know things in geography and how far the claims they are told are warranted. Whilst Sarah is – compared with my pilot data and the implications of the literature – unusually ambitious in this regard, her students do not consider 'how we know things' to the same extent as history and physics and opportunities to critically assess the status of knowledge claims appear limited.

Overall, the extent to which the teachers realise a curriculum envisaged in Young and Muller's F3 scenario is somewhat mixed. This is partly due to the relationship between the subject and the discipline. Where this is strong – as in history and physics – the curricula thinking reflective of an F3 scenario appeared easier achieve in the practice of the three teachers. However, this is also influenced by the traditions within relevant recontextualising fields. School history has enjoyed a very consistent approach within the official *and* pedagogic recontextualising fields since 1991 and the introduction of the national curriculum in England that has emphasised key features of an F3 curriculum scenario. School physics, meanwhile, whilst strongly connected with the discipline, has been part of ongoing debates about the importance of scientific literacy and NOS (nature of science) and consensus has been harder to find. School geography has the weakest relationship with the discipline and whilst strong in its overall rationale, lacks strong consensus and familiarity with a conceptual framework.

8.4 Conceptual development

My research has led me to engage with a diverse range of theorical perspectives and the way I bring these together to inform my work is the first aspect of conceptual development that I will discuss in this section. The second aspect concerns the way I have related and applied these theoretical perspectives to a comparative study of teacher knowledge across three subject areas. Research into teacher knowledge within subject areas is relatively common; comparative research across subject areas which deploys a common thematic and theoretical framework but which still respects subject specificity is much rarer. I will explore both aspects of conceptual development in this section before considering the limitations of my research.

When I embarked on this PhD, my interest was primarily in the distinctive pedagogies of different subjects but over time, my interest shifted towards the ways in which different school subjects are conceptualised and how this affects teachers' decision making. Whilst this includes critical pedagogical decisions, it also relates to the different knowledge structures of subjects and the different aims that teachers have in teaching them. My pilot study played an important role in this evolution because it suggested that what differentiated different subjects was less about the pedagogical choices in terms of lesson structure and activities and more about the aims that underpin them. The literature was also crucial in moving me away from a primary focus on pedagogy and towards a more holistic focus on knowledge, curriculum and pedagogy combined.

My first serious engagement with theoretical perspectives about knowledge came from the work of Young (e.g. 2008) and Young and Muller (e.g. 2010). Whilst their work introduced me to valuable ways of conceptualising the value of knowledge, it also raised a series of questions for me, especially as I began to analyse my data. The first concerned the separation of knowledge (or curriculum) from pedagogy which was an impossible boundary to maintain when analysing the practice of the teachers in my research. Conversely, I felt that Bernstein (2000) in some ways privileged pedagogy over the distinctiveness of subjects and their knowledge structures too much. Searching for a theoretical framework that would acknowledge subject specificity and accommodate both curricula and pedagogic perspectives took me initially to Shulman's (1986) work on pedagogical content knowledge (PCK). However, whilst PCK was groundbreaking in its attempts to define the special features of teacher knowledge to include subject specificity, I found the distinction between CK (content knowledge) and PCK a little unclear and tended to agree with Deng (2007) that Shulman made an assumption that disciplines in universities and subjects in schools were effectively the same thing and simply required teachers' pedagogical expertise to make them accessible.

By this point I had begun to engage much more seriously with Bernstein's concept of recontextualization which was to become a central feature of this thesis and even part of its title. As I analysed my data, it became evident to me that the teachers in my research, although constantly thinking about pedagogy, were making pedagogical choices based on a deep sense of what their subject was about, what it was for and what constituted progression in learning about it. This seemed to me to be knowledge which included but extended *beyond* both pedagogy and the discipline as framed in the field of production. In other words, the teachers were part of the field of recontextualization. Whilst this accords with Bernstein's account of recontextualisation, the *significance* of teachers' role as recontextualization agents was not as evident in his analysis as it was in my own.

Two further theoretical frameworks proved highly influential to me at this stage. The first framework of these was that of *curriculum making* which Biddulph and Lambert (2015) used to describe what teachers do every time they teach a lesson in order that it might contribute to a broader sense of, in their example, what geography means for young people. They use 'curriculum' as shorthand for 'bigger ideas' rather than its more common usage to describe the content of school curricula. Alongside the framework of 'curriculum making', I found the continental tradition of *didactics* invaluable (Hopmann, 2007; Hudson, 2016). Any notion of separating curriculum from pedagogy makes no sense within *didactic* traditions, which emphasise the aims of teaching with reference to the subject, the students and the needs of wider society (see the didactic triangle on p. 57). This in many ways provided the final piece of the puzzle for me in bringing the thesis together, enabling me to draw on theoretical frameworks such as the concept of Powerful Knowledge without it restricting my thinking about teacher knowledge and practice. Indeed, both *curriculum making* and the tradition of *didactics* provided a way of bringing multiple theoretical perspectives together because within each of them, knowledge *and* pedagogy *and* people (students, teachers, society) are brought together in a relationship.

This fusion of different theoretical perspectives is, I believe, one of the distinctive contributions of this thesis. The impetus for this was the need to analyse teachers' practice in schools where many of the early theoretical perspectives I engaged with were important and influential but which only took me so far. It was at the nexus of different perspectives that I found a satisfactory way to analyse what was going on in teachers' practice, a reflection of the highly complex activity of teaching and the depth and breadth of expert teachers' knowledge. It is this *application* of a range of theoretical perspectives and traditions to the practical sphere of teaching that forms the second key area of conceptual development within this thesis. There has been plenty of research into teachers' practice within specific subjects (such as Wineberg, 1991, in history and Askew, 2014, in mathematics) and there have also been lavishly funded, large-scale research projects intended to shed light on the generic characteristics of effective teaching (such as the Teaching and Learning Research Project (TLRP), n.d.). But comparative research examining teacher knowledge and practice across specific subjects which balances a common framework with subject specificity is much harder to find. Yates et al (2017) carried out valuable work in Australia interviewing teachers and academics across history and physics but the focus was on curriculum content and design and not on individual lessons. My research attempts to apply a common methodological approach to analysing teacher expertise whilst also valuing the distinctiveness of specific subjects. Hence, as well as literature which explores issues of curriculum, pedagogy and teacher knowledge generically, I also engaged with literature specific to each subject in order to understand the subject's heritage, curriculum traditions and the debates that are currently live within subject communities. I also became as familiar as I could with curricula expectations in English schools and the content knowledge specific to the lessons I observed. This was immensely time consuming but enabled me to draw comparisons across the three subject teachers in terms of, for example, their aims, understanding of progression and conceptual frameworks which shared common characteristics (through my focus on the role of knowledge, knowers and forms of knowing in the teachers' practice and decision making) but also differences. My work represents a contribution to attempts to find a common language to talk about knowledge, practices and aims across subjects whilst respecting and acknowledging subject specificity.

My analysis of the three case studies drew heavily on the work of Winch (2013) whose concept of inferential know how was especially helpful in enabling me to unpick what the teachers knew about the conceptual framework of their subjects, enabling me to move beyond 'knowledge' as simply 'what do teachers want their students to know' and towards 'what do teachers want their students to know *and* how do they want students to be able to think about and with this knowledge?' Winch's argument about epistemic ascent – that different types of 'know how' are essential to achieve it – helped me to develop and apply some of the theoretical work of Young and Muller to my research at a time when empirical research about Powerful Knowledge was still in its infancy. Again, I hope my work represents a contribution to this field. Similarly I hope the way I have drawn on Bernstein's work, especially regarding recontextualization and recognition codes, demonstrates how relevant his thinking still is to empirical research into classroom teaching. The process of recontextualization that he so brilliantly describes has played a key part in this thesis and although I ultimately believe that he underestimated the role of subject specificity and the teachers themselves in shaping curricula, the complexity of the process he describes across three fields remains highly relevant and still needs to be better understood.

I am, however, also mindful of the limitations of this research. First and foremost, this research is based on the practice of only three teachers. It would be quite wrong to assume that they each represent the only examples of good practice within their subject areas or that they are therefore representative of expertise within their fields. I am confident that they met my criteria of 'expert' and that they demonstrated this through all my interactions with them but that does not mean that they represent excellent history, geography or physics teaching everywhere. Secondly, my focus is on expert teachers and I make no claim at all that they are typical within the profession. Thirdly, I am mindful that by straying beyond my comfort zone of history education, I am potentially trespassing on others' territory. I firmly believe that we need to do this much more if we are to promote and support stronger curriculum development in schools, but I also believe that we can only do so humbly and heavily dependent on others. In an ideal world, the geography and physics chapters would have been co-written but I opted for the next best thing, sharing them with other experts and taking on board all their feedback. Nevertheless, there may have been nuances that I missed in the physics and geography data that others would have spotted.[15]

8.5 Implications

In this section I will return to the two broad areas of school curriculum and teacher development identified in my initial impact statement in order to explore more fully the major implications of my work for policy and further research.

[15] This is, however, a subjective process and even the history data would doubtless have been analysed differently by another history educator.

In terms of the school curriculum, I would argue that despite the current emphasis by Ofsted (2019) on knowledge and the importance of the curriculum, the current Ofsted inspection framework emphasises the importance of 'the knowledge and cultural capital they [the students] need to succeed in life' (p. 9) without any reference to a broader framework which with to evaluate the quality of school's curriculum. It continues to emphasise the importance of knowledge for future learning and for employment and lacks a sense of what the knowledge is valuable for *beyond* these instrumental goals. The curriculum appears to regard the school curriculum as fairly inert and static, rather than as a dynamic interaction of the needs of students and society, the expertise of teachers and the distinctiveness of subjects. The teachers in my research went so much further in their aspirations for their subjects than access to cultural capital, readiness for examinations or preparation for the world of work, important though at least some of these unescapably are, especially in the current system.

The reductionism of the Ofsted framework would not matter if schools themselves had a more developed, common language to talk about the possibilities of their curricula. As Lambert and Young (2014) have argued, however, this is not the case and a deeply instrumental view of the curriculum persists. I have already referred to the way in which the sophistication of the three teachers' explanation of their goals and, certainly in history and physics, the way that they understood and planned for progression is at odds with the 'generic blandness or indeed distortion of many current approaches used to measure 'progress' in secondary schools' (p. 6). This is likely to arise from the current obsession with assessment in our school system which has come to dominate much of the discourse about curriculum in schools. The particular tragedy in the context of my research however, is not just that conversations about the curriculum in schools are impoverished but that consequently, assessment systems are devised with little regard to the different knowledge structures and distinctive aims of different subject areas.

One implication of this research is the need to develop a curriculum framework which takes seriously distinctive forms of knowledge, the needs of students and the society to which they belong and the ways teachers make learning happen. In other words, the 'knowledge, knowers and knowing' triad that I have drawn on or the didactic triangle which sees curriculum as the outcome of bringing subject, students and teachers together. A further dimension of such a framework ought to be issues of *quality,* or more specifically what Hudson (2018) has termed epistemic quality. Hudson's research into mathematics teaching and learning suggests that the depiction of knowledge and the act of teaching in the current Ofsted framework is over simplified, with knowledge accretion and retention privileged over thinking and understanding.

Creating and making a school curriculum is not only a matter for senior leaders in schools and my research demonstrates that there will be pools of expertise amongst staff, even if the expert teachers in my study are not representative of all teachers. Curriculum thinking is likely to be at its richest and deepest within departments but it is far from clear how far this thinking is drawn upon or even valued by senior leaders. Certainly in my discussions with the three teachers in this research, all three remarked that the conversations we were having about purpose, vision and progression were not typical in their context. Part of the reason why such discussions are not more common may relate to the lack of a common language that enables teachers across subjects to talk about matters of curriculum in fruitful ways that do not preclude the distinctiveness of their subjects. I would like to see this research contribute in some way to the development of such a language.

Any attempt to raise the level of curriculum debate and secure greater epistemic quality in teaching and learning is also dependent on the quality of teachers and here, the implications of my research are significant. Given that I am arguing that teachers play a bigger role in the recontextualization process than is often recognised in the academic literature or understood in schools, one key implication is that teachers need to be properly equipped to carry out this important function properly. I suggest, following Shalem (2017), that teachers need to have knowledge and understanding of all three (subject specific) fields of recontextualization, including the recontextualizing field of which they are part. Shalem's example of the teachers who, despite being provided with scripted lesson plans, were not able to teach an aspect of literacy effectively, was a very good illustration that however much governments or other bodies try to regulate what teachers do, the teachers' own knowledge and expertise cannot be replaced. The current landscape of teacher education is not wholly promising in this regard, as teachers' ongoing professional development opportunities are not as subject specific as teachers would like (Cordingley et al, 2015) and initial teacher education is somewhat fragmented with no guarantee of a strong subject specific component. Without a strong subject element in teachers' initial and continuing development, it is hard to imagine how epistemic quality might be advanced further within classroom settings.

