Teaching and Learning: 
the construction of an object of study

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Abstract

While disparities between the declared and the enactive curriculum have been widely observed, the significance of what is actually taught has not been investigated. This study proposes that the enactive curriculum is not merely deviant from the declared curriculum; rather, it is part of the curriculum-making process. Teachers necessarily produce the curriculum as an object of study which students encounter in the classroom. This object of study expresses the teacher's conception of what students need to learn, and is intelligibly related to what they do learn.

To explore this idea, the research project focused on the study of physics and history at Year 12, where teachers used a common curriculum and worked to a common external examination. Teachers of these subjects were interviewed about their practice and what they wanted students to learn. A phenomenographic analysis of these interviews showed a systematic relationship between the teacher's focus and the embedded metaphors s/he used to describe students' learning.

In physics and history, the teachers' conceptions formed a parallel sequence. What was to be studied was described in a widening context: from a narrow focus on facts or algorithms, to a wider view of a body of knowledge or theory, to a relational view where the physicist or the historian was seen to construct theoretical interpretations or readings of relevant detail. There was corresponding variation in the questions and tasks in which students were engaged.

Eight teachers, four from each subject, from a range of schools and expressing different conceptions, subsequently agreed to participate in an observational case study. Their students undertook qualitative exercises at the beginning and end of the year, and their lessons were observed over an extended period.

Consistent with the interview findings, the case study teachers' conceptions of what was to be learnt were evident in the discourse and expectations of the classroom. The teachers focused their students' attention on structurally distinct aspects of the subject, and positioned them differently in relation to it. The teacher's own engagement with the discipline brought into view some issues and obscured others. In general, students responded to their teacher's clues to what the subject was about, in terms of what they focused on, how they went about a task,

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and what they actually learnt. In effect, the teachers produced considerable variation in physics and history as cultural practices.

These findings help to explain the persistence of student "misconceptions" in physics. More broadly, they have implications for curriculum change and teacher development. It is plain that teachers play a critical role in curriculum implementation. Further, it appears to be valuable for teachers to adopt a relational view of what is to be learnt. Variation in ideas about what is to be learnt could therefore usefully be brought into view in teacher training and professional development, and would be an appropriate focus for collaborative reflection and discussion between teachers involved in curriculum change projects.

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Declaration

This is to certify that

(i) the thesis comprises only my original work,

(ii) due acknowledgement has been made in the text to all other material used,

(iii) the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies, appendices and footnotes.

Katharine Anne Patrick
29 January 1998
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Preface

This study focuses on what is taught in the classroom. I propose that teachers construct an object of study for their students which is not patent in curriculum documents; that in different classrooms, the same formal curriculum is rendered differently by different teachers. Different teachers construct for their students different versions of the discipline they are teaching, and bring them into a different relationship with it. How teachers think about their subject - what they believe it involves, how they understand students to relate to it - frames what they do in class, and ultimately affects what students learn.

An anecdote to illustrate what I mean. One teacher I interviewed had just finished her first year of teaching the Year 12 Australian History course. She described her experience as gruelling: no-one else in the school taught Australian History, and though her predecessor was still on the staff, and had passed on his folders of worksheets, he was not available to be consulted. Ms Turnbull had to think out for herself what was required. She read previous exam papers, attended a briefing for new teachers of the subject, studied the handbook with great care, and consulted a friend’s husband who had taught the subject for many years to see if she was on the right track. Even then she waited anxiously to see what was on the exam paper, very relieved when the questions turned out to be ones she had equipped her students to answer. The point which most preoccupied her was discerning a focal issue around which she could organise study of the topic Migration to Australia 1840-1875. Ultimately, she decided to focus on the issue of success - how did migrants understand success, how successful were they, and what did their success depend on - which was in fact the subject of an examination question.

Ms Turnbull’s interest in identifying a focal issue was not obviously required by the course outline, which lists the concepts and skills which students are expected to acquire. It was part of her conception of what is involved in the study of history. Other teachers thought about it differently. Among the teachers in the case study, Ms Farmer focused on changes in the physical environment: she wanted her students to be able to picture what Melbourne used to be like, from the early days when lines of washing were strung across Flinders Lane and obstructed horsemen as they rode through. Ms Parbo, by contrast, was passionately engrossed in the capacity of history to transform her students’ appreciation of points of view other than their own: she constantly emphasised differences in perspective, the points of
view from which European or Aboriginal participants, feminist or traditional historians might view a particular event. In this study I develop an account of the ways in which these teachers, and others, constructed the Australian History curriculum for their students, and how the students went about learning it in their different classrooms.

Is it perhaps only history which is susceptible of being so variously understood? Surely Physics, hardest of the hard sciences, is straightforwardly defined by the curriculum, which plainly sets out what is to be learnt, and corresponds to an examination in which students are tested on how effectively they can apply the principles contained in the curriculum? The knowledge claims of science have traditionally been distinguished from those of social and humane studies such as history; the processes and concepts taught to students differ.

To take another illustration, this time from the teaching of physics, let me hold constant the school and the teacher, and consider comments made about Physics by a single teacher, two years apart. I interviewed Ms Konstantinidis towards the end of her second year as a teacher - also her second year as a Year 12 Physics teacher, since she was the only teacher in the school qualified to teach physics. I asked her what the study of Physics at this level was about, what she most wanted her students to learn. She said she would like her students

to be spot on with the basic concepts, so they will have an understanding which they can use in the future and which will always be with them.

At this point Ms Konstantinidis represented physics concepts as straightforward, readily acquired and used. Two years later she was less confident. In answer to the same question, she said:

I want them to have a sense of achievement, and a sense of enjoyment, and feel that the physics that they learn isn’t just for the exam, and that they understand at least some parts of it. They can understand it in the basic application sense, this is what you apply to get the right answer, but understanding has more to it than that - looking at the broader overview, seeing the subject as having a bit of relevance to their world.

For Ms Konstantinidis, understanding physics concepts was now no longer a seamless whole. She still represented physics concepts as straightforward, but she saw what students did with them as problematic. The notion of understanding had taken on a new dimension. It involved a distinct move which students needed to

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make in their learning: in order to see the relevance of what they had learnt, students had to move back and take a wider view. To achieve this, she needed to teach, and to get students to learn, something which she had not previously thought needed separate attention - the application of physics theories to the explanation of everyday life. It was no longer enough to rehearse formulae, work through to a crucial formula, and draw a box around it (“I know I draw the box round it too”). This constituted an important change in Ms Konstantinidis’ conception of what students needed to learn, and what they needed to do in order to learn it.

These brief examples begin to suggest that how teachers understand what needs to be taught shapes the lessons they teach, and that there is a powerful connection between what teachers teach, and how they expect students to learn.

Where do these conclusions lead us? First, teachers are not merely carriers of information, even if they think they are, because the way they choose to shape and present the material they teach constructs an object of study for their students. Teachers’ decisions constitute a significant phase of curriculum development. It follows that teachers occupy a pivotal position in relation to the curriculum and student learning. If this is true, there needs to be more than token teacher participation in the discussion of curriculum issues. Their views of what and how to teach are critical. Secondly, teachers’ practice needs to be understood as a related whole. If, as I argue, learning is linked to what is to be learnt, a teacher may only be able to make significant changes in how s/he teaches if s/he also rethinks what is to be taught. Finally, if there are significant differences in what teachers teach, this ought to alert us to a problem in the interpretation of externally assessed outcomes. If different teachers constitute the curriculum differently, their students in a real sense are offered different subjects to study. Assessment necessarily enacts a particular reading of the curriculum; if this is different from the teacher’s, external assessment is called into question as a measure of student ability.

This last point may perhaps be read as a call to bring to order errant teachers who are not teaching what the curriculum and the examiners prescribe. Embedded in this interpretation is a suggestion that the meaning of the curriculum and the prescriptions of the examiners are transparent, so that competing readings are seen as obstructive, like smears on the glass. The point of view I propose is quite different. I argue that the process of reading and enacting curriculum is part of a cultural process of reconstituting knowledge, in which teachers are active partici-

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pants. Their practices define for their students, at least for the time being, what is involved in the study of physics, or history; at the same time, they disclose not just diversity, but contestation, about how those studies should be defined.

What do students study in the physics lessons of different teachers? or the history lessons of other teachers? What are they expected to do? How is the study of physics, or Australian history, constructed for them? And what do they make of it?

The research reported here investigated these questions in relation to the study of Australian History and Physics at senior school level.¹ I began by interviewing teachers about the study of these subjects; I went on to explore different ways in which some of these teachers constructed the study of their subject in the classroom, and collected data to evaluate their impact on how students tackled tasks in the subject.