To conclude in terms of policy, my research points to the need for a new conceptualisation of curriculum and therefore of assessment in schools which takes seriously the need to justify curriculum choices and design in terms of the knowledge structures and aims of individual subjects. There is also a need to frame these knowledge structures and aims using a common language. Establishing independent subject advisory groups with strong links to the three fields of recontextualization and with representation at a senior level within the civil service (as in Singapore, for example) could be a fruitful way to support this. Currently such groups are either politically or examination oriented (as with ALCAB, the geography advisory group referred to in Chapter Five). Some subject associations act as *de facto* subject advisory groups and certainly provide invaluable support to teachers and useful advice to government when asked but their status is not always clear. Finally, there is an urgent need to re-examine the initial and ongoing development of teachers to ensure that provision is made for teachers to understand the recontextualization of their subject, the characteristics of epistemic quality in their teaching and the ways in which they are responsible for curriculum making in every lesson they teach. These elements are enormously demanding and cannot be addressed in one year of training alone.

In terms of research, continued work on what 'powerful knowledge', a 'future three curriculum' and 'epistemic quality' might look like in practice is essential. I would also argue that a shared understanding of these features across subjects amongst researchers is a prerequisite of such a shared understanding developing in schools. A practical way to move this agenda forward is for subject specialist researchers to work collaboratively with colleagues in other subjects, not in order to identify generic principles but rather to understand similarities and differences across subjects within a common framework. A further research agenda which emerges from my work is the need to understand the recontextualization process better across subjects, not just within individual classrooms as I have done, but across all three fields. An understanding of how this process differs by subject would be very helpful. It would also be valuable to understand how the process differs by context which could be at a national scale (for example, how the process differs according to key stage or type of school) or an international one (for example, how does the process work differently in Finland compared with the UK or the US?). Involving teachers in this research as participants would seem, from my research, to be highly desirable. Although the teachers I analyse in this thesis were the subjects of my research, the interviews were in reality a joint endeavour to build understanding and I think that 'expert' teachers in particular have a significant role to play in helping us to move forward in our understanding of concepts such as epistemic quality. Finally, my work points to the value of drawing on the continental tradition of *didactics* in an English context as a way of bringing pedagogy and curriculum together within a more holistic consideration of purpose, aims and progression.

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Appendices

Appendix 1 Teacher consent form

Institute of Education

13 October 2016

Dear X

Many thanks for your interest in taking part in my research. I though it might be helpful to set out more precisely what I'm trying to do and what it will involve for you. My interest is in understanding the kinds of knowledge that subject teachers draw on when planning and teaching lessons, particularly the disciplinary knowledge associated with their subject and how this connects with more generic professional knowledge. There are existing studies that have explored similar areas but my research differs in two important respects:

1. I wish mine to be a comparative study across three subject areas (history, geography and physics) rather than focusing on a single subject which is usually the case.
2. I am not interested in linking types of teacher knowledge with effectiveness.

The second point, above, is particularly relevant. Studies commonly seek to prove a link between good subject knowledge and positive outcomes for students. Whilst this is valuable, it is not my focus. This is why I only wish to work with experienced teachers who are already deemed to be effective within the school because my interest is not about the impact of these teachers on learners but rather the impact of different kinds of knowledge on their planning and teaching decisions. In other words, I am not going to be making judgements about the quality of your teaching.

My research will mainly comprise the following elements:

a. Roughly four hours of interviews with you which I will record (audio only).
b. Observation of a sequence of Year 11 lessons which I will film, purely because I am not able to capture everything in the lesson itself at the time. Only you and I will see the film. If the school requires parental permission, I attach a letter which can be sent out as appropriate or amended if you or the HT prefer to send this out in the school's name.
c. A focus group interview at the end of the sequence with three pupils.
d. Copies of relevant documentation relating to the work of the department.
e. Any other activities which may be relevant and accessible on my visits eg open evenings, departmental meetings, an interview with your second-in-department

Your name and the name of the school (and any other relevant colleagues) will be anonymised in any written work arising from this research, including the PhD itself and any subsequent publications. All transcriptions will be treated as confidential and not shared with anyone except you (you are welcome to a copy if you would like it).

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I am very happy to share my findings with the school once the PhD is completed. I am hoping that I can provide some insights into the nature of subject expertise and the way this influences high quality teaching and learning in a systematic – rather than 'gut feeling' – kind of way.

I think that covers everything. If you are still happy to take part and have the permission of your Headteacher, I'd be grateful if you could sign the form, below, and let me have that when I come in.

Very many thanks for your involvement – it is hugely appreciated.

Yours sincerely.

[redacted]

Alison Kitson
Senior Lecturer in History Education

Declaration of consent

I am happy to give my consent to be involved in the research project as stated in this letter. I understand that I can withdraw this consent at any time.

Signed ____

Name ____

Date ____

Appendix 2 Headteacher consent form

Institute of Education

20 June 2016

Dear Mrs X

I am hoping to conduct research for my PhD in your school during the autumn term, working specifically with X in the geography department, and I thought it would be helpful to set out my intentions exactly. My interest is in understanding the kinds of knowledge that subject teachers draw on when planning and teaching lessons, particularly the disciplinary knowledge associated with their subject and how this connects with more generic professional knowledge. There are existing studies that have explored similar areas but my research differs in two important respects:

1. I wish mine to be a comparative study across three subject areas (history, geography and physics) rather than focusing on a single subject which is usually the case.
2. I am not interested in linking types of teacher knowledge with effectiveness.

The second point, above, is particularly relevant. Studies commonly seek to prove a link between good subject knowledge and positive outcomes for students. Whilst this is valuable, it is not my focus. This is why I only wish to work with experienced teachers who are already deemed to be effective within the school because my interest is not about the impact of these teachers on learners but rather the impact of different kinds of knowledge on their planning and teaching decisions. In other words, I am not going to be making judgements about the quality of X's teaching.

My research will mainly comprise the following elements:

a. Roughly four hours of interviews with X which I will record (audio only).
b. Observation of three lessons which I will film, purely because I am not able to capture everything in the lesson at the time. Only X and I will see the film. I have a letter which can be sent out to parents as appropriate or amended if you prefer to send this out in the school's name.
c. A focus group interview at the end of the sequence with three pupils (again, parental permission will be required and a letter is available).
d. Copies of relevant documentation relating to the work of the department.
e. Any other activities as agreed with X which may be relevant and accessible on my visits.

The name of the school and X will be anonymised in any written work arising from this research, including the PhD itself and any subsequent publications. All transcriptions will be treated as confidential and not shared with anyone except the interviewee who may request a copy for their own interest/use.

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I am very happy to share my findings with the school once the PhD is completed – I am hoping that I can provide some insights into the nature of subject expertise and the way this influences high quality teaching and learning in a systematic – rather than 'gut feeling' – kind of way.

If you would like to discuss any aspect of this further, please do not hesitate to contact me. The form at the bottom would need to be signed if you are happy for the research to go ahead but there is no rush for that. I hope to meet with X this term to set things up and then visit on a further four occasions in the autumn.

Many thanks.

Yours sincerely

[redacted]

Alison Kitson
Senior Lecturer in History Education
a.kitson@ucl.ac.uk

Declaration of consent

I am happy to give my consent for research to be carried out in the school as stated in this letter. I understand that I can withdraw this consent at any time. I also confirm that the main participant in the research, X, is an outstanding member of staff at the school and an expert practitioner in her subject.

Signed ____

Name ____

Date ____

Appendix 3: Parental 'opt out' consent form for filming lessons

Institute of Education

UCL

31 October 2016

Dear parent/carer,

I am a senior lecturer at UCL's Institute of Education and I will be carrying out some research this term at your daughter's school with the kind permission of the Headteacher. My research focuses on the types of knowledge that teachers have and how this affects their planning and teaching. As part of my data collection I will be observing and filming four physics lessons taught by X to your daughter's class. My purpose in observing the lessons is to note down everything the teacher does to promote effective learning, but I cannot physically capture everything myself, so the film will enable me to make a more accurate and complete transcription of the lessons afterwards. I should stress that my focus is not on the pupils themselves and individual pupils will not be discussed in any detail. The film will be used solely for the purpose of my research and will only be viewed by myself and the teacher delivering the lesson. The name of the school will not appear in any publications resulting from this research.

If you do NOT wish your daughter to be present in these lessons, please complete the slip below and return to the class teacher.

Yours faithfully,

Alison Kitson

I do NOT wish my daughter to participate in the filmed lessons taught by X

Name of pupil ____

Name of parent/carer ____

Signature ____

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Appendix 4: Parental 'opt in' consent form for student focus group

Institute of Education

UCL

7 November 2016

Dear parent/carer,

I wrote to you a week or so ago to explain that I am a senior lecturer at UCL's Institute of Education and I am carrying out some research this term at your daughter's school with the kind permission of the Headteacher. My research focuses on the types of knowledge that teachers have and how this affects their planning and teaching. Many thanks for allowing your daughter to be in the lessons that I have observed and filmed. The sequence of lessons is now almost over and I would like to interview three or four students afterwards to ask them about their experience both of the lessons and the subject of physics more generally. I am writing to ask your permission for your daughter to be involved. The interview will be done as a group and will last approximately 30 minutes. It will not be a test of what they have learned! This will be recorded in audio only and any reference to what is discussed will not be traceable back to specific pupils. All names, including the name of the school, will be anonymised in any publications.

I would be hugely grateful if you could return the permission slip, below, if you are happy for your daughter to be involved in the interview.

Yours faithfully,

Alison Kitson

I give my consent for my daughter to be interviewed as part of a short focus group interview for the purposes of education research.

Name of pupil ____

Name of parent/carer ____

Signature ____

Appendix 5: Interview outlines for teachers

Interviews One and Two (guide only)

A. Biographical details (in brief) (Interview One)

i. Subject knowledge

- Degree?
- Post grad qualifications?
- Relevant work experience prior to teaching?

ii. Teaching career

- Route into teaching?
- Years of experience?
- Current role in school?
- Other qualifications in education eg Masters
- Any subject specific CPD in the last four years?

B. Details about the department and school (Interview One)

- Describe the school (size, nature of cohort, ethos, outcomes)
- Describe the department/subject in the school – size, profile in the school, popularity of subject with students, outcomes, ethos

C. General views about teaching their subject (Interviews One and Two)

- What are the main aims in teaching history/geography/physics?
- How are these aims broken down into achievable areas/goals?
- How do you decide exactly what to teach at key stages 3 and 4?
- How do you think geography/history/physics is similar and different to other subjects?
- What aspects of your subject do pupils find hard? Why?
- What do you understand by the term 'enquiry'?
- How do you make use of evidence in your classroom?
- What do you understand by the term 'thinking historically, geographically, scientifically'?

D. Background about the sequence (Interview two)

- What is the context of the sequence – nature of the class, what they have been studying, where it fits in the scheme of work, what will come after it.
- What are your aims in this sequence?
- What are the challenges in achieving these aims? What obstacles may you and/or the pupils face in achieving them?

Interview Three – the lesson

Take the full transcription of one lesson with specific prompt questions attached.

Start with a general question about the lesson – how does the teacher feel it went?

For each decision highlighted by AK on the transcript:

- Clarify and agree what is going on.
- ***Ask the teacher to explain why she/he made particular decisions at that moment, either at the planning and/or teaching stage.***
- Ask the teacher to evaluate the impact of the decisions on the overall outcomes of the lesson and on pupil progress.

Interview Four – the sequence (guide only)

- Recap on the overall aims of the sequence and the reasons behind it.
- How far were these aims achieved? Why/why not?
- Why did you sequence the lessons in that order? Could you have sequenced them differently?
- What previous learning did the sequence build on?
- What subsequent learning will the sequence support?
- Anything else you want to say about the sequence?

Appendix 6: Interview outline for students

1. What did you think the purpose of the sequence was – what were the aims?
2. What did you learn? What did you find difficult?
3. What did you enjoy about the lessons?
4. How did the sequence connect with other topics you have learnt?
5. What do you think is the point of (subject) in general?
6. What do you enjoy about it?
7. What don’t you enjoy about it?
8. What difference would it make to you if you did not study it? What wouldn’t you know?

Appendix 7: Example of lesson transcription

Physics lesson (1)
2/11/16
Y11 (16 pupils)
Layout – rows (lab)

Time	What's going on
	Pupils enter the room. T: 'We're going to start a new topic, sound, some of you have done it before, some of it you haven't.' Takes the register. 'So you're going to be thinking about sound and waves. Some animals use sound and waves – you know about bats. Any others? PA: dolphins PA: whales 'I'm going to show you an animal you may not have seen using sound. Look at what this owl does. This film is about an owl in Canada.' Film clip – shows an owl detecting a lemming underneath snow by hearing it rustling. Humans cannot hear it but the owl can because the owl's face acts as am amplifier - a satellite dish. The feathers collect and channels sound inwards. Acts like having giant cupped hands behind each ear. TQ: So even under the snow, the owl gets the sound. What was the owl doing – what was it listening for? PA: Rustling TS: Even though the sound was opaque (checks meaning of this) to the light, it was transparent to the sound. TQ: how has the owl adapted through evolution? What did it have? PA: a dish face TS: yes, a dish face, most were feathers and the actual face is quite small. And why two ears? What does that hep it to do? PA: amplifies sound TS: no, the dish amplifies it, it's the stereo – we have it – it tells us where we are TQ: anyone seen bats like this? – we'll be looking at them later on – echo location. Pupils write title 'Waves and sounds'. 'Over 3-4 lessons – depends how long it takes – it takes as long as it takes – we need to recap on what you've done before, especially vibrations, hearing, how sound travels. Then go further- diffraction, measuring the speed of sound, ultrasound, how we visualise sound.' TQ: how many of you did sound at primary school? (no one puts up hand). How many did it in years 7/8/9? (few hands – 'sort of'). 'I need to get you up to speed. I'd like you to start with a little experiment. I'm going to give you something that makes a sound. No expense spared here (holds up large piece of red card). These pieces of card are going to act as wobble boards. I want you to see how you can make sounds of different frequency or pitch. How many of you do music? I want you to see what you have to do to make louder or quieter sounds, and higher or lower sounds. You have 5 minutes'. Writes on board – high, low, loud, quiet.

	Girls spend about 3.5 minutes trying out different ways of moving the card to change the sound. T then uses lolly sticks to choose girls to feedback. Starts with one pupil: ‘Can you show how you made a loud sound – what did you physically do?’ PA: moves arms TQ: moves arms a long way or a short way? PA: long war

Appendix 8: Detailed summaries of the lesson sequences

Geography

First sequence: UK landscapes (Y10)

Context

Year 10, new GCSE specification – Edexcel Geography B: 'The UK's evolving physical landscape' with a suggested enquiry question of 'Why does the physical landscape of the UK vary from place to place?'

Lesson One

Sarah starts with a slide which has a picture of the lake district on it and asks the question –'what geography might be happening in this picture?' Students identify eg water cycle, weather, V shaped valleys, biodiversity. Sarah then homes in on physical landforms and reveals title for the lesson – 'The UK's evolving physical landscape' – and explains that this includes three topics – UK landscapes, rivers and coasts. It is the first of these that will be taught over the next four lessons.

Sarah then distributes worksheets where students must guess ('intelligent guesswork') where in the UK two pictures are and what they can deduce about the landscape in each case. The two places are the Lake District and Dartmoor. Then S reveals the specific title for the lesson – 'Landscapes from the past'. She introduces Malham Cove as an e.g. and asks – what is it made of and how was it formed? She then explains that the landscape results from geology, past tectonic processes and past processes cause by glaciation. She shows them a short clip about Malham Cove and they complete a case study sheet about it which involves them identifying where it is, explaining the geology (limestone, tropical fish remains, other rock strata eg Millstone grit), tectonic processes (continental drift, convection currents uplifting rocks – Giggleswick Scar), glaciation (V shaped valleys, giant waterfall).

Lesson two

The lesson starts with a quick exam style question – 'explain one way past tectonic processes influenced the physical landscape of the UK'. Everyone is encouraged to write something, even if it is just one word and Sarah then goes through it, emphasising the importance of a specific UK example and terms such as tectonic plate movement and convection currents.

She then goes over the Malham Cove sheet from last lesson to check everyone has completed the box on glaciation. She refers back to the slide from lesson 1 about Giggleswick Scar and asks questions about V shaped and U-shaped valleys and why they look slightly different (V shaped – eroded by river, U shaped – eroded by the rock in glaciers. Students complete the sheet. For those that finish early, there is a challenge task to annotate a cross-section of a U-shaped valley.

The next part of the lesson focuses on rocks. The title is 'What is the distribution and characteristics of the UK's main rock types?' and Sarah asks them to name the three main rock types (sedimentary, igneous and metamorphic), explain how they are formed and give examples as a test of what they already know. Once that is done and everyone has the correct answers, Sarah asks them what rocks we should know.

Students suggest e.g. granite, marble, limestone, chalk, slate. Sarah then moves onto a mix-and-match sheet - ten rocks you should know – on which students must decide what type of rock each example is, how is was formed and what characteristics it has. Students find this quite hard! Sara shows the answers on a slide and students correct their copies.

Finally, Sarah shows a map of the UK with colours to indicate rock types. She asks students to note down three things about the distribution of the UK's rock types before the end of the lesson.

Lesson three

Sarah starts by recapping from the previous lesson. The first task is then for students to mark key physical features on a blank map of the UK – so upland areas, highest points, rivers, lowland areas – using the textbook. Students get on with this well.

The next phase of the lesson involves unpicking the Tees-Exe line on a UK map. Sarah starts with a discussion about the difference between a birds-eye view and a cross sectional view and why using both is helpful in explaining the relationship between relief and geology. She stresses the layers of rock in the cross-section (using a cake analogy). Then she asks students to explain what a geological map of the UK alongside a relief map of the UK can tell us – establishing through questioning that lots of lowland is formed of sedimentary rock and that the highest points eg in Scotland are igneous and metamorphic. She explains about the Tees-Exe line and demonstrates this with maps. This effectively ends the lesson on geology, carried over from the previous lesson. As an interesting end to this phase, Sarah asks them if they know what GIS means (geographical information systems) and she demonstrates how it works on the screen – they draw a cross-section of Hyde Park.

Then Sarah sets them a quick exam question – explains one way that rock type influences the relief of the land in the UK. Students use green pen to correct/add to when Sarah goes through it.

In the final phase of the lesson, students look at one example of upland (Lake District) and one example of lowland (Weald). Sarah stresses that this lesson is different to the first one because the focus is on weathering and climatological processes, post glacial river processes and slope processes and NOT on tectonic and glacial processes and geology. Sarah checks they know about weathering from their science lessons – three groups of weathering, chemical, biological and physical. She gives out a sheet where students have to match examples of weathering with these three types.

Lesson four

Sarah starts by recapping on where they are and reminds them of the differences between lessons one and three/four. The key is that now, students are looking at the interaction of physical processes which gives you particular landscapes.

Sarah moves onto mass movement (all processes that cause rock materials to move down slope under gravity) and dramatic landslides v. slow movement. Lots of inferences from images here. Sarah explains that the slower movement is known as soil creep. Students write definitions in their books using images/diagrams on the board to help them. Then Sarah explains more about landslides and mudflows, drawing on recent events.

Sarah then recaps – they have done something on three different types of weathering and two types of slope processes. She then moves onto look at post-glacial river processes – U shaped valleys and misfits (tiny rivers).

Then Sarah sets them a task to complete information about the Lake District and the Weald. This takes about 15 minutes.   Sarah then goes through it with the students. She shows them a 4-mark exam question and discusses what they would need to do to get full marks – emphasising the importance of referring to specific places.

In the final phase of the lesson, Sarah moves onto 'people and the landscape'. The example she uses are the South Downs and she shows them a photo and asks – 'what influence of humans can you see on this landscape?' students come up with answers such as farming, paths, fences, villages. Sarah gives out the final place example sheet for students to complete. She shares with the information from the South Downs national park website which breaks down types of farming in the area, quality of the land, diversification (eg vineyards).

Second sequence: climate change (Y9)

Context

The students have already had a lesson on climate and geological times in the past and the fact that there were ice ages and the climate has always changed. After this sequence of four there is another lesson on what will happen if the world heats up by 2/4/6/8 degrees.

Lesson One

Sarah starts with a slide and a picture of people drilling into ice. She leads a phase of Q and A to see if students can work out what it has to do with climate change. Then she introduces the purpose of the lesson – the understand how we measure past and current climate change and assess evidence that humans have cause current climate change.

Asks students for kinds of evidence that the climate is warming. She has good answers (average temps, ice melting, water levels) but then moves them onto to thinking about finding out temperature before records began in 1850.

After another brief discussion, Sarah shows graph about CO2 levels from ice cores. Takes questions from the students and emphasises that the key point for this lesson is – how do we know this stuff? She shows a film clip of someone in Antarctica who is drilling and then asks students to complete a flow chart of the processes of ice drilling to find out temperatures in the past. The key point is that the bubbles in the ice contain ancient atmosphere and the levels of GH gasses in it will help us to understand temperatures in the past.   She clarifies what we mean by greenhouse gases. She then moves onto another way to find out global temperatures in the past – dendrochronology (tree rings). She explains what this means and then asks students to study a cross section of a tree trunk. The key point is that thick rings indicate a warmer climate because there is stronger growth.

Finally, Sarah moves onto glacial retreat with a mix and match activity of glaciers then and now. Ends with a clip which looks at evidence for climate change and why we are responsible.

Lesson Two

Sarah starts the lesson with a slide entitled 'how to humans increase the rate of climate change?' with five pictures. Students have to work out what each photo represents. After comparing what they have written, they compare with their neighbour and a whole class discussion follows about, for example, cutting down trees, factories, methane from cows. Sarah then reads out the lesson objectives - 'how do humans increase the rate of climate change? And 'identify a range of human and physical impacts of climate change'.

Sarah hands out a table to complete which consolidates the starter activity (human action on one side, how does this contribute to climate change on the other) and encourages students to use geographical terminology such as greenhouse gases and fossil fuels. 'Pollution' too vague. She then goes through the sheet with the students who add to it using green pen.

Sarah then introduces the idea of the Anthropocene. Asks students what it might be, then shows a clip than explains it by going back to the Industrial Revolution. Asks them what was positive about the end of the clip – that there are things we can do to help.

She moves onto analysing data about annual greenhouse gasses emissions by sector (farming, industrial processes, transportation etc). Students find it difficult so Sarah provides extra support. She wants them to draw some conclusions about what they can see and come up with three statements. In discussion, she models how to make good, specific statements by referring to percentages etc. There is an interesting discussing about the students being surprised transport isn't a bigger deal – Sarah links this with the media and what is emphasised for our purposes.

Sarah makes a point of not ending on a gloomy note – says she is confident we can come up with amazing technical advances to help.

Lesson 3

Sarah settles class and asks them to think of four impacts of global warming using picture clues on the first slide. After individual and then pair discussion, Sarah leads a whole class discussion going through each picture and working out what it suggests- e.g. rising sea levels, drought, destroyed crops, climate change refugees, more mosquitoes etc. Sarah stresses that we don't know for sure what the impacts will be but these are scientists' best guesses.

There is then a market place activity for groups to present different impacts to each other – impacts on food, water, sea levels, Antarctic albedo, wildlife and weather.

Lesson 4- what approaches could there be to trying to reduce global warming and its impacts?

NOT OBSERVED

This lesson focused on approaches to reduce global warming and its impacts. Students learn the difference between adaptation (living with it) or mitigation (trying to stop it) before looking at five different approaches which they have to rank. Finally, they look at a list of 12 specific things that can be done and match them to the five approaches (e.g. ‘’find a way to store CO2 underground’ belongs with ‘find ways to remove CO2 from the atmosphere’. Students must decide which approaches are best.

History

Lesson One

The lesson starts with a PP slide outlining the learning objective:

'to consider to what extent did life change for ex-slaves after the Emancipation Proclamation'.