In Chapter 1, I argue that this view of curriculum offers a perspective which makes sense in the context of recent work on curriculum, teacher knowledge, and student learning. Chapter 2 discusses the procedures I adopted for the different elements of the project. Altogether I interviewed thirty-three Year 12 teachers in a variety of schools in and around Melbourne: eighteen teachers of Physics and fifteen teachers of Australian History. The next stage of the project was a case study of the practice of a smaller number of these teachers (four Physics teachers and four Australian History teachers, all in different schools), selected because what they said seemed to represent different ways of viewing these subjects. I observed lessons taught by these teachers over an extended period. At the beginning and end of the year, I also asked students in Year 12 classes taught by these teachers to respond to some questions, and to do an open-ended exercise, so as to provide a basis for discerning the effect their teachers had on their understanding of the subject.

In the chapters which follow I report my findings. In Chapter 3 I analyse the results of the initial interviews, focusing on what these teachers said when they talked about their practice, in terms of what and how they expected their students to learn. Chapter 4 (Teaching Physics)² and Chapter 6 (Teaching Australian

¹ In the Victorian examination system in force at the time, these were both centrally examined subjects with a prescribed curriculum (Group 1 Higher School Certificate).

² A draft version of material contained in this chapter was presented as a paper at the Annual

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History) discuss how the case study teachers described the study of their subject, and how their descriptions correspond to the construction of the subject in their classrooms. Chapter 5 (Studying Physics) and Chapter 7 (Studying Australian History) report what the students in each class said about the study of the subject and how they tackled some relevant tasks, comparing what they did at the beginning and at the end of the year and analysing the effect of the teacher’s approach. Finally, in Chapter 8, I discuss the implications of my findings.

I start, then, by reviewing the literature, arguing that my perspective offers a novel and useful way of viewing what teachers do.

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A draft version of material contained in this chapter was presented as a paper at the Annual Conference of the Australian Association for Research in Education (Patrick 1990).

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CHAPTER 1
Teachers and the curriculum

Glendower
I can call spirits from the vasty deep.

Hotspur
Why, so can I, or so can any man.
But will they come when you do call for them?

(Henry IV Part I, Act III, scene i)

The test of a good teacher... is not whether he writes clearly on the board, or keeps good
discipline, or knows how to work the latest visual aid, but whether his pupils learn what he
tries to teach them... To teach is to teach something to somebody. (Passmore, 1980: 23)

When teaching methods are compared the question of “what is learned” or “what should be
learned” is hardly ever considered. Comparing teaching methods mostly means comparing
general technical arrangements such as the use of textbooks, lectures... and so on. There is
an emphasis on what the teacher does or what the learning material looks like, rather than
on what the learner is supposed to learn... In order to talk about teaching in a reasonably
precise way at all, we have to consider both what competency - and not least what
understanding - the teaching method aims at developing and how it is supposed to be done.
(Marton, 1988: 19)

The research reported in this study investigated what was taught in different
classrooms. My project was to explore the different ways in which teachers
understood what was involved in the study of two particular school subjects
(Australian History and Physics), and to discern the effect of their different concep-
tions on their students’ learning. My focus is therefore not whether teachers
succeed in inducing students to learn, but what they teach, how it relates to the
processes of learning they construct for their students, and what their students
learn. This chapter unpacks these questions, and argues that they are worth
considering.

What do teachers teach?

In the talk and activities of the classroom, teachers construct the study of a subject
for their students, and position their students in relation to it. In different
classrooms, teachers using the same curriculum can construct quite different objects
of study for their students.

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I propose that in their joint engagement in the language, activities and tasks of the classroom, teachers construct with their students both what they are to learn and how they are to learn it. The work of the classroom constitutes both the object of study, and students' relation with it. In the classroom, teaching is actually constitutive of learning.

In saying this, I want to capture the idea that what is taught - what is made available for students to learn - is actually constructed in the classroom. In this sense, teaching and learning are intimately related. The questions, tasks and procedures of the classroom simultaneously offer the students a particular version of the discipline, and bring them into a particular relation with it. In these classroom activities, the teacher constitutes for the students what is involved in the study of the particular discipline: what counts as knowledge and how it is arrived at; what is to be attended to; how it is to be interrogated; what it is for; and how it is to be used. At the same time, in the same activities, s/he positions both the students and him/herself in relation to this object of study, determining what they are severally or jointly expected to do: what role they are to play in asking or answering questions (and of what kind); what responsibility they are to take; what use they are to make of their experience, observations, or understanding. In the process of constructing curriculum, teachers are pivotal cultural agents, involved in the construction and reconstruction of knowledge - in Bourdieu's terms (1977/1972, 1983), they contribute to the formation of cultural capital. Hence thinking about what is taught

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opens up the issue of how knowledge and ways of knowing are transformed and reconstituted in the processes of education.

It may be objected that this account over-simplifies and overstates the impact of the teacher: that students are likely to bring to the classroom expectations, ideas and dispositions which conflict with what the teacher wishes to teach them, with the result that they do not learn what their teacher wishes them to learn. Nevertheless, students necessarily operate within the situation and in relation to the object of study which the teacher makes available to them; this is the context within which their resistance is developed, and in relation to which it can be understood. In the classroom, in fact, it is precisely the moments of conflict between students and teacher which most clearly define and delimit the object of study which the teacher is constructing.\(^1\)

I want first to develop an argument for the significance of this way of looking at what is taught, and then to connect it to issues which have been raised in other studies of curriculum and curriculum implementation.

**A new perspective on what teachers teach**

Curriculum is a code-word, a keyword, in Raymond Williams' phrase, which stands both for the scope of what is to be taught, and the syllabus which prescribes it. Considered in terms of its scope and application, curriculum can be conceived as a term which embraces the different ways of knowing, or "forms of knowledge", into which students are to be inducted. Considered as the site where what students are to learn is determined, curriculum can be conceived dynamically as a process over time, with what Goodson calls "pre-active" and "enactive" phases (Goodson 1988). What teachers actually teach - the "enactive" curriculum - can therefore be seen as constituting and reconstituting for students particular ways of knowing and

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1 This term, which is not new, does not have a particular source. It has been used to denote the concrete object which is the focus of students' attention. As can be seen from this discussion, I use it more abstractly, to denote the discourse and tasks of the classroom. Cf Entwistle and Marton (1994) on the "knowledge object" implicit in students' accounts of what they are to learn.

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objects of knowledge. The enactive curriculum, which constitutes what students are expected to learn, enacts the teacher’s understanding of what needs to be learnt.

Hence what is taught is not just sequential particulars and their associated tasks, but a sense of a discipline and the student’s relationship to it. Teachers participate in the formation, re-formation and continuance of the discipline - see, for instance, Goodson’s work on the emergence of the relatively new disciplines of geography and of rural studies (Goodson 1993a, 1993b; see also Goodson 1978, on history; and Goodson 1990 on the relation between teachers and knowledge). Here we can see the work of the teacher in a wider cultural context (cf Bourdieu’s notion of a discipline as a contested field, Bourdieu 1983). In the work of the classroom, the teacher constitutes for his or her students what it is appropriate to do and to attend to in studying physics, or studying history. Insofar as the work of the classroom takes a different focus, and involves students in different kinds of activity, what it is to study history or physics may be quite differently constructed in different classrooms. The construction of curriculum within the school can be understood as part of the process by which particular ways of knowing are constructed and reconstructed.

Seen in these terms, this study has a significance which goes beyond the classroom. Teachers are positioned as cultural agents, making curriculum - not merely interpreting and more or less effectively putting into practice a curriculum which has been fixed outside the classroom. The process of curriculum-making is understood as extending into the classroom. The curriculum in the classroom can be understood both as a practice which is produced within and shaped by a particular cultural and ideological context, and also as a practice which itself shapes students’ experiences, thereby constituting for them a particular object of study, and contributing in a wider sense to the constitution and reconstitution of a field of knowledge. Teaching a subject involves more than translating written objectives into classroom practice. Teachers read curriculum requirements in the light of their understanding of the fields of knowledge to which the curriculum relates. In their practice, teachers constitute for their students a representation of particular fields of knowledge.

Instead of seeing the school as a site where students are inducted into different forms of knowledge, therefore, we can see it as a site where teachers participate in the struggle over how a particular form of knowledge is defined, and position students in relation to it; where teachers construct both what students study, and

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how they are to learn it. This does not imply a simple correspondence between how teachers talk about a discipline in the abstract, and the form they give the discipline in their teaching; rather that in their practice they constitute for their students a representation of what the discipline is. If knowledge is itself socially determined, teachers are involved in its formation, not merely as more or less effective agents, but as participants. Teachers are far more than bearers of information.