After a brief reminder of what the Emancipation Proclamation was (from a previous lesson), Tom distributes a copy of a painting printed in a US magazine in 1865 (Appendix x) and as a starter activity asks the students to explain the vision of the future it depicts for freed slaves in no more than ten words or in a sentence. The picture shows on the left the negative experiences of slaves and on the right, the positive experience that awaits them after emancipation. After a few minutes, Tom spends 16 minutes exploring the picture with the students through question and answer. Tom starts with questions relating to the picture eg 'what is it showing?', what is tipping your hat 'a sign of?' before allowing students the chance to revise their ten words or to write a sentence . He then asks for contributions and chooses some of the words that come up to write on the board: prosperous, free, safe, equal, freedom, normal, change, rights, respect, equality. There is an interesting brief exchange about 'normal' as a word to describe having a family, education and jobs and Tom asks 'What's your normal? Did everyone think it was normal – did everyone go to school – think about the Industrial Revolution?' Tom then ends this phase by asking if this positive vision was true – 'How did life *actually* change – did it suddenly get rosy and lovely…? I'm not so sure'.

The next phase starts by Tom introducing the big question for the lesson(s) – what was the legacy of slavery? – and he checks that the students understand the term legacy. He signposts where the sequence of lessons is going by identifying three things they will be looking:

1. How things changed and how they stayed the same in America and for the freed slaves
2. How Black people argued about what to do next
3. A case study of Rosa Parks

He pulls this together by introducing an exam-style question –'Emancipation brought immediate change to the lives of ex-slaves in the USA. Life was better': do you agree with this interpretation? There is a brief discussion about the question with the students where Tom stresses the need for balance (with a picture of scales on the PP to demonstrate this) and the need for historians to support opinions with arguments. He ends the exchange by saying 'In history there are facts such as the 1863 proclamation and there are areas of interpretation'.

In the next phase, Tom sets up an activity where students, in pairs, look for information relating to four areas of ex-slaves' experiences after 1865 (security, opportunities, prosperity and equality) on a handout. They write one or more codes relating to each area (eg 's' for security) in the margin. Tom models this with them first. As students work on the task, Tom writes an extension task on the board which is to add further codes: a tick for a positive change, a cross for a negative change and a box for no change. He intervenes three times during the activity, once to explain what acres are, once to stress that the class should be looking at this from the freed slaves point of view, not from the perspective of white people and once to explain what congress is. This activity leads to another one in which students physically position themselves on a continuum with 'continuity' at one end of the classroom and 'change' at the other. He starts with the theme of ‘security’ and asks pairs of students to decide where they should stand. After some brief questioning about why pupils chose to stand at different points of the continuum, he gets students to position themselves differently on the continuum according to whether they think ex-slaves’ security was better or worse. There is a huddle of students in the middle at this point and Tom asks for some reasons why they chose to stand there. This is repeated for the theme of ‘opportunities’ (most students choose to stand at the ‘big change’ and ‘better’ ends of the continuums) and ‘equality’.

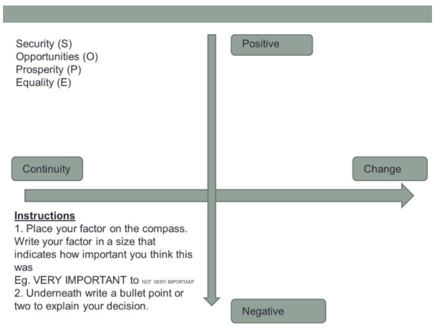
In the final phase, students return to their seats and write a sentence with an overall judgement in answer to the exam-style question. Before they leave the lesson, they indicate whether they agree with the statement (thumbs up), disagree (thumbs down) or believe that there was no change to the lives of ex-slaves (thumbs halfway).

Lesson Two

The lesson starts with an introduction to the learning objective for the lesson – shown on PP – which is:

‘To understand the different methods undertaken by Black people to improve their position in the early twentieth century.’

Students quickly move onto a starter activity where they use the information from the previous lesson to plot the progress of ex-slaves after emancipation onto a ‘compass’ chart:



After five minutes, Tom recaps the previous lesson and reminds them of the central question – did life really get better for ex-slaves after emancipation? He explains that today’s lesson is about what people did about this. Students then have a brief discussion in pairs about what area (security =1, opportunities =2, prosperity =3 or equality =4) Black people should have focused on first at the end of the 19th C – because it was most important or could be changed quickly. Tom then asks them to hold up fingers to show whether they went for 1, 2 3 or 4. Most go for 4 (equality). Tom questions three students about their choices, one of whom chose prosperity and two of whom chose equality.

As a transition to the next phase of the lesson, Tom explains that what the students think isn’t really the issue – but it gets the into the ‘mindset of people at the time…the point is that it was the same for people at the time – there was a debate….many wanted a focus on rights they deserved; others wanted a focus on pay. Int he short-term a focus on prosperity. Of course equality but short-term first.’ He explains that the purpose of the lesson is to find out what the different proposals were around 1900 after reconstruction period and goes on to describe the situation by 1900 (supported by a PP slide), i.e. most ex-slaves still working as sharecroppers, Jim Crow laws imposed segregation, few Black children attended school and most Black people in the south did not vote because of restrictions imposed. He then moves on to lynching, asking students what it is and exploring why it might have happened. The outcome, he explains, was that lots of Black people left the south and moved to northern cities like Chicago, New York and Boston. That takes him onto the KKK (PP slide) and prompts the question 'so what does the picture say about America now that the KKK was marching through Washington, the capital city?' After four exchanges, Tom sums up as '…in theory the government is saying that everyone is equal but in reality it didn't care enough.'

Tom then sets up the main activity for the lesson. He reminds students that a decision had to be made about the main priority for action and explains that around the room is information on the walls about four groups – fact files. Using this information, students need to find out who the group/person was, what their aims were, what methods they used and what they achieved. In groups of four, each student takes responsibility to find out about one person – and to note down key information in summary form. Once they have completed this, they will teach each other so each member of the group has information about all four people who are:

- Marcus Garvey/Universal Negro Improvement Association
- Booker T. Washington/National Negro Business League and National Urban League
- W.E. Du Bois/the National Association for the Advancement of Coloured People
- A. Phillip Randolph/National Negro Congress

Students spend about six minutes gathering information during which Tom emphasises the need for a summary and explains to one student what a trade union is. When he brings the students back together as a group he provides this explanation to everyone ('a trade union is a group of people who get together to improve working conditions). He then sets up the next phase of the task which is for each group member to teach each other. This task takes 7-8 minutes. Tom stresses that they do not need to write down everything – just summaries. As they are working on the task, Tom encourages those who are making quick progress to think about who was the most successful.

In the final phase of the lesson, Tom reads out a GCSE exam-style question:

'Which of the following helped to bring about most progress for ex-slaves in the early twentieth century – Booker T Washington or A Phillip Randolph? You must refer to both factors in the your answer.'

He then quickly outlines what a good answer might look like:

'If you had this, you'd say I'll tell you about some of things Booker T Washington did to bring about progress and then I'll tell you something about the ways Phillip Randolph did and I'll explain what he did and why it was good and then I'll give my judgement that overall that I think this person or that person was the most important or did the most because….'

He then sets a task for students which is to decide who was most important for bringing about change in four areas: political, economic, confidence, equality. Students rank each person 1-4 against each criterion. As students complete the task, Tom prompts some of them to consider other criteria such as education.

The lesson ends without a plenary as time runs out.

Lesson Three

Tom starts the lesson by praising the students for their work so far and reminds them what they're done so far and explains that 'today's lesson goes further than that and looks at what happened after the second world war'. The starter activity is to look at some photos which provide clues about why, after WWII, there was a new drive for equality. Students discuss the pictures between themselves before Tom leads a whole class discussion involving nineteen pupil exchanges. Tom then sums the discussion up – Black people fought a war against racism, they saw a better life in Chicago and New York, radios spread the word, books made them better educated about the world.

At this point, Tom directs them to the learning objective:

'To re-write the story of Rosa Parks'.

He says he doesn't really like the word story and asks them why not – 'sounds like it's made up'. He then asks students to discuss with each other what they already know about Rosa Parks after which they see how many of the words on Tom's slide (tired, old, back, refused etc) appeared in their discussions (students hold up fingers to indicate how many). Tom concludes from this that a. 'there is an accepted view of events' and b. people know only half the story – they know the events but not the consequences.

He then directs them to an extract from a textbook copied onto a sheet for them to look at. At this point he says that he feels they have committed a 'cardinal sin' in previous lessons which is to believe things at face value. They read the textbook extract together and agree that it tallies with much of what they already knew. Tom adds in the consequences, not covered in the textbook, about the Supreme Court ruling against segregation. Next, he focuses students on the need to verify the account of Rosa Parks and not take it at face value and sets up the main activity which is to read two sources, starting with the police report:

'How reliable do you think this source is? Next the content of the source – does it help us to think more about what actually happened on the day RP refused to move from her seat? Is it clear for instance where Rosa sat on the bus? Based on this evidence do you think this is the first time this would have happened? Finally, as an extension – just to discuss, not to write down – if you could interview these two police officers, what would you as them?'

Students discuss the sources for about five minutes before Tom leads a whole class discussion about the reliability of the source and what it might tell us.

Students then move onto the court affidavit for the Rosa Parks case and again they evaluate its reliability and decide what it tells us. After another whole class discussion, Tom directs them to a short biography of Rosa Parks where they learn that she was 42, so not as old as people usually think. A final class discussion about the biography follows and Tom ends it with a quote from Rosa Parks:

'People always say I wouldn't give up my seat because I was tired. The only tired I was was tired of giving in.'

He sets homework which is to rewrite the textbook account of Rosa Parks – 'This is not a story we're making up. Add where she was actually sitting, that she'd had run in with the bus driver before, that she wasn't old and tired etc.'

In order to leave the classroom, students have to answer a question a few questions about why the 'accepted version' of the Rosa Parks incident is slightly different to what actually happened. He ends with 'what does it tell about being a good historian?' to which a student answers 'you look deeper into sources.'

Lesson Four

At the beginning of the lesson there are two learning objectives on the board:

1. To understand the events of the CR movt in the 1960s
2. To review the unit and consider the importance of this history

Tom sets the scene by referring to the previous lesson and explains that after the bus boycott, there was an upsurge in people's determination to change things. He plays them Sam Cooke's 'A Change is Gonna Come' written in 1962 and asks them to consider whether it was a sad or hopeful song, why Sam Cooke sang it and why Barack Obama quoted this song when he first became president. He adds in further detail about Cooke's inspiration, Bob Dylan, whose 'Blowing in the Wind' was about Jewish experiences.

Students put their thumbs up or down to indicate whether they think it is a hopeful or a sad song. There is then a whole class discussion about the song which leads to the reason for his hope - Martin Luther King leading the Civil Rights movement.

Tom plays an extract from the 'I have a dream' speech which makes explicit reference to the grandchildren of slaves and slave owners living in harmony together – 100 years on. He explains the two outcomes from MLJK's meeting with JFK – the Civil Rights Act of 1965 and the Voting Rights Act in the same year. He goes on to explain that despite being a great triumph not everyone was happy – everyday problems like job, pay, police treatment continued – and Black Power was born. He shows the picture of the athletes giving the famous Black Power salute at the Olympics.

To illustrate the mood of Black Power, Tom plays them James Brown's 'Say it Loud' and asks students to pick out the message. 'Why would James Brown think that black people needed to be able to say I'm black and I'm proud? After playing the song, Tom asks the students to discuss three questions: what is the message, what does he mean by 'we'd rather ie on our feet than be living on our knees?' and why Brown felt the need to encourage people to say 'I'm Black and I'm Proud'? A whole class discussion follows and Tom ends it by asking the question 'so what has changed'? Lots of people thought Obama being president meant that this had happened.

He sets up a Socratic discussion based on one they have done before. Students stand in a circle in groups. Each group has a 'pilot' for each question who stand in the middle and are the ones to contribute with guidance from their group. The questions – which take students back to the very start of the whole unit, so pre-slavery, are:

1. Is the Black Peoples of the Americas Unit a 'victim' story?
2. Do you think this unit is important to study?   (verbally, Tom adds – would this unit be important anywhere or especially in London?)

3. What have we learnt about being good historians from this unit?

   Students only have time to discuss the first question in detail and to touch briefly on the second.

   Key issues that arise from the discussions include:

- Not a victim story but a story of growth – not victims by the end
- It is a victim story because lots of people died
- Victims at first, but not by the end

   Tom ends the lesson (and the sequence) by directing them to the second question. Here, the points include:

- Important because if we don't, if no-one does, that was it all for? They struggled for years – if we don't learn about it, not worth it.
- We mustn't repeat past mistakes.
- What if people from that ethnicity came to that country – we need to empathise.

Physics

Lesson One

Robert starts the new topic by showing a film clip of an owl in Canada who hears a lemming underneath snow by using its face as an amplifier. After writing the title 'waves and sound' students are then given wobble boards (large pieces of card) and asked to make louder/quieter and higher/lower sounds with it. Through a Q and A, Robert picks out some key points:

- Moved arms a long way to make a loud sound
- Can feel air particles moving
- Quiet sound only needs a small movement
- Quick movement makes a high sound
- Slow movement makes a low sound

Students then make some notes about this.

In the next phase of the lesson, Robert shows the students some animations on the IWB to reinforce the point that small and big movements affect the amplitude (volume). Checks students understand what amplitude and frequency are. Reinforces that amplitude is about how far we move something and frequency is about how quickly we move it. Students make brief notes and Robert introduces the term 'hertz' to measure frequency (students already seem to know this). This is followed by an activity in which students hit tuning forks against cork in order to think about what causes sound. This makes the point that there are vibrations in the air. In order to not only hear but also see these vibrations, the students hit the tuning forks and place them in a beaker of water. Students draw a diagram and explain in their books what happens and why. Robert links this back to the previous activities through a Q and A recapping on relationship between quick/slow vibrations and pitch (frequency) and then short/long vibrations and volume (amplitude).

Next Robert connects this with the students' own hearing and plays notes of different frequencies. He goes higher until no one can hear it and makes links to hearing deteriorating as people age and ringing in the ears after a loud concert. 20 Hz (hertz) is the lowest we can hear and 20,000Hz is the highest. Students summarise this in their books.

The final phase is about how sound moves from one place to another. Robert refers back to the wobble boards and the students feeling air move. He asks what happens if air particles are taken away and establishes that sound cannot travel in a vacuum but can in any other medium (solid, liquid, gas). He finishes by a recapping Q and A where he goes through the main points of the lesson. After the students have packed away, he ends with a taster of the next lesson in which students will think about we picture sound and shows them an oscilloscope on the IWB which shows sound waves moving differently at different pitches and volumes.

Lesson two

Robert starts with a recap of the last lesson, specifically the range of frequencies humans can hear. After the register he sets out the focus for today – what sort of wave is sound how it travels and how fast it travels. He shows a clip of someone surfing, people doing a Mexican wave (to model transverse waves) and people bumping into each other (to model longitudinal waves). He then uses Q and A to draw out the learning about transverse and longitudinal waves including what the students have done on this before. Today the focus is longitudinal waves. Students copy down a summary off the board.

Next, Robert shows an animation on the IWB with a speaker and longitudinal waves in motion with the lines representing lines of particles which 'joggle' backwards and forwards. But if the students de-focus their eyes they can see a pulse moving from left to right. Discussion establishes that this is energy being transferred by particles which is why sound doesn't travel in a vacuum. He then draws a transverse wave on the board and asks students to describe the wavelength (e.g. one peak to the next) and name the distance from middle to top/bottom of the wave (amplitude). He then asks students to put the amplitude and wave length on a diagram of a longitudinal wave before going through this with them. Discuss compression (waves close together) and rarefaction (waves far apart) – the students are already familiar with these terms.

Robert then returns to the Mexican wave idea – the students model small amplitude (small movement) and large amplitude (large movement) – before asking what is the amplitude if you are moving side to side (longitudinal). He models this on the IWM animation. The slinky demonstration follows – Robert holds one end and a student holds the other. They demonstrate making it louder and an echo. Students then have a go in pairs themselves before a class discussion to establish how they made a loud wave (displaced it more – move it further away), a quiet sound (less energy), a high sound (moved it quickly). Students make notes about this and copy down information from a slide about longitudinal waves.

The next phase is entitled 'Speed of a wave'. Robert explains that students need to know two things – wave length (in metres, measured in lambda) and frequency (waves per second, measure in hertz). Speed = $v = f\lambda$ or speed = frequency x wavelength

Students copy down a slide about wave speed. Robert then gives students some questions to answer now and to finish at home. After packing away, Robert quickly demonstrates a small transverse wave and a longitudinal wave using the students as 'props'. Ends with a quick recap on compression and rarefaction.

Lesson three

Robert starts with a quick recap on what kind of wave sound is (longitudinal) and what it means. Then the students huddle round the front from a demonstration using an oscilloscope, both 'live' and on the IWB. They see how sounds they make – either by speaking in a microphone or by Robert pressing a note on the IWB – create waves and that these differ according to amplitude (volume) and frequency (pitch). Robert gives out graphs on which students have to draw different kinds of sounds e.g. high and loud, high and quiet. Robert briefly explains the next sheet on which students can calculate the time period of different waves. After they have done this, Robert explains to them how to calculate the speed of a single wave, still using graphs. The students have a go at this and then Robert goes through it with them.

The next phase is to calculate the speed of sound. Robert explains that this is a key experiment they need to know about but also a very unreliable one. He explains what they will do outside and they all then go onto a school field to conduct the experiment using two blocks of wood, a trundle wheel and stopwatches. A student stands at the far side holding the blocks and two other students measure the distance between her and everyone else. When the student hits the blocks together the students start the stopwatch and stop it when they hear the sound. They repeat this several times and record the outcomes.

Back in the classroom Robert asks them to remove anomalous readings and to then calculate the speed of sound using the equation: speed = $\frac{\text{distance}}{\text{time}}$

He also asks them to consider reliability and which of the two measurements (distance or time) they trust the most. He records some results on the board – range from 534 m/s to 272 m/s before revealing the true value – 330 m/s. He ends by getting them to speculate how they could have made their results more accurate – e.g. taking out the mobile phone and filing to remove reaction speed.

Lesson four

The lesson starts with a recap about the previous lesson and the experiment outside. Robert focuses on the reliability of the data they generated with a focus on the difference between accuracy and precision and on systematic errors as well as how to improve accuracy. Then students complete their pink sheets and Robert goes through it with them afterwards. He then shows them a short film made by his Y13 group where they filmed how high a small ball can bounce. They measured it ‘live’ and then reviewed it on the film and they were 2cm out! This helps to explain why filming the speed of sound experiment could be helpful.

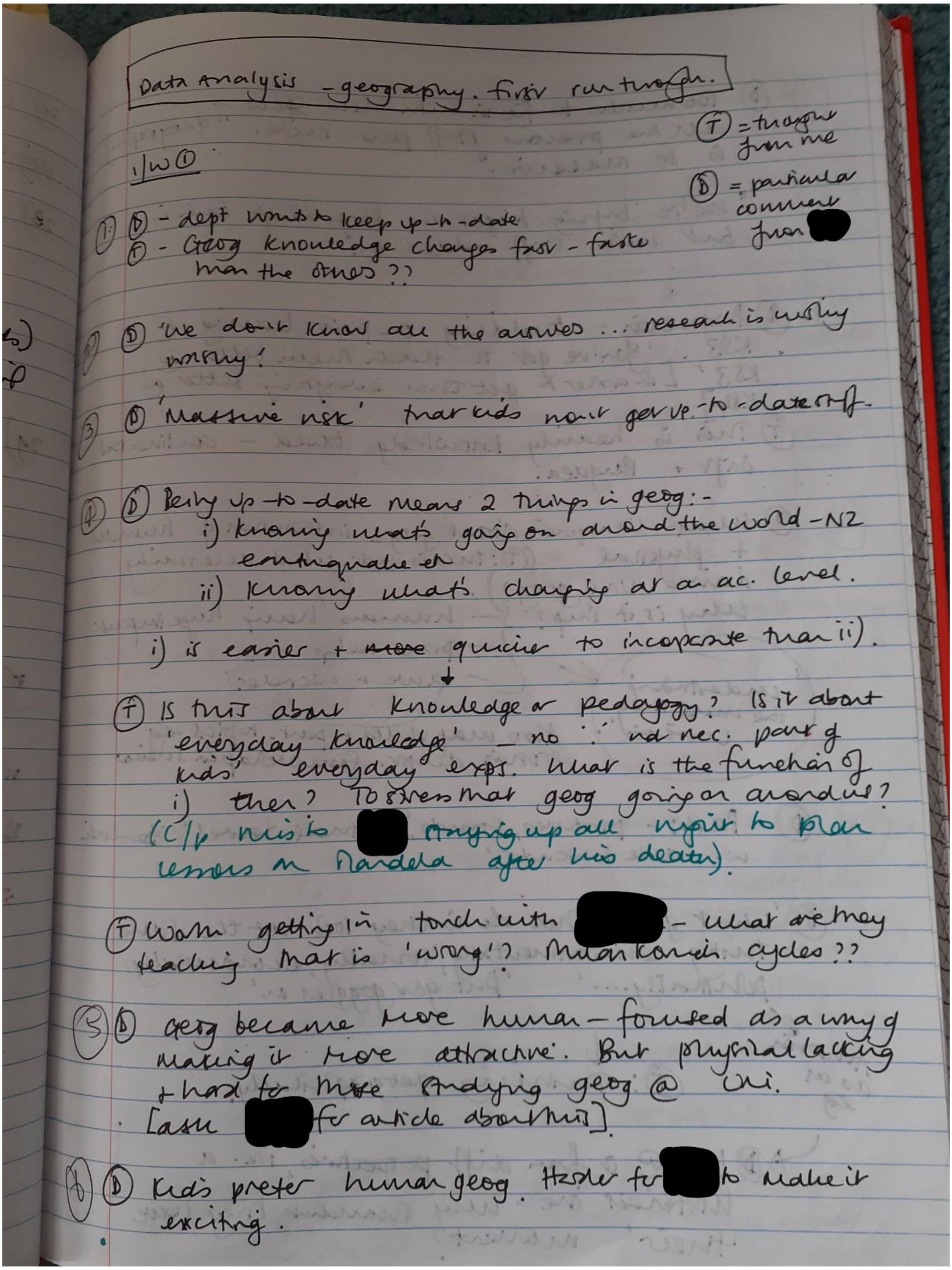
Robert spends the rest of the lesson on sample exam questions with the students. The students spend 16 minutes on these and then Robert goes through the answers with them. Key learning points include:

- How graphs show loud/quiet/high/low sound waves
- How to draw a good graph to show results from an experiment (using the acronym SLAPU – scale, line, axes, potting points, units).
- How the experiment could be improved

He emphasises ways that students can lose (or gain) points e.g. by not noticing the units (milliseconds, not seconds), not following ‘SLAPU’ methodically, not reading the question and spotting the command work ‘suggest’.

He ends the lesson by signposting the next topic, light waves.

Appendix 9: Example of initial 'noticings' (geography)


Data Analysis - geography. first run through.

(T) = thought from me

(D) = particular comment from [redacted]

I/W (1)

(1) (D) - dept wants to keep up-to-date
(T) - Geog knowledge changes fast - faster than the others??

(2) (D) 'We don't know all the answers ... research is worthy worthy!'

(3) (D) 'Massive risk' that kids won't get up-to-date stuff.

(4) (D) Being up-to-date means 2 things in geog:-
i) knowing what's going on around the world - NZ earthquake etc
ii) knowing what's changing at an ac. level.

i) is easier + ~~more~~ quicker to incorporate than ii).

(T) Is this about knowledge or pedagogy? Is it about 'everyday knowledge' - no ∴ not nec. part of kids' everyday exps. What is the function of i) then? To stress that geog going on around us?
(C/f this to [redacted] ~~rushing up all~~ rushin to plan lessons on Mandela after his death).

(T) Worth getting in touch with [redacted] - what are they teaching that is 'wrong'? Milankovitch cycles??

(5) (D) Geog became more human-focused as a way of making it more attractive. But physical lacking + hard for those studying geog @ uni.
[ask [redacted] for article about this].

(6) (D) Kids prefer human geog. Harder for [redacted] to make it exciting.

Appendix 10: Initial draft coding (geography)

Geog. ~~History 1~~ insert PK? Overarching idea = interaction of humans & the physical world.