This way of understanding the relationship between teachers and the curriculum provides an important new perspective on teachers’ classroom practice. Curriculum implementation studies, studies of “teacher knowledge”, and studies of “expert teachers” have all tended to treat the curriculum as unproblematic, in the sense that a particular view of it is privileged. These studies represent novice or inexpert teachers as failing to implement the curriculum, or lacking the skill or knowledge to implement it appropriately; what is actually taught is seen as an unwanted outcome, the result of an anomaly, deficit, or resistance by the teacher. If we understand the classroom as the site where teachers make the curriculum, however, we can see these discrepancies differently. Rather than appearing anomalous, they point us to the curriculum which the teacher actually implements - the enactive curriculum, or what Donald Schön calls “reflection in action” (Schön 1981, 1985). From this vantage point, we can register what is taught in the classroom as potentially intelligible rather than deviant, and we can begin to develop an account of the teacher’s practice. Shifting the focus on to the curriculum in practice, and treating it as problematic rather than given, therefore opens up the possibility of investigating and understanding what is actually taught.

Making use of this perspective means that the process of developing curriculum can be seen as extending into the classroom itself, where the teacher frames and shapes the curriculum for his/her students. The teacher’s practice necessarily embodies a view of the curriculum and what is involved in learning it. Instead of asking why teachers do or do not implement a particular curriculum or view their subject in a particular way, we can ask what it is that teachers actually teach - what reading of the curriculum they communicate to their students. We can view classroom practice

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1 cf Gallagher’s argument that teachers’ ideas are important because they “formulat[e] and understanding of scientific knowledge and the nature of science” among the citizenry in general. (Gallagher 1991: 121)
as an end-point of the process of making curriculum, rather than judging what happens in the classroom as a more or less effective implementation of an externally fixed curriculum.

There is, however, a difficulty in conceiving of classroom practice so explicitly in curriculum terms. It is hard to avoid using the formal or externally fixed curriculum as a reference point, and to look instead at what is taught as a coherent whole. The construct of an object of study is helpful for this purpose. It helps us to focus on what precisely teachers teach and students learn.

In the next section I argue that the need to take this step is demonstrated by the considerable number of studies which identify discrepancies between the prescribed and enactive curriculum. These studies focus on the difference between what is taught and what is prescribed. What actively is taught is, on the whole, left implicit. If we refocus our gaze on what actually happens in the classroom, and try to characterise what is taught - in my terms, the object of study in the particular classroom - I believe we can more readily begin to make sense of what students are asked to learn in that classroom, and why they go about the task of learning as they do.

Conceptions of curriculum

I want first to consider the anomalies reported in a number of classroom-based studies. In each of these studies, what was observed varied significantly from what was supposed to be taught: there were discrepancies between what the teacher said s/he was going to teach, and what the researcher heard students describe, or actually observed in the classroom. These discrepancies support the view that what is taught is not adequately signalled by formal curriculum descriptions.

Tasker (1981) reports from an observational study of secondary classrooms that students typically invented a purpose for the lesson which was “subtly but significantly different from the purpose intended by the teacher”; they “often showed little interest in or concern about those features of an investigation which the teacher, or textbook writer, considered to be critical scientific design features”; their knowledge structures were “frequently not the structures the teacher assumed”; and their understandings, developed from the outcomes of experimental work, were also “frequently not those that the teacher assumed were developed”. Edwards and Mercer (1987) observed lessons in several upper primary school classrooms, again
in schools where there was a declared philosophy of exploratory learning, and found that it was routine for the teacher to control the students' tasks and the conclusions they reached. Bergqvist (1990) observed lessons and talked to students in a Swedish comprehensive school with a philosophy of open, democratic, student-directed learning, and found that teachers strongly controlled the work students did and the conclusions they came to, while students perceived tasks as routine and teacher-controlled rather than exploratory.

It is in fact quite common for classroom studies to point to discrepancies between what students do in the classroom and what is laid down in the school curriculum or philosophy. Observation of such discrepancies is not confined to a few qualitative studies. Although each of the projects I have cited was relatively small-scale, and might be dismissed as anecdotal, their findings appear to be confirmed by a number of wide-ranging reviews of classroom practice in US and British schools (eg Cuban 1984, Goodlad 1984, Bennett et al. 1976, Galton et al. 1980)1. What goes on in classrooms has, it appears, been surprisingly unaffected by the waves of curriculum innovation and pedagogical reform which have dominated public debates about education in the past hundred years.

The contradictions in these various reports relate both to learning situations and to lesson content. Curriculum change is not implemented, or not implemented in line with the philosophy of the new curriculum. Students misunderstand what they are supposed to learn, and go about learning it in ways which are inconsistent with the rhetoric associated with the lesson. The students' behaviour is directly related to the teacher's practice: contrary to the declared philosophy of the school, the teacher actually implements a controlled and segmented curriculum.

The feature of such accounts which has attracted most attention is the inconsistency between the prescribed and the enactive curriculum. Different analyses of the reasons for this inconsistency have been put forward: constraints in the teacher's working context (Connell 1985, Doyle 1986, Seddon 1988, Hargreaves 1994); contradictory ideologies of learning which are simultaneously brought to bear on the teacher (Edwards and Mercer 1987); and pressures for curriculum change which are

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1 cf also Tobin and Gallagher (1987), reporting an observational study of a small number of science teachers teaching at different levels in two Australian post-primary schools.

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It can be inferred from the analyses proffered by these authors that what is taught, and how it is learnt, is different in different classrooms. Doyle (1986), for instance, focuses on the constraints of the teacher’s work as the source of an anomalous emphasis on relatively undemanding tasks. He suggests that the demands of classroom management systematically lead teachers to set tasks which are unlikely to fulfil the stated aims of a curriculum formally “constructed around understanding or meaning”. He remarks:

In many hours of classroom observation, I have seldom seen students accomplish tasks in which they are required to struggle with meaning... Recently I have become intrigued with this problem for two reasons. First, most normative models of curriculum are constructed around understanding or meaning. Secondly, there is evidence that students are often proficient at computations and procedures but fail to understand what they are doing. (Doyle 1986: 374)

He attributes this in part to the teachers’ concern to ensure that complex tasks are do-able by students, by breaking them down into smaller segments which can be taught sequentially - as recommended by instructional designers. He comments,

The prompting is heavy and the focus seems to be on keeping the activity moving smoothly and getting a correct product rather than teaching a process. I often wonder whether familiarization makes all learning algorithmic and episodically coded to school settings and, thus, fails to enable students to use their school learning flexibly. (Doyle 1986: 174)

In one junior secondary science classroom, the curriculum was particularly atomised: a great deal of information was imparted, students did a lot of work, but the topics were studied in a disconnected fashion and did not follow a logical progression. “It was not clear,” writes Doyle, “that any overall meaning or semantic thread was built into the system.” This, however, did not disturb the students:

Engagement was high and students did a lot of work... There is no evidence that [they] were bothered by the apparent lack of content progression or integration in this class. There was a logic to the work system, that is tasks were predictable and easy to accomplish, and the students seemed to be satisfied with this arrangement. (Doyle 1986: 375)
He concludes:

Meaning is vulnerable in classrooms... The studies considered here suggest that certain types of task are suitable for classrooms, that is they fit the constraints of teacher and student work systems in these environments, and these tasks tend to represent the curriculum as discrete skills and procedures rather than as occasions for struggling with meaning. (Doyle 1986: 374, 377)

This interpretation of the discrepancy between “normative” curriculum goals and classroom practice is couched principally in terms of the demands of classroom management. Elsewhere in the same paper, however, Doyle points us to another way of construing differences in teachers’ practices. He suggests that teachers who focus their students’ attention on different features of an apparently identical task do so because they have different understandings of what is to be learnt, and correspondingly different conceptions of how it is to be studied. Thus, comparing accounts of two small-group reading lessons, he writes:

One might argue (although the case is not completely clear) that reading was depicted in Teacher G’s class as a process of extracting and rehearsing information from a text, and in Teacher S’s class as a process of updating personal knowledge. (Doyle 1986: 370)

In this comment Doyle represents “reading” as a process involving different kinds of activity for different teachers; at the same time, we can see that the students’ attention would be drawn to quite different features of the text they are studying. In the terms of this thesis, each of these teachers constructed for his/her students a different object of study; accordingly, what the students did and how they came to learn was different. The “discrete skills and procedures” which Doyle observed in the mathematics classroom might similarly be characterised as constituting a particular object of study, though Doyle himself does not take this step.

Edwards and Mercer (1987) report that the students they observed were preoccupied with what needed to be done, rather than how it was to be understood; these students interpreted the lessons as requiring them to work through a set of procedures, and they attained what Edwards and Mercer describe as “procedural knowledge”, rather than the “principled knowledge” of the curriculum. Edwards and Mercer construe this outcome as the result of a “compromised process”:

[Compared with Bruner’s ideal], our own depiction has been of a more compromised process, where the negotiation [between teacher and students] is a rather one-sided affair in which the teacher’s role as authoritative bearer of the ready-made knowledge simply finds alternative, more

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subtle means of realizing itself than the crudities of brute 'transmission'. (Edwards and Mercer 1987: 163)

The teacher in post-Plowden England is depicted as the butt of competing pressures. The task of inducting students into “an established, ready-made culture” is at odds with the Piagetian notion of “discovery learning”:

There occurs within pedagogic activities a tension between the demands of, on the one hand, inducting children into an established, ready-made culture and, on the other hand, developing creative and autonomous participants in a culture which is not ready-made but continually in the making. An emphasis on one aspect or the other is what characterizes the familiar dichotomies of educational ideology, between transmissional teaching and the child-centred approach, ‘traditional’ and ‘progressive’ education. (Edwards and Mercer 1987: 163-164)

Embedded in the ideologies described here are competing conceptions of knowledge (ready-made, or in the making) and competing conceptions of learning (transmissional, or child-centred). Edwards and Mercer suggest that the teachers they observed typically resolved the conflict between these conceptions by finding a subtle means of bringing students into a relationship with “ready-made” knowledge. By implication, how students understood the work of learning, how they apprehended what was to be learnt, and what they actually learnt, was intimately connected to the way in which their particular teacher resolved this conflict.