Knowledge – what is being taught? NB choices – what are they? How many are given? what are left and why are the made?	Knower – who is the learner and what are their needs? NB choices – what are they? How many are given'? what are left and why are the made?	Knowing – What does the learning look like? NB choices – what are they? How many are given'? what are left and why are the made?
Too much geog! Propositional Being up-to-date → knowledge changes fast. Terminology?? & Key processes a) academically b) and others. Knowledge overload @ GCSE. Progression – knowledge as $\boxed{\text{cumulative}}$. Building towards generalisations?? Locations. / place. – obsession. Procedural – thinking / being like a geographer Seeing the world like a geographer – what makes a good geographer?? – reading the landscape? Map skills. Inference, deduction. Data. Graphs. GIS.	Meaning & engagement – world around them – ~~be~~ using current egs. – harder w physical. awe & wonder. ~~beautiful~~ places. this is only seq. @ beg. Relevance to their lives now – prac help in everyday lives. – exp the world around them. Understanding their world now & future Some = scientifically minded, others less so. Accessibility too much not fast. Morality? – Amazon – we know better now. Taking their everyday knowledge further Students think they have knowledge!	Assessment Struggling to assess the kind of geog. thinking outlined – falls back onto skills? how wd you assess 'perspectives', 'relating to'? Dialogue Te~~acher~~ ~~led~~?? Ped. choices 1+3 – cd be hg? 1+2 – cd be other way round. based on – moving – accessibility

supporting w. evidence. looking at something from diff. perspectives. eg Amazon. Uncertainty – wishy washy evidence – impacts of climate change.

Appendix 11: Example of final coding (history)

a. History codes

1. Knowledge: *What* is to be taught?
Propositional knowledge ('know that'): 1a. core knowledge 1b. entitlement 1c. chronology Inferential 'know how': 1d. narratives 1e. big pictures 1f. conceptual complexity Procedural 'know how': 1g. perspective recognition 1h. 'being a good historian' 1i. Progression
2. Knowers: Who are the *learners* and what are their needs?
2a. Maturity 2b. Morality 2c. Meaning and engagement
Knowing: What does the *learning* look like?
3a. Influence of a constructivist theory of learning, especially dialogue 3b. Assessment

b. Coding of interview transcript

Extract from Interview 4 with Tom

So, the learning objective or learning outcome was to re-write the story of Rosa Parks

Yes, that was the idea.

So why did you take that angle of all the ways you could teach about Rosa Parks? Why was that lesson basically following that kind of trajectory towards that final task?

Well, actually initially that wasn't the lesson that I had in mind. I had two other lessons in mind, and that came out of my second idea. So my first idea was I wanted to do something about what makes somebody significant, so why she was a significant figure? The context of the sequence of lessons is that I felt that I needed to provide them with some kind of narrative and chronological framework to explain the legacy post-slavery, and we had a limited amount of time. So my idea was to think immediate, think medium-term, think long-term. So I decided I'd have to do something on Civil Rights. I decided against trying to do too much. I think to try and give them a picture I'd have to pick out an event or an idea, and focus in on that rather than try and give an overview. It's so difficult, isn't it? What do you select? You can see from today's lesson that I tried to give an overview, and it became a sort of race-through, and I don't think that's ever so effective.

So I decided I'd look at an event or a person. Initially I thought Martin Luther King, but then I figured, actually there'll be other opportunities for them to look at Martin Luther King, and I really felt that actually it's good to look at a woman, to be blunt about it. So I wanted them to see a female historical figure. So originally I was going to do about what was the significance of Rosa Parks, but then I came to the conclusion, actually they wouldn't have enough contextual knowledge to be able to sort of say what really resonated about her - why was she remembered - what was the impact? It felt to me like they needed to know more about Civil Rights to understand the chain of events and so on. So that was the original plan.

Then my second thought was that actually I know from previous lessons that I've taught, with Rosa Parks both in Year 8 and also when we do Civil Rights with GCSE students, that it's always been a bit of a sticking point about whether it mattered or not that she was a member of the NAACP already, and whether she was just a sort of innocent bystander. She still was of course, but some students have always found that to a reason to be outraged, like they'd been sold a lie. Other students had come to a completely different conclusion which is that it makes it even more heroic. So I was kind of interested in that notion. So actually, what I initially set out to do was look for different interpretations. That was my original idea; I could introduce them to the narrative, and then we'd look at different interpretations and build something around that. I wasn't quite sure but that was the basic idea. So I did a bit of reading myself, and it wasn't clear.

I couldn't find too clear cut interpretations - particularly ones that would work for Year 8, but in doing that I did Google literally Rosa Parks interpretations, and one of the things that came up was the National Archives of America. They did have two slightly different interpretations of her, and the significance of her, and it was kind of interesting, but actually in the process of doing that I then saw these other pieces of primary evidence to go with it, and I thought, actually that would make for a more interesting lesson, and we would arrive at that discussion about did it matter about her back-

AK **Alison Kitson**
1f -*2^{nd} order concept*
1a teach things that are significant

AK **Alison Kitson**
1d and 1c importance of chronological narrative

AK **Alison Kitson**
Mainly 1~~d importance~~ of a narrative/relationship between overview and depth.
NB 'what do you select?' – no core! ***(1a).***

AK **Alison Kitson**
2c value of studying a woman

AK **Alison Kitson**
1f and 1d they need to know **enough** in order to understand **significance** – good eg of interplay between 1^{st} and 2^{nd} order

AK **Alison Kitson**
2c – knows what will engage the students

AK **Alison Kitson**
1f – shift from significance to interpretations

AK **Alison Kitson**
2a – needed to be accessible

AK **Alison Kitson**
1f – shift towards evidence here

AK **Alison Kitson**
2c – more interesting

story and so on. In actual fact, because of the nature of trying to do it in one lesson, we didn't really get into that in the end. That's kind of where I'd hoped to end up, but by feeling was that I needed a hook for the whole thing for the sort of re-establishment of the narrative beyond just the sort of popular culture myth I suppose. I figured that this would be the way to do it.

I find with this class in particular that if they have a focus on a task, not only does it keep them sort of focussed during the lesson, but it provides them with a sort of end game that they can work towards. So the idea of re-writing the textbook was to get them to realise that actually there's a more nuanced story, and how are they going to construct this new account? So that was the reason behind the textbook - re-write the textbook. So it's to sort of encourage them to sort of challenge the perception as they found it at the beginning.

I confess that there's some work around - so the National Archives of America had bits and pieces like that. They had a series of lessons to do Rosa Parks, so I cherry-picked a little bit. So that's essentially where they came from. I realise I probably wouldn't have got through it in a lesson, so I had that as the homework task. So, I guess the re-writing was an opportunity for them to re-establish - use their own evidence - use their own judgement, and basically a kind of hook, I suppose. Yeah, that was the sort of thinking behind the whole thing.

Presumably you've taught Rosa Parks before.

Yeah.

So, you've taught it differently previously?

Yeah. Generally I've done the significance thing. So we talked about what is significance, and because they've got a bigger picture...

They spend longer on it.

Yeah, and they were able to see the sort of - the similarities for instance - they could draw parallels between that and Linda Brown case, in the sense of a test case. They knew what a test case was. Whereas, I felt like for this particular lesson, because we hadn't had the same amount of time, it would have been very difficult for them to understand what a test case is, and how this set precedent, and so on. They just didn't have that sort of framework to fit it into the contextual understanding.

So, generally speaking that's how I've done it before; we sort of tell the story, so to speak, and then ask them to think about, why was this important, and so on. I think the problem with doing that lesson as I've done it in the past is it becomes almost a sort of political sociological lesson, as opposed to a history lesson. It becomes sort of; so what are your thoughts - which is fine and it's interesting, and it provides them with an interest in the topic I suppose, but it's not necessarily about development as historians either. A lot of that is based upon their hunch, and guesswork and so on, and not necessarily rooted in actual evidence and reality I suppose.

Alison Kitson
1d/1f -back to narrative – and understanding problems of that narrative

Alison Kitson
2c/3a

Alison Kitson
1f – understanding concepts of evidence and interpretations
1h – implicit here = what good historians do – use the evidence well

Alison Kitson
1h – skills of good historians

Alison Kitson
1d – didn't know enough of the narrative

Alison Kitson
1d - narrative

Alison Kitson
1d - narrative

c. Coding of lesson summaries

Lesson Three

Tom starts the lesson by praising the students for their work so far and reminds them what they're done so far and explains that 'today's lesson goes further than that and looks at what happened after the second world war'. The starter activity is to look at some photos which provide clues about why, after WWII, there was a new drive for equality. Students discuss the pictures between themselves before Tom leads a whole class discussion involving nineteen pupil exchanges. Tom then sums the discussion up – Black people fought a war against racism, they saw a better life in Chicago and New York, radios spread the word, books made them better educated about the world.

At this point, Tom directs them to the learning objective:

'To re-write the story of Rosa Parks'.

He says he doesn't really like the word story and asks them why not – 'sounds like it's made up'. He then asks students to discuss with each other what they already know about Rosa Parks after which they see how many of the words on Tom's slide (tired, old, back, refused etc) appeared in their discussions (students hold up fingers to indicate how many). Tom concludes from this that a. 'there is an accepted view of events' and b. people know only half the story – they know the events but not the consequences.

He then directs them to an extract from a textbook copied onto a sheet for them to look at. At this point he says that he feels they have committed a 'cardinal sin' in previous lessons which is to believe things at face value. They read the textbook extract together and agree that it tallies with much of what they already knew. Tom adds in the consequences, not covered in the textbook, about the Supreme Court ruling against segregation. Next, he focuses students on the need to verify the account of Rosa Parks and not take it at face value and sets up the main activity which is to read two sources, starting with the police report:

'How reliable do you think this source is? Next the content of the source – does it help us to think more about what actually happened on the day RP refused to move from her seat? Is it clear for instance where Rosa sat on the bus? Based on this evidence do you think this is the first time this would have happened? Finally, as an extension – just to discuss, not to write down – if you could interview these two police officers, what would you as them?'

Students discuss the sources for about five minutes before Tom leads a whole class discussion about the reliability of the source and what it might tell us.

Alison Kitson
1d- filling in gaps/completing the narrative

Alison Kitson
1h- understanding what history is – not just made up – based on evidence. Aspects of **1f** here too – understanding what history is.

Alison Kitson
3a – starting with what they know – scaffolding.

Alison Kitson
1f – we don't know the whole story

Alison Kitson
1h – explicit reference to being a good historian

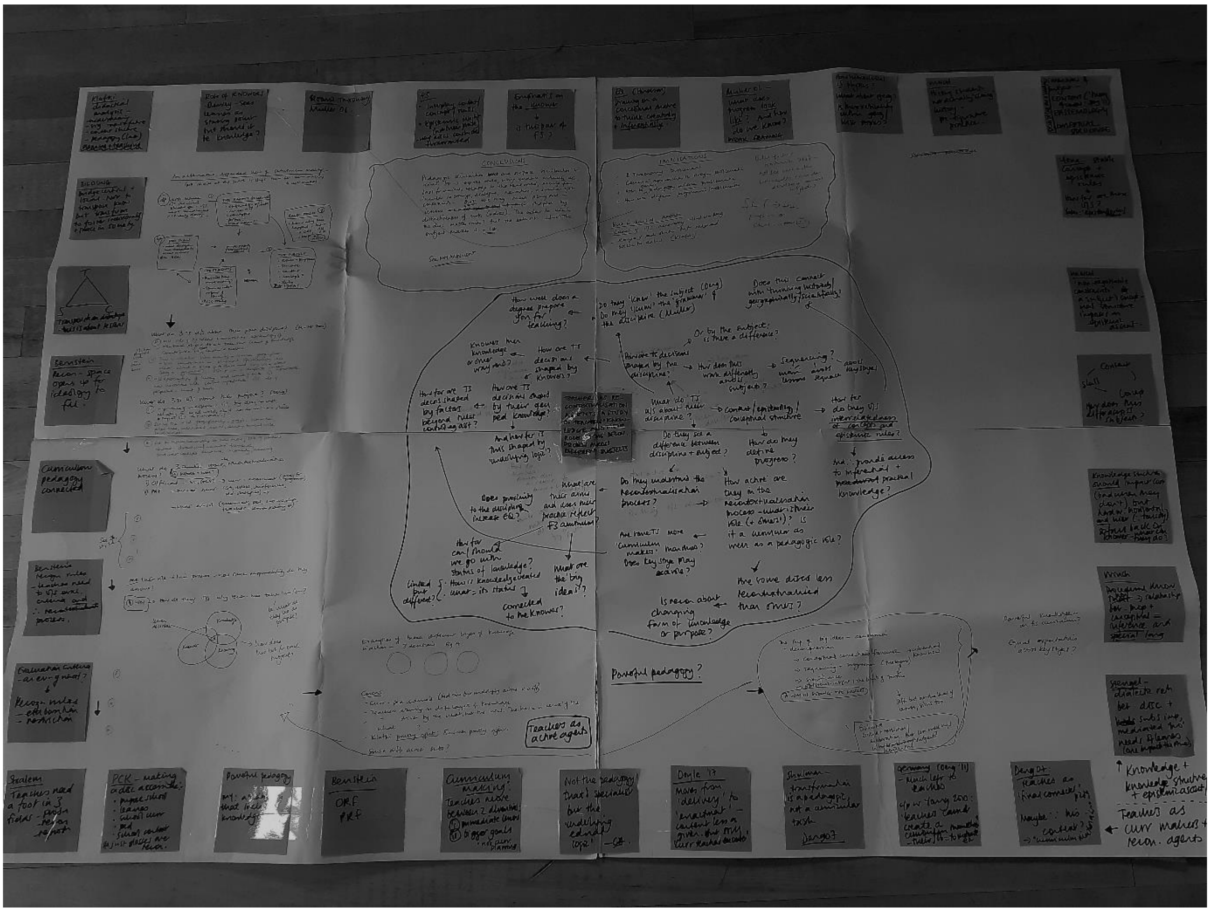
Alison Kitson
1d – completing the narrative