In his work on classroom discourse, Hull (1986) also points to a conception of ready-made knowledge and its effect on students’ learning, though his account positions the teacher differently. Hull renders the teacher as actively expressing a particular conception of knowledge in his/her management of work in the classroom. He discerns an association between an "objectivistic" conception of knowledge and what he calls "monologic" teaching, where the teacher's voice is preponderant. Through time pressure, directed questions, and attenuated texts, teachers with this "objectivistic" conception of knowledge systematically exclude what students bring to and make of what they're taught, and instead generate a grammar of the subject which creates a gap between student and teacher. This expositional approach produces a classroom discourse which is dominated by the "coercive etiquette of subject languages":

It seems as if it is finally the coercive etiquette of subject languages and their minimal grammars that keep teacher and learner from speaking openly about the things that are in their minds. (Hull 1985: 228)

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Hence, Hull argues, student learning is actually disabled by teachers’ understanding of content knowledge as fact. While Hull’s focus is on the deficiencies of the classroom processes which he describes, he plainly depicts the work of the classroom as expressing the teacher’s conception of what is to be taught.

Johnston (1988), discussing discrepancies between the constructivist philosophy behind a CLISP lesson and the lesson as one teacher actually taught it, calls attention to the teacher’s view of learning. She reports lessons taught by two teachers who had volunteered for the Children’s Learning in Science Program, both following the lesson plan developed by CLISP; the lesson actually taught by one of these teachers differed significantly from the principles of the declared lesson plan, so that the teacher (rather than the students) drew conclusions from what the students had done. The teacher commented afterwards that he was pleasantly surprised - he hadn’t expected so many of the correct points to be made. The notion of using the process of student discussion to uncover students’ own ideas for later evaluation was apparently not visible in the lesson he taught, although it was salient in the CLISP lesson plan. In discussing the work of these teachers, Johnston quotes Osborne and Gilbert (1985): “all teachers have views of learning, which are implicit in their practices, but are rarely articulated even to themselves”. She concludes that changing teachers’ practice may involve restructuring their beliefs, which is problematical and potentially both threatening and time-consuming.

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1 Scott et al in Fensham et al (1994) report a more recent CLISP project, concerned with the phenomenon of rusting, where the teacher was concerned to ensure that “you’ve got to have a slot for (the science view)... You don’t need the right answer unless your idea doesn’t work” (207). He established his own experiments to test hypotheses not proposed by his students, and ultimately dominated the process of developing acceptable conclusions, particularly in relation to the proposition that iron is essential to rusting. The authors comment that “during discussion of the nature of rust activities and weighing the nails, the teacher did not interact with the class to the same extent in establishing the argument that rust was a ‘new substance’. We are left with little evidence of the extent to which this argument was followed by the students and from the post test it appears that fewer students did construct this notion.” (218)

2 A similar study is reported by Cronin-Jones (1990). She observed two teachers conducting a series of lessons which she herself had planned, and uses interview and observation to depict

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None of these researchers is directly concerned with the teacher’s perspective on what is to be taught. Nevertheless, they point us to a way of understanding what teachers do. In their papers, the contradictions between the teachers’ rhetoric and their practice are read as discrepancies which need to be explained. The teacher’s framing of the curriculum is represented as deviant, faulty, contradictory or incomplete; the teacher’s rationale for what s/he teaches is relevant only insofar as it makes his/her deviance intelligible. The declared curriculum is taken as a yardstick against which the implemented curriculum is to be measured. If, however, we focus on the curriculum as it is implemented in the classroom, we can be led by the suggestions offered by Hull, Doyle and Johnston, and interpret the teacher’s practice as an enactment of particular conceptions of knowledge and of learning. Focusing on the teacher’s practice offers a clearer and more intelligible view of the curriculum which s/he enacts and which his or her students experience.

This way of viewing curriculum picks up a suggestion by Goodson (1988). Goodson proposes that an understanding of how schooling has developed needs to take account of curriculum, as well as pedagogy; and that curriculum needs to be seen as constructed, rather than given.

To begin any analysis of schooling by accepting without question a form and content of curriculum that was fought for and achieved at particular historical points on the basis of certain social and political priorities, and to take that curriculum as a given, is to forego a whole range of understandings and insights into features of the control and operation of the school and the classroom... We are, let us be clear, taking about the systematic ‘invention of tradition’ in an

how elicited “beliefs” influence implementation of curriculum, seen as obstacles to successful implementation. Belief areas discerned were beliefs about how students learn, a teacher’s role in the classroom, the ability levels of students in group, the relative importance of content topics. Both teachers believed in student factual knowledge as a desired outcome, drill and repetition as appropriate methods. Cronin-Jones’ curriculum however was based on a constructivist model, involving student exploration with teacher as guide. The teaching which Cronin-Jones observed was consistent with the teachers’ beliefs, but inconsistent with the pedagogical principles designed into her curriculum. She concludes that curriculum designers need to “develop intended curricula which are more congruent with real-world teaching contexts and do not deviate significantly from existing teacher beliefs”. (Cronin-Jones 1990: 248)
arena of social production and reproduction, the school curriculum, where political and social priorities are paramount. (Goodson 1988: 21)

Goodson is here talking about curriculum as a construction which is politically (but not necessarily) related to “forms of knowledge” defined and purveyed by institutions such as universities. Studies of new subjects and disciplines, such as geography and rural studies, make clear that the process of ‘inventing tradition’, to which Goodson refers, involves the recruitment of institutional allies; new ways of thinking, which generated these ‘new’ subjects, are also historically visible in the emergence of science as a school subject. Goodson argues that while disciplines such as history and physics may be conceived as established bodies of knowledge with a weight of institutionalised support, their connexion with school subjects is a matter of historical development - “achieved rather than inevitable”. Hence the school subject can be seen as part of the enterprise by which forms of knowledge are constructed and reconstructed. The school can be seen as a site located in time and place, where subjects such as history and physics are constituted in an intersection of competing ways of marking out these particular forms of knowledge.

This way of looking at classroom teaching is clearly related to what Young (1977) called “curriculum as practice”. Writing on the limits and possibilities of curriculum change, Young distinguished between two ways of reading curriculum, which he called “curriculum as fact” and “curriculum as practice”. Curriculum as fact is a reading which reifies the curriculum: it is seen as a fixed, external body of facts. By contrast, curriculum as practice is a reading which locates curriculum in what teachers do. Ball and Bowe’s discussion of policy-as-practice (Ball and Bowe 1991) provides a parallel. They argue that locating policy in written policy documents privileges a particular stage of the policy-making process, and implies that the policy document has a “real” reading; they claim that to draw a distinction between policy and implementation is essentially bureaucratic. On this view, the process of policy-making does not end with the issue of policy documents, but rather continues as those documents are read and re-read by practitioners. In the same way, we can envisage a continuing process of curriculum-making, in which the “enactive” curriculum is constituted by the teacher in the classroom.

Teacher knowledge

This brings us to the issue of “teacher knowledge”. In the essay quoted earlier, Hull argues that there is an intrinsic connection between conceptions of knowledge

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and conceptions of teaching. We can see conceptions of curriculum as varying likewise. Baldly, if the curriculum is represented as constructed by the teacher, its meaning is no longer fixed. How the teacher understands it, and therefore what the student learns from it, can be seen as necessarily problematic, provisional and variable. Learning can readily be interpreted as a social and interactive process with an uncertain outcome. If, on the other hand, the curriculum is seen to denote a body of knowledge which students should master, variance in what is taught will depend on the teacher's command of that knowledge, and would properly be evaluated against it, just as students' knowledge is. In this view, learning is represented as a quantity, rather than a process.

It follows that there is an intimate connection between conceptions of knowledge, or epistemologies, and conceptions of teaching and learning. Lee Shulman's influential work on teachers' knowledge illustrates the significance of this proposition.

Shulman, in his well known Presidential Address to the American Educational Research Association in 1985 (Shulman 1986), diagnoses differences between teachers in terms of the extent of the teacher's knowledge. The expert teacher has not only content knowledge (familiarity with a particular subject matter), but also pedagogical content knowledge (knowledge of how the subject matter can be organised so that it can be effectively taught). Correspondingly, the content-related difficulties of new teachers, or teachers of new subjects, are ascribed to unfamiliarity. Shulman's categories give us a picture of teachers gradually accruing knowledge and finding additional ways to organise it for their students. His model suggests that the principal task of the teacher is the transmission of knowledge. It is noticeable that the act of knowing - the process by which teachers or students come to acquire knowledge - is invisible. The question driving his analysis of teachers' knowledge is suggested by the lead question in a subsequent article which he co-authored: "What do expert teachers know about their subject matter that novice teachers do not?" (Gudmundsdottir and Shulman, 1987: 59). Elbaz (1991) comments shrewdly:

To Shulman (1987) for example, the novice teacher is of interest insofar as she allows us to observe how pedagogical knowledge develops; but the emphasis is on the knowledge base, a given if not absolutely fixed body of understandings, and how it comes into being. The novice herself has no contribution to make to the knowledge base, and in this respect she is treated as an object of research... The thought that the 'buggy routine' of the novice might teach us
something new about what is possible within the constraints and pressures of schooling, that we might learn from the struggle of the beginning teacher to realize something different, that the novice's view of her cooperating teacher's classroom might enlighten the latter, all these possibilities are foreign to a discourse which places educators in a clear hierarchy with the scholar above the expert teacher, who is in turn above the novice. (Elbaz 1991: 8)

Actually, there is no room in Shulman's model for expert or novice to generate insights, because the salient difference between them is in how much they know, and not in what they make of it. Shulman's consistent use of the term "knowledge" implies that both subject matter and pedagogical principles are given, and denies significance to the rethinking of curriculum or pedagogy. Paradoxically, he appears to valorize knowledge, but to disregard the meanings it is given.

Shulman's perspective is that of the teacher educator, focusing on the preparation needs of pre-service and novice teachers. His model is particularly useful in identifying the kind of coaching which would be most helpful when a teacher is unfamiliar with a particular topic, has never taught it before, or is about to teach it to a year level or ability grouping of children which s/he has not previously encountered. The model was framed as a way of understanding the resources of teachers, not the experience of students.

Shulman's tacit assumptions about "knowledge" and "expert" decisions set up the curriculum as fixed. In their article on social science teachers, for instance, Gudmundsdottir and Shulman compare the knowledge base of two teachers, Harry, a veteran who has been teaching history for thirty-seven years, and Chris, a novice teacher who has just graduated in anthropology. They remark that Harry has a selection of ways of presenting the American history course that he teaches. He taught it as Black History one year, but has abandoned this because of the issues significant to whites which it leaves out. Instead he now emphasises the importance of the Age of Jackson. This is encapsulated by Gudmundsdottir and Shulman:

1 As he points out in his address, his emphasis on content came at a time when pedagogical method was the dominant focus. For a case in point, cf Tobin and Espinet (1989), who report an unsuccessful attempt to help an elderly teacher, a minister of religion, who had been called on to teach science and was struggling through by reading aloud from his notes, by providing him with ideas for reorganising his class and doing small-group work (and apparently no help with the content of the textbook).
In Harry’s view, students will not understand American history without understanding the Age of Jackson. There are three key ideas in the Age of Jackson that must get across to students if they are to understand their history: the growth of democracy, the growth of industry, and the potential for conflict. (Gudmundsdottir and Shulman 1987: 63)

The structure of Harry’s current course, and the images he selects, explicitly develop a particular representation of American history for students in his classroom. He is quoted as speaking of “three key ideas”, “the important issues of Jacksonian America”, “the true essence of Jefferson”. These are presented as unchallengeable assertions, backed by expert authority: “The expert has developed sophistication in segmenting and structuring the curriculum and knows the pros and cons of each approach” (Gudmundsdottir and Shulman: 67). Young teachers are to learn “where the discipline is going” from a “Master teacher” who will give them “the larger picture” (ibid: 69).

This way of construing knowledge obscures the significance of particular ways of understanding or structuring content. It causes problems if we want to characterise what is actually taught. Gudmundsdottir and Shulman emphasise that Harry’s is not the only way of teaching American history: Harry himself has occasionally taken a different approach in the past, and colleagues use a “judicial approach”, or choose to focus on economic development, or teach by topics. Shulman’s model, however, does not provide space in which we can characterise Harry’s decisions on how to structure his course, and the image of American history which he offers his students. His decisions are presented merely as evidence of his flexibility and the range of his pedagogical content knowledge. The problem is that because Harry is treated as someone with “expert knowledge” (Gudmundsdottir and Shulman 1987: 63), the representation of American history which he has decided to offer his students is accepted at face value, as the result of expert judgement.

If we consider classroom practice from the student’s point of view, the range of options on which Shulman focuses are no longer visible. Students experience the curriculum which is presented in the classroom. Teachers always teach something, in the sense that they bring their students into some relationship with some object of study. Shulman’s model does not allow us to represent the particular curriculum which Harry’s students experience (whose history is Harry presenting? does he...
have black or Hispanic students?\textsuperscript{1} It focuses on the teacher’s resources rather than on what s/he teaches, and thereby treats as given exactly what I want to bring into view as problematic - the nature of the curriculum which the teacher presents.

Teaching as a cultural practice

It might be said that if teachers are regarded as the interpreters of the curriculum, their local and idiosyncratic readings of it are being privileged. Young’s purpose in the essay quoted earlier was to warn against focusing exclusively on curriculum as the creation of individual teachers. He argues that the focus on individuals implies that curriculum change depends on action by individuals, whereas the political realities of the contexts in which teachers work - and, particularly, the widespread reading of curriculum as fact - actually limits and determines what is possible. He writes,

\begin{quote}
The... conception of ‘curriculum as practice’ can... mystify to the extent that it reduces the social reality of curriculum to the subjective intervention and actions of teachers and pupils. This limits us from understanding the historical emergence and persistence of particular conceptions, of knowledge and particular conventions (school subjects for example). In that we are limited from being able to situate the problems of contemporary education historically we are again limited from understanding and control. (Young, 1977: 237)
\end{quote}

From the point of view of locating responsibility for the shape of curriculum in the classroom, Young’s point seems just. Since the publication of his essay in 1977, there have been both critics and advocates of teachers as curriculum-makers who have argued as if the teacher were somehow culturally self-contained. Barrow (1984), for instance, appears to recommend that in view of the provisional nature of generalisations and theoretical propositions, teachers should give most credence to their own intuitions about particular students in a particular classroom. The tendency towards individualism is visible in the teacher images/personal history literature, and has been recognised as a problem in the movement towards locally or

\textsuperscript{1} For an example of an alternative way of looking at such choices, see Diorio (1985). Diorio presents a study of the ways in which history was used in the nineteenth century as a tool of moral training, and argues that this use for history teaching is no longer seen as culturally relevant: there has been change both in the study of history and in its role in schools.

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individually negotiated curricula (Rizvi and Kemmis, 1987). Detailed descriptions of individual cases do tend to imply that the individual teacher’s work is a matter of individualistic and adventitious decisions, particularly if the teacher’s classroom practice is sharply distinguished from his/her declared philosophy and intentions.¹

Young’s argument is taken further in a more recent paper by Goodson (Goodson 1990) arguing that the curriculum should be conceived as a "social construction". Goodson views the processes which generate curricula as an integrated span, “firstly at the level of prescription itself, but also at the levels of process and practice” (Goodson 1990: 299). Like Young, therefore, Goodson is interested in the processes which generate curricula; but whereas Young was particularly concerned with the processes enabling curriculum change, Goodson widens the perspective to curriculum overall. He argues that the focus on innovation has in fact been counter-productive; that research interest in the local implementation of curriculum innovations has in practice colluded with the continued representation of curriculum as prescription. While agencies such as the Centre for Applied Research at the University of East Anglia have focused closely on teachers’ practice, their research has been separated from the rhetoric of curriculum objectives. On the whole, teachers have been assumed to teach in conformity with the prescribed curriculum, and the discrepancies between curriculum in practice and curriculum as prescribed have been tacitly ignored. This has liberated teachers from close scrutiny, but the price has been that they have been excluded from curriculum discussion. Goodson calls for a research program investigating the social construction of the whole process of curriculum-making, including both the development of prescribed curricula and classroom processes.

Goodson’s perspective makes clear the context in which Young’s warning needs to be read. Both Young and Goodson are primarily concerned with identifying the social forces which shape curriculum. My focus is slightly different: I want to see how the language of the teacher, and the teacher’s conceptions, are embodied in the curriculum which constitutes the teacher’s practice - to describe what the “curricu-

¹ See for example Reynolds and Saunders, in Calderhead (1987), who interpret the dissociation between curriculum documents and school practice in terms of “loose coupling”, a relationship between formal protocols and everyday conduct where the outcome in practice is determined by situation-specific “trade-offs between aims and actualities” (211-213).