Alison Kitson
1h – what good historians do

Alison Kitson
1h – interrogating evidence as basis for claims

Alison Kitson
3a – dialogue/discussion

Appendix 12: Preparation for Chapter Seven



Appendix 13: Flyer to promote A Level physics

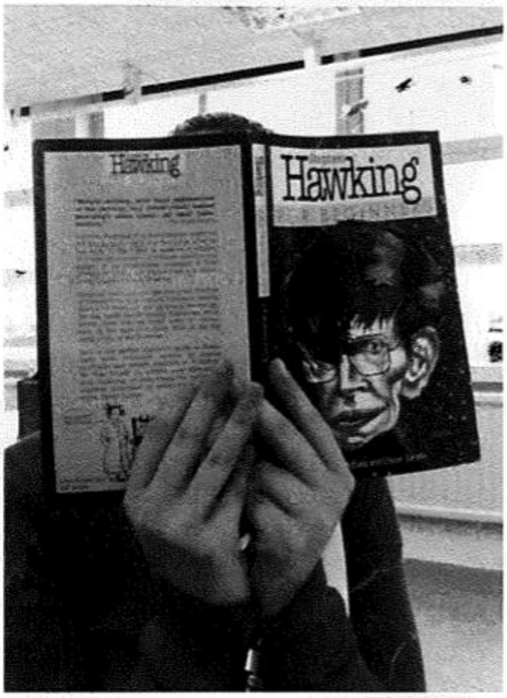
GO-Accelerate

Contexts

- that link physics to everyday life, industry, research frontiers, careers
- enhance interest and motivation
- provide a rationale for study
- underpin a 'spiral curriculum'

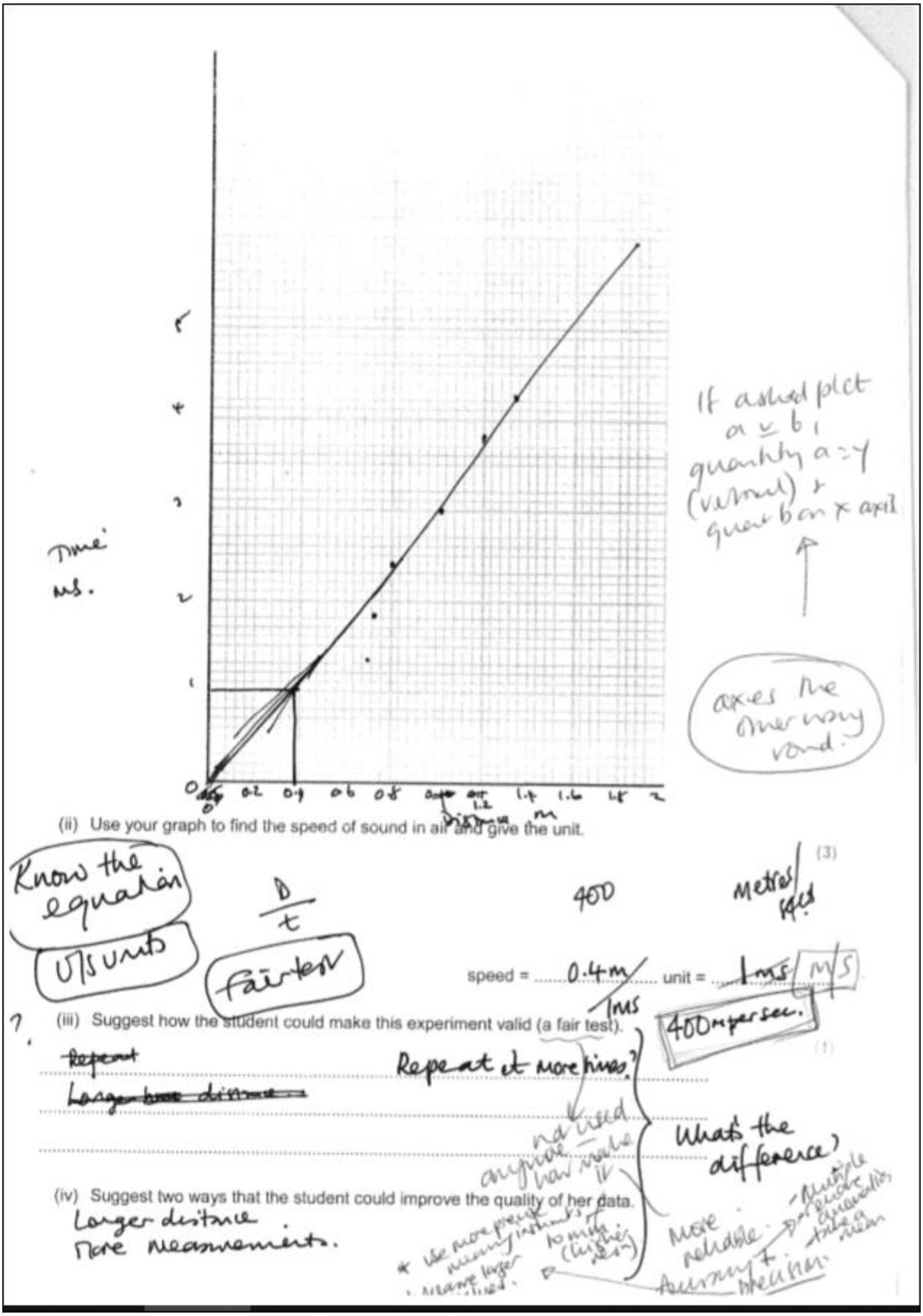
Contexts include

- sport
- food industry
- archaeology
- telecommunications
- building design
- astronomy



Background Reading for Astronomy

Appendix 14: Extracts from the end-of-sequence physics test paper



(ii) Use your graph to find the speed of sound in air and give the unit.

(3)

Know the equation

U/S units

$\frac{D}{t}$

fair test

400

metres/secs

speed = 0.4m/1ms unit = 1ms M/S

400m per sec.

(iii) Suggest how the student could make this experiment valid (a fair test).

(1)

~~Repeat~~

Repeat it more times?

~~Larger distance~~

What's the difference?

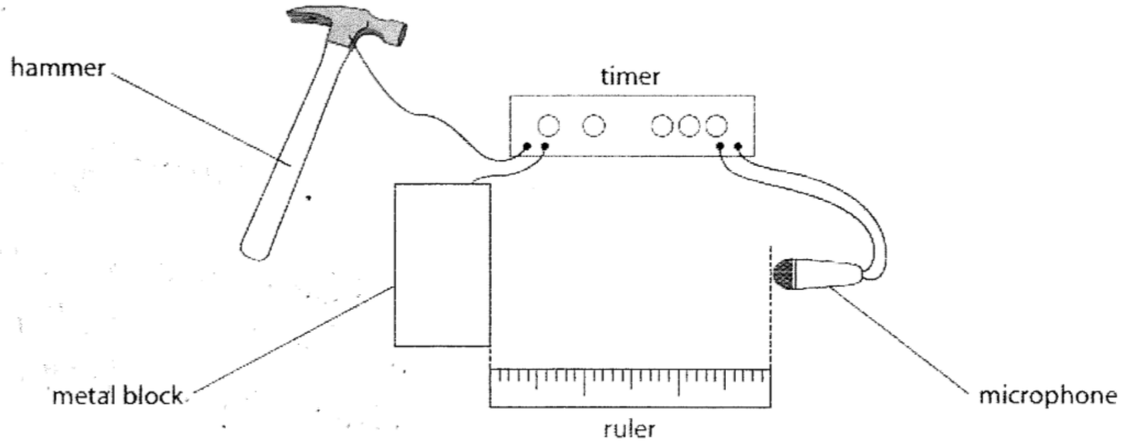
(iv) Suggest two ways that the student could improve the quality of her data.

Larger distance.

More Measurements.

More reliable. Accuracy + precision.

(b) The diagram shows the equipment used by a student to measure the speed of sound in air.



The student measures the distance between the front of the metal block and the microphone.
She then uses this method to measure the time taken for sound to travel from the metal block to the microphone.

u/s how to measure time.

- start the timer by hitting the metal block with the hammer
- stop the timer when the sound produced reaches the microphone
- record the time taken for sound to reach the microphone in milliseconds

The student repeats the experiment six times, changing the distance between the metal block and the microphone for each experiment.
The table shows her results.

Distance in m	Time in ms
0.62	1.8
0.80	2.4
1.00	3.0
1.20	3.8
1.38	4.2

(i) Use the student's results to plot a graph of distance against time and draw the straight line of best fit.

(5)

Appendix 15: Geography key stage three scheme of work

KS3 Geography course 2016 – 2017: Topic summary

Year 7

7.1 Exploring my world (Skills theme)
- Intro to Geography; topics, skills & main concepts
- Locational knowledge at a range of scales
- Basic intro to age of Earth (geological timescale)
- Recap & extend map & atlas skills
- Intro to range of investigation skills in Geography
- Develop a sense of place

7.2 The Air around us (Climate theme)
- Define key vocabulary and different types of weather
- Measure & forecast weather (micro climate observation)
- Understand 3 types of rainfall
- Air pressure and depressions
- Study major climate zones and their locations
- How climate affects activities such as framing & tourism

7.3 Population (People theme)
- Study the increase in population at different scales
- Intro to global spread of humans over time
- Causes for the change in population & DTM
- How to interpret population structure from graphs
- Example of policies to control population increase/decrease
- Population growth and pressure on resources
- Different types and reasons for migration

7.4 How water shaped the land (Water theme)
- Geological timescale
- The extent of the last ice age
- How glaciers are formed
- Evidence of glaciation (landforms)
- Recap and extend knowledge of water cycle
- Processes of erosion and deposition in rivers
- Features along a river's course

Fieldwork – Investigating rivers (Skills theme)
(links to 7.4)
Skills lesson: analysing fieldwork data

7.5 Russia focus (Places theme)
- Location knowledge of Russia and its major cities and features
- Different biomes and climates zones within Russia
- Distribution of Russia's population and industry
- Issues in modern Russia such as conflict over the Crimea region
- Social issues such as low birth rate and economic problems
- Case study on a specific landscape and how it is threatened.

Year 8

8.1 Can the Earth cope? (Climate theme)
- Locate and describe the world's major biomes
- Study how soils are formed and soils in different ecosystems.
- Understand the structure and threats to the tropical rain forest
- The environment of hot deserts and cultures that live in them
- Introduce the causes and effects of desertification in arid regions.
- The natural landscape of the Arctic tundra & changing ways of life

Fieldwork – investigating biomes (Skills theme)
(links to 8.1)
Skills lesson: analysing fieldwork data

8.2 Where do we live? (People theme)
- Understand causes of urbanisation (eg rural to urban migration)
- Pressure on services & changing functions of growing urban areas.
- Case study of a rapidly growing city in India and its current issues.
- Different land uses and how this can be modelled
- Issues in richer cities (eg crime, transport, housing)
- Compare the sustainability of current & future urban development

8.3 The Moving Earth (Earth theme)
- Study the geological timescale
- Types of rocks, the rock cycle and process of weathering
- Evidence for theory of continental drift & distribution of hazards.
- Causes and measurement of earthquakes
- Compare the effects of earthquakes in different regions.
- Study of volcanoes and many effects on landscapes
- Factors that can reduce or increase the impact of tsunamis.