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lum as practice" is, within the classroom. Young argues that conceptions of knowledge and conventions of school subjects are historically situated, and not invented by individual teachers; this should not debar us from looking at how different conceptions and conventions are rendered in practice.¹

I certainly do not wish to imply that teachers are culturally insulated, nor that they individually determine the shape a curriculum takes. Their views of their subject are not an idiosyncratic invention. Teachers are embedded in the culture of a department and a school (see eg Ball and Lacey 1980, Ball 1985, Page 1987, Domingos 1989). They also carry with them a personal history in place and time which locates them within social and cultural practices beyond the school, involving their own experiences of schooling and of instruction as student teachers, and their initiation into the teaching of their chosen subjects (Elbaz 1981, 1991). We can read their views of their subjects, and learning in them, as cultural expressions.

At the same time, their views do differ. At any particular time, current learning theories and the cultures of particular disciplines are constituted in an accretion of ways of thinking and working, a kind of archaeological silt (cf Gramsci, Cuban 1984), so that teachers are likely to vary in the way they understand what is involved in teaching or learning a particular subject.² It follows that a knowledge of the broad cultural context does not immediately enable us to read off any particular teacher’s position. If we are to understand the teaching and learning going on in

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¹ It should be clear that I am also choosing to focus on what is taught, rather than on the role which the teacher adopts in relation to it. For a view of different roles which teachers may adopt in teaching history, cf Evans (1990).

² Durkheim put it like this:

“In each of us, in varying proportions, there is part of yesterday’s man [sic]; it is yesterday’s man who inevitably predomnates in us, since the present amounts to very little compared with the long past in the course of which we were formed and from which we result. Yet we do not sense this man of the past, because he is inveterate in us; he makes up the unconscious part of ourselves. Consequently we are led to take no account of him, any more than we take account of his legitimate demands. Conversely, we are very much aware of the most recent attainments of civilisation, because, being recent, they have not yet had time to settle into our unconscious.” (Durkheim E (1938) L’évolution pédagogique en France. Alcan. Paris, p 16. Quoted Bourdieu (1977/1972): 79.)
particular classrooms, therefore, we need to attend to practices at the classroom level. We can give an account of the curriculum as practice, while accepting that practice is generated within a powerful social and cultural context, itself worth exploring, though that is not my project here.

This way of representing the cultural context of the curriculum implies that the curriculum is essentially relative, defined by interests and ideas at a particular place and time. From the perspective of the individual teacher, however, the cultural context in which s/he works is an experienced reality. Johnson argues that the teacher’s knowledge needs to be understood as a totality of felt and thought experiences, literally incorporated:

The teachers’ knowledge is... the very way they construct their reality as they live it through their embodiment, with all its tempos, moods, patterns, and projections. No verbal and intellectualized account of the teacher’s beliefs could ever do justice to the experienced reality of this web of experiential processes that constitute the teacher’s knowledge-in-process. (Johnson 1989: 372)

The conception of knowledge expressed here is close to Dewey’s - the idea that (to quote Johnson 1989) “knowledge is not some fixed and static thing, but rather an activity (of knowing) by means of which we are able to transform our experience” (Johnson 1989: 363). This active, relational view of knowledge makes the intersubjective activity of the classroom an arena for the expression and construction of knowledge by teacher and students alike.

Making use of the construct of an object of study in this way implies that what is taught has a unity and coherence, which is constructed by the teacher, and which may differ from what is implied by the formal written curriculum. This proposition is explored in the research I report here. I focus on what teachers attended to when they talked about students learning their subject, and what they presented to their students as salient. What, in each classroom, did the study of history or physics involve? Can a coherent object of study be discerned in what teachers did, and students experienced? Did it significantly shape students’ understanding of what they were studying?

My project was designed to investigate these issues. In the next chapter, I describe my methodology, and consider the literature which influenced it.

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CHAPTER 2
The research project

Chapter 1 argued that we need to reconceive the process of making curriculum, to include the classroom discourse and tasks by which the teacher both constructs an object of study for his/her students and brings them into relationship with it. The usefulness of this perspective depends on whether teachers differ to any marked extent in what they offer their students as an object of study, and whether the differences actually affect what their students learn. My research explored these issues in relation to the teaching and learning of Physics and Australian History at Year 12 level.

In outline, the project involved interviewing a number of Year 12 teachers (18 teachers of Physics, 15 teachers of Australian History); observing some of them in the classroom over two to three terms (an average of 25 lessons); and collecting data from their students at the beginning and end of the observation period. Figure 2.1 depicts this methodology.

Figure 2.1 Methodology

In this chapter I review the literature which guided this methodology. The review addresses two main issues: first, how we can identify and analyse differences in what teachers construct for their students as an object of study; and secondly, how we can identify and analyse outcomes in terms of student learning. In the discussion which follows, I link my analysis of the nexus between teaching and

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learning to this methodology and to the phenomenographic approach which I adopted in analysing the data which resulted.\textsuperscript{1} I conclude by discussing the significance of the particular subjects and level of study which were the focus of the project.\textsuperscript{2}

The object of study: hearing what teachers say

The initial phase of this research project was a series of interviews with physics and history teachers, in a range of schools. My objective in these interviews was to find out how teachers themselves described what they taught. I focused on the details of teaching: how exactly a recent topic had been introduced, what the teacher had done, what the students had been expected to do, and what issues they had encountered. This focus on specific detail was a deliberate strategy.

As discussed in Chapter 1, educational studies have repeatedly found that teachers act in ways which are inconsistent with their declared objectives. This finding is not specific to teachers. Inconsistency and even dissonance between "the accounts which agents produce" and what they do has been an issue for generations of sociologists and anthropologists. Bourdieu, reflecting on his study of the Kabyle of Algeria, developed a notion of "practical knowledge", which he argued was inexplicit precisely because it was habitual (Bourdieu 1977/1972: 18-21). Giddens (1984) expresses a similar idea:

Human agents or actors - I use these terms interchangeably - have, as an inherent aspect of what they do, the capacity to understand what they do while they do it. The reflexive capacities of the human actor are characteristically involved in a continuous manner with the flow of day-to-day conduct in the contexts of social activity. But reflexivity operates only partly on a

\textsuperscript{1} Appendix I details the analyses which I conducted and discusses the steps involved.

\textsuperscript{2} This methodology required a series of permissions and clearances, which were duly obtained: from the Departmental Ethics Committee of the Centre for the Study of Higher Education, University of Melbourne, as a category C (non-intrusive) project; from the Victorian Department of Education and the relevant Regional Managers; from the principals of the schools where I conducted interviews and observations; from the teachers whom I interviewed and observed; and from the parents of the students themselves, or the students where they were aged eighteen or over.
discursive level. What agents know about what they do and why they do it - their knowledgeability as agents - is largely carried in practical consciousness. Practical consciousness consists of all the things which actors know tacitly about how to 'go on' in the contexts of social life without being able to give them direct discursive expression. (Giddens 1984: xxii - xxiii)\(^1\)

If we consider this distinction in the terms provided by Argyris and Schön (1978), "discursive expression" and public statements of principle and declared policies correspond to "espoused theory", while the private, spontaneous and automatic decisions of "practical consciousness" are informed by "theory-in-use".

Nonetheless, the metaphor / teacher images literature suggests that the language we use to describe our practice is coherent with what we do, and that teachers' descriptions of their practice can provide us with a key to understanding what they do in the classroom.

Underpinning this line of enquiry is the work on metaphor which has been pursued by Lakoff and Johnson (eg Lakoff and Johnson 1980, Lakoff 1987, Johnson 1987, Johnson 1989). Lakoff (1987) argues that the metaphors we use in everyday speech, even when they are so familiar as to be invisible to us, express fundamental relationships, orientations, and ways of categorising our experiences. Schön (1983, 1987) suggests that how we talk about a problem involves framing it in a particular way - he uses the idea of "reflection-in-action". A new perspective, that is, a new way of thinking about a problem, constitutes a reframing of it, the employment of a different metaphor.

Munby (1986), in a seminal article, develops the connexion between Schön's work and Lakoff's. In this article Munby applies the idea of the "framing metaphor" to the analysis of how a particular teacher ("Alice") described her lessons. He identifies in her remarks a cluster of language items around the notion of movement ("I move on" "they go smoother" "getting started as quick as I wanted"). Learning is construed as "picking up" as the moving object goes by. Munby concludes that Alice's rendering of her lessons as "a moving object" is so salient that it represents a

\(^1\) cf Bourdieu (1977/1972): "the true nature of ... practical mastery is learned ignorance, a mode of practical knowledge not comprising knowledge of its own principles" (19).

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lesson and of the success of her teaching in terms of learning and where the children 'are'. This is not to claim that Alice is aware of her use of this metaphor. Instead, it is an attempt to answer the question of why Alice speaks in these ways. Presumably, the words have a special force for her, and the unpacking of the metaphorical content of her speech seems to point directly to how she 'sees' teaching. (Munby 1986: 206)

This kind of insight has been pursued within a stream of research focusing on how individual teachers talk about their practice, and how changes in their language connect with changes in their practice (the "teacher thinking"/"teacher images" literature). Russell and Johnson (1988), for instance, analyse the language of four teachers interviewed at intervals over a two year period, and connect changes in the metaphors the teachers used in describing their practice with changes in their perspective on teaching and their teaching practice. Wendy's teaching practice did not change over the period; she continued to describe her main task as "covering the curriculum", "getting all the key points in". By comparison, Nancy, also a beginning teacher, began by talking about "stepping back and looking at myself", but by the end of her first year she had moved on to talking almost exclusively about her observations of her students ("pinpointing their problems", "finding out where the kids are doing things"), and her classroom management had changed to take account of what she saw. These studies are sensitive to the relationship between the teacher and the work s/he undertakes in the classroom in a way which seems likely to enhance our understanding. The detailed work in studies such as these suggests that insights into an individual teacher's practice can be gained by attending to the precise language which the teacher uses to describe it.

As can be seen from Munby's study, quoted above, the insights this approach offers are essentially qualitative. They derive not from listing metaphors and counting the number of times a particular metaphor is used, but from discerning an underlying commonality between different metaphors. Munby calls this commonality a "framing metaphor", in Alice's case her rendering of lessons as "a moving object". It is assumed that metaphorical representations with a common focus also have a common character, because they represent the individual's sense of his/her relationship with whatever the focus is; and that the individual him/herself may not be aware of it. The researcher's task is to interpret what the teacher says by identifying and articulating these underlying tropes or framing metaphors.

The notion of a framing metaphor implies that what is taught can be understood as a gestalt, an intelligible whole; that there is a commonality in the way the teacher

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presents different topics and gets students to deal with them. This commonality cannot be discerned from lists of topics, or academic tasks, or assessment practices, because it subsists in what the teacher makes of them. Rather, it is discerned from what teachers say about what needs to be learnt. The themes they pursue in describing their practice are intelligibly related to what they say in class, and what they ask students to do. Analysis of metaphor thus uses the language of the individual teacher to develop an account of what the teacher does.  

While the analysis of metaphors seems a useful way of identifying how teachers represent students' learning, and their relationship to the curriculum, it is less promising as a way of accessing their representation of the subject content itself. The framing metaphors which Munby and Johnston and Russell identify indicate active relations ("covering the curriculum", "getting started quick", "stepping back and looking at myself"). These are the bodily metaphors which are so frequently incorporated into everyday speech (see Lakoff 1987). In these extracts the teachers are using metaphor to represent their own role as teachers, and their relationship with children as learners in their classroom, rather than curriculum content. If we work with the idea that their descriptions of their practice are likely to give clues to the representation of curriculum they develop in the classroom, we shall need an approach which incorporates more of their discourse in the analysis. Here I want to turn to the phenomenographic work of Marton and his associates.

Marton (1988a) puts forward the view that understanding is a critical element of knowledge, and that changes in understanding constitute the most significant element of learning. He argues that differences in how we understand a phenomenon are visible in what we notice about it and how we see its parts as being related - "what aspects, what parts, what relations are discerned and focussed on" (Marton 1988a: 3-4). To illustrate this idea, Marton uses the metaphor of figure and

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1 It therefore stands in direct contrast with analyses which classify teachers' practice into externally generated categories such as "transmission" or "understanding-oriented". The metaphor of transmission, particularly, has been used by researchers to connote both a belief in "knowledge as fact" and an expectation that teaching is a fairly simple process of transferring knowledge from teacher to learner. These ideas are recognisable, but they are rarely shared by the researchers who categorise teachers as "transmission" teachers, so that the term actually becomes pejorative rather than illuminating.
ground: looking at the same picture, different people discern different figures, and construe differently the background against which the figure appears (personal communication). Marton uses this idea to analyse different ways in which students apprehend, or understand, the same phenomenon, but the principle of his work is clearly applicable to the analysis of what teachers say about their practice. The underlying idea is that the salient features of a phenomenon - what we focus on when we talk about it - constitute what is important about it for us in that particular context. Thus when a teacher talks about a subject s/he teaches, s/he gives it a particular shape, by focusing on particular aspects of the subject - those which are salient to him/her - and presenting these aspects within a particular frame of reference. Here, the focus the teacher gives the work is the figure, and the frame of reference s/he uses is the ground.¹

This analytical procedure has something in common with the process of identifying dominant metaphors used by researchers such as Munby. Both Marton and Munby emphasise the importance in the initial investigation of developing the analysis from the data, rather than trying to match observations to a pre-specified set of categories. Both emphasise the importance of attending to dominant features of the discourse they are analysing. An significant difference, however, is the focus of the analysis which results. Munby, like Russell and Johnston, characterises how particular individuals represent what they are doing. Marton's is a "second-level" analysis: he seeks to develop categories of representation, grouping together like ways of representing a particular phenomenon. This makes it possible to go further than the individual case, to recognise common ground in the ways different teachers talk about their practice. Marton's approach can therefore be construed in terms of discourse theory, in that what each teacher says is no longer seen as purely idiosyncratic; instead, teachers are seen as taking up positions in different discourses.²

These conclusions have clear implications for the present project. Elements of discourse - "conceptions", in Marton's terminology - are not purely idiographic; they are constituted in shared ways of talking. If the interpretation of what teachers have to say is to develop into an account of the discourses they use, it requires more

¹ cf also Marton (1981), for an early formulation of this approach, and Marton and Booth (1997), for a recent overview.

than attending at an individual level to teachers' language and the way they represent specific curriculum areas. The phenomenographic method of characterising what teachers say entails using a semi-structured, open-ended approach to interviewing them, so that differences between them can emerge; the development of an account of different discourses in the same curriculum area thus entails interviewing a number of teachers, so that differences and commonalities in what they say can become visible. In the present context, which involves characterising, rather than recognising, the discourses teachers use, phenomenographic analysis seems particularly appropriate.

Rather than working up detailed accounts of the histories of individual teachers, then, I wanted to talk to enough teachers to be able to categorise different ways of representing the study of physics and history, and to follow these interviews with classroom observation of teachers who spoke about their practice differently. As I have said, the first stage of the research involved open-ended interviews with thirty-three teachers: fifteen teachers of Year 12 Australian History, and eighteen teachers of Physics. These teachers were approached individually. I did not attempt to achieve a random sample, but to cover a reasonably wide range of school types and settings: single-sex and co-educational, Government and non-Government private, in wealthy, middle-range and lower status areas. In several larger schools with two or more Physics or Australian History teachers, I interviewed two teachers rather than one. Because I undertook that schools, teachers and students would remain anonymous, they are not listed here.

In these interviews, my main purpose was to ask teachers about their practice in relation to the particular subject. I began each interview with the same question, about the study of the subject ("What would you say that the study of Australian History/Physics at Year 12 is about? What would you most want your Year 12 students to carry away at the end of the year?"). The rest of the interview was semi-structured: each interview covered similar ground, and I asked much the same questions.¹

I used the transcripts of these interviews as the basis for analysing different ways in which these teachers represented knowledge within their subject, and students' learning in relation to it. In these analyses, described in Chapter 3, I particularly

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¹ Appendix 2 gives the interview schedule.

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considered what different teachers focused on in talking about the study of a particular topic, and the language they used to describe it, especially the dominant metaphors. My analytical procedure therefore combined insights from the work on metaphor and teacher thinking described above, and the phenomenographic approach developed by Marton.

A question which may be raised in relation to this approach is whether the conclusions would be replicated, either by someone else reading the material to be categorised, or by someone using the same categories to sort the material. Researchers focusing on a different aspect of what is said or written might well develop different sets of categories (cf Marton 1988b). Following Sandberg (1994, 1997), I have taken the view that inter-judge agreement might verify the effectiveness with which the categories were explained, but would not validate the categories themselves. In effect, the categories are valuable only insofar as they are found to be persuasive and productive in relation to the issue being considered. I have tried to provide sufficient illustrative material for this to be evaluated by the reader.

The object of study: observing teachers’ classroom practice

In the second phase of the study, I observed a small number of teachers in the classroom, teaching Year 12 Physics and Year 12 Australian History. I selected these teachers because their descriptions of what they were teaching, and how they went about it, suggested that there would be substantial differences in what their students experienced. These case studies were the main part of the research.