8.4 Africa focus (Places theme)
- Introduce the diversity of African cultures and natural landscapes
- Consider the different levels of development within the continent
- Study the distribution of population, cities and economic activity
- Consider causes & effects of issues and conflicts, such as piracy
- Study the role of tourism as a growing industry in some regions
- Develop enquiry skills to investigate information sources

8.5 Coasts & flooding (Water theme)
- How we use the coast
- Causes of coastal erosion; waves, Lsd, fetch, geology
- Study coastal erosion landforms
- Understand processes and landforms of deposition
- Coastal defence strategies and methods
- Compare coastal and river flooding – causes
- Compare coastal and river flooding - management

Year 9

9.1 Development (People theme)
- Define development and quality of life
- Measuring and mapping development
- GIS Skills lesson: analysing development indicators
- Understand complex causes of the development gap
- Case study of a poorer African country's development
- The role of trade and aid in addressing development gap
- Examples of top down development
- Example of localised bottom up development
- Case study assessing sustainability of Water Aid's work

9.2 Changing climate (Climate theme)
- How has Earth's climate has changed naturally over time
- Study different sources of evidence of climate change
- Examine extent of past glaciation
- What are the effects of climate change on glaciers
- GIS Skills lesson: analysing past climate data
- Study human causes of recent rapid climate change
- What are the predicted impacts on natural environment
- Understand the probably socio-economic impacts of cc.
- Compare responses of mitigation and adaptation

9.3 China focus (Places theme)
- Overview of the diverse culture and history of China
- Highlight China's rapid, recent economic development
- Location knowledge of China's major cities and features
- What is life like in a new city such as Chongqing
- Comparison of development between China and India
- GIS Skills lesson : evaluating sources of economic data
- Impacts of economic growth on nat. environments
- Compare China's trade and links with rest of world

9.4 The Stressed Earth (Earth theme)
- Overview of the exploitation of vital natural resources
- Different sources of energy; their location and consumption
- GIS Skills lesson: investigating energy demand/supply
- The rise of Opec countries and sources of tension in region
- What are the impact of extracting, burning fossil fuels
- Compare pros & cons of increasing renewable energy
- How can intensive food production damage landscapes
- Case study of area of desertification
- What can be done to reduce this impact of farming

Appendix 16: Rationale for the geography key stage three revision

Much of the KS3 curriculum remains as last year. Clearly, we do not want to waste all the really good work everyone did last year. There are three main concepts that that I think distinguish KS3 from earlier stages:

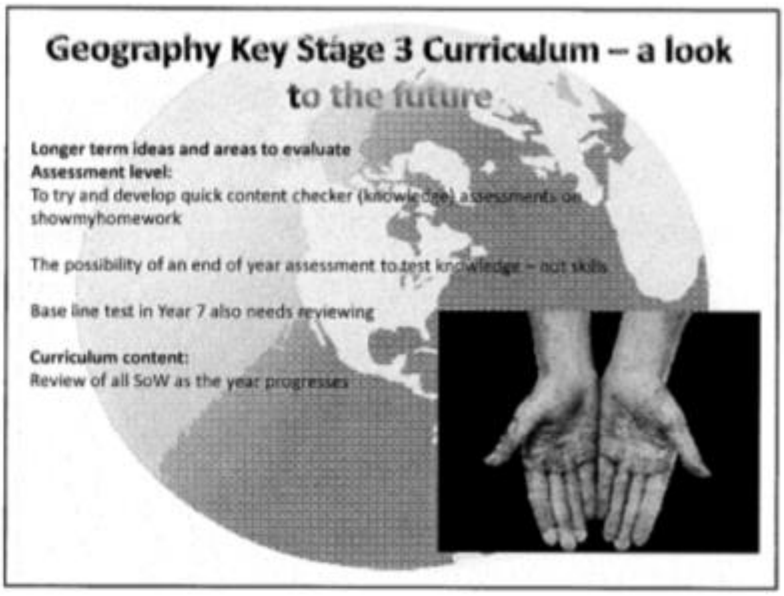
- The **interaction** between human and physical processes to ‘create distinctive’ landscapes
- Understanding how these landscapes **change over time**
- Develop more **critical analytical** and interpretation skills

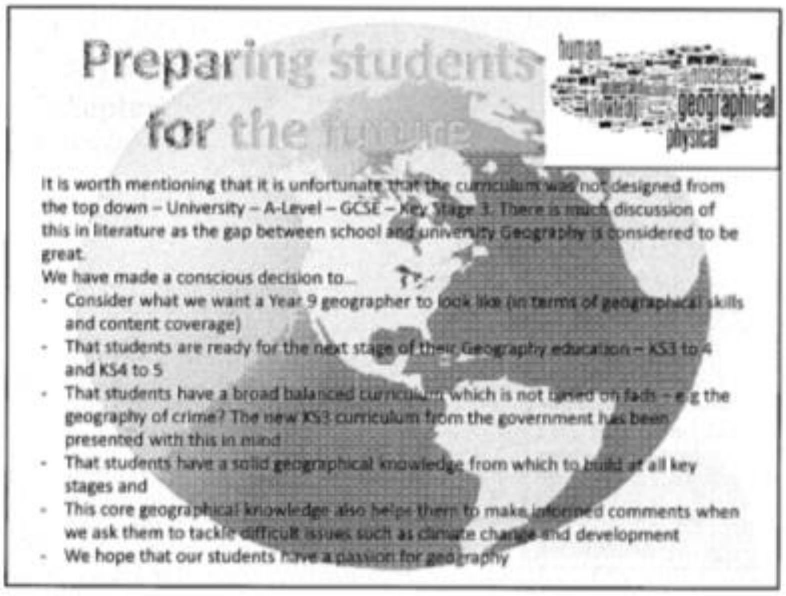
However, we do need to make some changes in light of our review in July and to make sure we plug any of the gaps from the NC Programme of Study. Key review points were:

- The old ‘themes’ created too much of a separation of between human and physical geography
- Whilst a theme approach is useful for planning etc, they too rigid
- The old ‘shaping the land’ them was too big and needs to be split up
- The old skills’ theme was problematic and took too much time up
- In its place we have follow lessons for fieldwork and skills peppered thru all, esp. Y9
- A few other topics, such as Stressed Land (intrinsically harder to create narrative), were not quite right yet.
- We need to get India and Middle East in.

We will keep a broadly thematic approach but there is more flexibility in size. The new curriculum can be viewed in three sections (which follows the organisation of the NC Prog of Study)

Appendix 17: Extract from a presentation to the senior leadership team about geography





Appendix 18: Draft version of geography coding

Geography codes

Knowledge: *What is to be taught?*
- core know.

Propositional knowledge - student ent.

Moving for everyday

Terminology (precision and abstraction)

Human and physical processes (narrative?)

Entitlement -what should young people know about and why?

Seeing the world as a geog.

Intention

Procedural knowledge ('thinking geographically') - thinking like a geographer

A way of seeing the world? (perspectives, big concepts, connections)

Geographical skills and the role of evidence (how do we know what we know?)

- diff. perspectives.

Progression

What does it look like?

Knowers: *Who are the learners and what are their needs?*

Awe and wonder

Relevance and morality engagement

Accessibility and maturity

Knowing: *What does the learning look like?*

Influence of a constructivist theory of learning (esp. dialogue)?

Assessment

The role of visual images

i) relational thinking

Intention

Seeing the world as a geographer.

Appendix 19: Tom’s history entry to the sixth form prospectus

Course content

The AQA History A Level is designed to help students understand the significance of historical events and the nature of change over time. The units of study appeal to those seeking to gain a deeper understanding of the past through political, social, economic and cultural perspectives.

‘Industrialisation and the people: Britain 1783–1885’ is a breadth study across an extended period of time that considers key questions such as ‘how did democracy, society and the economy develop in Britain during the Industrial Revolution?’ and ‘how important were ideas, individuals and governments in shaping these developments?’

The depth study allows students to consider different perspectives and interpretations of events and change. ‘Revolution and dictatorship: Russia, 1917–1953’ enables students to study the coming and practice of communism in Russia by examining issues of political authority, the power of individuals and the inter-relationship of governmental and economic and social change.

Students also undertake a ‘personal study’ - historical investigation of approximately 3500 words , using primary evidence and responding to the different interpretations of academic historians.

Assessments

AS Level

Unit 1

Written exam: 2 hours 30 minutes
Students are required to answer three questions linked to historical interpretations worth a total of 80 marks. (40% of A-Level)

Unit 2

Written exam: 2 hours 30 minutes
Students are required to answer three questions; two essays and one question linked to source material worth a total of 80 marks.

A Level

Units 1 and 2, in addition to:

Unit 3
Coursework
Students are required to complete a personal study of approximately 3500 words worth a total of 40 marks. (20% of A-Level)

Skills Required

To be a good History student you need a passion and eagerness to explore the past through a range of historiographs. You must be able to work independently and in groups to explore and understand different historical ideas and interpretations. Good communication skills are essential to deliver ideas as well as being able to feedback through class presentations. A firm grasp of written English is required in order to cope with the demands of the various skills used in History, such as essay writing and the interpretation of historical sources.

Career Value

History is an excellent academic qualification to possess. By its very nature, the subject is about enquiry and analysis of information, and any career which requires the analysis of information will be open to someone with these critical skills. Examples are careers in law, business, marketing, and management. History, as a qualification, is highly regarded by universities and employers because the ability to communicate fluently and with clarity, using knowledge and understanding, is at the heart of the study of History.

Appendix 20: Year 8 scheme of work for history

Year 8

Week	Big question	Topics to include
31 August 7th September 14th Sept 21st Sept 28th Sept	***How did religion in Britain change during the reformation?***	Intro to Britain 1500 Henry VIII Edward and dissolution Bloody Mary Elizabeth Gunpowder plot
5th October	Review and respond	
12th October 19th October	***Why did the English fight a civil war?***	Intro to the English civil wars Disagreements over Power Money
26th October	Half term	
2nd Nov 9th Nov		Religion Triggers for war
16th Nov	Review and respond	
23rd November 20th Nov 7th December	***How did the English resolve differences caused by the civil war?***	The outcome of the war The trial of Charles Cromwell and the commonwealth Restoration
14th Dec	Review and respond	
21st Dec	Christmas	
4th January 11th January 18th January 25th January	***How did Britain become the 'workshop of the world'?***	Intro to the industrial revolution Coal, steel and steam Transport revolution – trains, roads, canals, The development of factories
1st February	Review and respond	
8th February	***How did life change for people during the Industrial revolution?***	Population change Agricultural revolution
15th February	Half term	
22nd February 29th February		Factories and towns, Child labour Public health
7th March	Review and respond	
14th March 21st March	***How did ordinary people become more involved in politics?***	Intro to democracy – 1832 Chartism Suffragettes
28th March	Easter	
11th April	Review and respond	
18th April 25th April 2nd May 9th May	***How did the trans-Atlantic slave trade develop?***	Africa pre-slavery Trade triangle Middle passage Auction Plantations
16th May	Review and respond	
23rd May	***How was slavery abolished?***	Resistance
30th May	Half term	
6th June	ASSESSMENT WEEK	
13th June		Abolition
20th June	Review and respond	
27th June	***What was the legacy of slavery?***	Civil rights

Appendix 21: Early draft version of coding for history

…s within topics - sequencing -

Knowledge

Propositional knowledge

chron ops of what happened when. What's in & what's out? what is depth what is breadth

a. **Narrative frameworks**

b. **Big pictures** how topics connect to make meaning - o/s topic and whole. → significance.

c. ~~**Depth and breadth**~~

Procedural knowledge- 'thinking historically'

a. **Conceptual complexity**

b. **What makes good history?** good historian?

c. **Perspective recognition**

~~f. Progression.~~ Comments → progression & recogn. codes

Knowers- NB LISTEN TO THE PUPIL INTERVIEW

a. **Morality**

b. **Maturity**

c. **Meaning**

d. ~~**Elaborated and restricted codes**~~ Implicit / explicit - codes.

e. Cultural & intellectual artefact.

Knowing Personal Deeper

a. **Influence of constructivism**

b. **Simple to complex**

c. **Assessment**

d. **Everyday 'portals'**

e. **Oracy and dialogue**

700 - 200