Merely listening to what teachers say about their work is of course no substitute for observing what they do. Differences between teachers, however analysed, might still be trivial in terms of what actually happens in the classroom. The logistics of classroom observation mean that it is only feasible for one person to observe a rather small number of teachers - with the objective of observing twenty-five lessons and at least one complete sequence of lessons taught by each teacher, I managed in a year to meet this objective for only six teachers. Over the two years of the case study phase, 1990 - 1991, I observed four Physics teachers and four
Australian History teachers.¹

The next question to be considered was how to discern and characterise what these different teachers made of the curriculum in practice - how they constituted it as an object of study. It has been relatively common to evaluate the "cognitive content" of teachers' questions, to map out the phases of a lesson, to identify groups and subgroups within the class to whom teachers give more or less attention of different sorts, to code classroom discourse according to register, systems of turn-taking and types of response. Such studies have generated insights into strategies of classroom management, from the teacher's point of view, and the ways in which students are socialised into the practices of schooling, from the student's point of view. My concern here was different. I was seeking to understand what these teachers taught; that is, what they presented for their students to learn, and how they tried to get their students to learn it.

The teaching of an object of study must proceed through the consideration of particulars, which cannot be assumed to be constant across space and time. Just as the discipline itself is constituted and reconstituted in its social practice, the study of the discipline is constituted for its students by the way particulars are selected and dealt with in the process of being taught. Describing how individual teachers represent history or physics for their students, however, involves doing more than specifying which particulars they deal with, through a blow-by-blow account of the process of teaching. It is an interpretative enterprise, a perspective on what the teacher is doing which results from seeing a pattern in what s/he does.

Ultimately, this project demands that we consider the development of a lesson taken as a whole, and as part of a series of lessons, rather than count up fragmented observations. The mundane process of collecting observations for this purpose, however, requires some decisions about the significant elements of a lesson. In the discussion which follows I describe my approach to interpreting what I see as significant features of teachers' classroom practice: the discourse of their classrooms and the work they got their students to do. Walkerdine has done some inspiring work in which she uses discourse analysis to discern "theory-in-practice" in classroom dialogue. In the related area of academic tasks, suggested as a field of

¹ My observations in Australian History were all conducted in 1990. I observed two Physics teachers in 1990 and two (Mr Matthews and Ms Konstantinidis) in both 1990 and 1991.
research by Doyle, I have particularly used the work of Säljö and Wyndhamn to suggest the significance of the academic task.

**Reading classroom discourse**

Walkerdine (1983, 1984, 1988) shows us how to read what teachers say to students as an enactment of taken-for-granted theory. Walkerdine analyses the construction of subjectivities - the way classroom discourse inserts children into dialogic practices, the differences between the discourse of the home and of the school, and the way in which the discourse of the school handles those differences. She uses segments of dialogue (some of them quite lengthy) to build up an account of how subjects involving reason, particularly mathematics, are constructed in the classroom as peculiarly masculine. This work takes us beyond the idiosyncrasies of individual teachers. It shows how the teachers’ practice was framed by the discourse of the "post-Plowden" classroom, which represents children, boys, girls, and learning in particular ways.

The process Walkerdine uses to make these implicit theorisations visible is largely contrastive: for example, she contrasts the activities and context of domestic transcripts of mother-child conversations using the terms "big" and "little" with the activities and context of classroom transcripts where the teacher is teaching children the concepts "big" and "small". These contrasts have a dual role. In Walkerdine’s argument, they are important because they establish the conflicts and dilemmas in the way girls are "inserted" into different discourses. In her presentation, their effect is to make the teacher’s practice seem problematic; it is suddenly easier to see it as constructed rather than natural. The dialectic, familiar from Foucault’s work as a contrast between past and present, is read off conflictual contemporary practices.1 In this respect Walkerdine’s approach is relevant and useful.

There are, of course, differences between what Walkerdine has sought to do and the

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1 A similar step is taken by Hollway in Henriques et al. (1994), in analysing current discourses concerning sexuality. She writes: “Foucault’s use of the term discourse is historical and this is crucial to the analytical power of the concept. For my purposes the emphasis must beshifted in order to understand how at a specific moment several coexisting and potentially contradictory discourses concerning sexuality make available different positions and differentpowers for men and women.” (230)
aims of the present project. Walkerdine has been particularly concerned with the ideology of primary education, most recently framed as Piagetian and post-Plowden thinking. This is a central theme, which she identifies as a commonality in her teachers' theorizing, so that the contrastive discourse she describes is sited in the home. My project is to develop an account of what I take to be different discourses; accordingly, the contrastive material which I present is sited in different classrooms. I have, however, followed Walkerdine's example to some extent in presenting different teachers' treatment of the same topic, or concept, so as to make visible what different teachers present as significant and meaningful, and what they ignore as outside the field of study.

The significance of academic tasks

The character of classroom tasks has a particular importance for this study. It has been relatively common to evaluate the "cognitive demand" of the tasks teachers set. Tobin and Gallagher (1987), for instance, following Doyle (1983), code student responses as factual recall, comprehension, procedure or opinion. Bennett and his colleagues (Bennett et al, 1984) took this approach a stage further, evaluating the demands of different tasks in terms of individual students' prior experience and performance, and reporting that teachers actually resisted the idea that they needed to set students challenging tasks. I want to consider findings such as these from a different point of view, in terms of what we can learn from them about what the teacher is actually teaching.

Säljö and Wyndhamn's studies of arithmetic tasks, already referred to, are pertinent here. As I interpret these studies, they imply that many students expect the context of a school task to supply clues on how to tackle it. In effect, these students read the instructions as an intrinsic part of the task. In one study (Säljö and Wyndhamn 1987), students were presented with three multiplication problems and a division problem ("A metal thread weighs about 3 grams per meter. How many meters of thread are there on a reel weighing 75 grams?"). The problems were presented in the context of four different texts. The more salient the orientation towards a multiplication approach, the more likely "average" or "weak" students were to proffer the solution "3 x 75". In their discussion, Säljö and Wyndhamn argue that

the overall results... support the notion that pupils use extraneous criteria to guide them through the tasks they perform. In this sense, what determines the degree of success with which pupils uses an algorithm does not depend on the mastery of the algorithmic tool per se,
but also on the context in which it appears, and the individual's ability to identify the algorithm in a "noisy" environment. (Säljö and Wyndhamn 1987: 240)

Students who were judged to be performing at a superior level were able to recognise the intrinsic demands of the task, irrespective of context. The less able students could solve problems like this division problem, so long as they had clues to help them recognise it. Säljö and Wyndhamn suggest that this indicates that these students' "choice of a mathematical algorithm to solve the problem rests on fragmentary understanding of whether the problem is of a division or multiplication type" (ibid: 243).

In a subsequent paper, Säljö and Wyndhamn argue that teachers' practice actually sustains this reliance on contextual cues:

> Competence growth can... be seen as resulting from conscious efforts to make it possible for students to handle tasks in situations when the educational framing of tasks becomes less prominent. To become internalized as a genuine part of a person's intellectual repertoire, the skill must be dissociated from the immediate context in which it was acquired. The difficulties inherent in achieving this dissociation of cognitive operations are probably grossly underestimated in formal educational institutions where the pedagogy relies on practising standard examples and where the problems of 'generalizing' are largely left to the pupil to solve on his/her own accord. (Säljö and Wyndhamn 1988: 70)

This conclusion has something in common with Doyle's work on "academic tasks" (Doyle, 1986), discussed earlier. Doyle argues that teachers reduce the cognitive demands of the tasks they set, so that tasks are grouped, practised, and clearly sign-posted. In his view teachers do this deliberately, to enhance students' chances of successfully solving the problems, and to reduce the difficulties the students confront. Like Säljö and Wyndhamn, Doyle argues that this process strips away the cognitive demands of the work and "truncates the curriculum". He emphasises the design of tasks presented to students. His work, confirming Säljö and Wyndhamn's supposition, suggests that teachers very often construct classroom tasks where the contextual guidance is so heavy that active thinking is not required or developed.

I want to extend this argument, and propose that tasks presented in this way actually construct for students an object of study which requires familiarisation and memory work. In a real sense, where the work they are set does not require students to "struggle with meaning", a curriculum has been constructed which involves
recognition and recall, where meaning is not brought into focus. The tasks teachers ask students to do are an important feature of what they teach.

The methodological problem is to set up a process of interpreting observations which will help us see the shape the teacher gives to the study of the subject, without imposing a preconceived pattern on the observations. For the sake of the argument, the interpretations offered need to be linked to the analysis of what the teachers said about their practice. The approach I have taken is to characterise what the teacher focuses on, what s/he does and asks students to do, and what points are set aside or rejected. In Chapters 4 (Physics) and 6 (Australian History) I consider in some detail what each teacher did in selected lessons. It is obviously important to relate these lessons to the teachers' practice more generally, and I go on to discuss how representative they were, and how individual teachers' practice relates to their framing of the curriculum. At this point I call on evidence from the considerable number of other lessons I saw each teacher give.

**What students learn**

The project also incorporated two exercises which students were asked to complete at the beginning and end of the year in which I observed them. These exercises were designed to provide material for evaluating the significance of differences in teachers' discourse and practice. Do teachers actually make a difference to how their students understand their subject?

This question opens up the issue of the relationship between teaching and learning, and what I have described as the pivotal role of the teacher in communicating the curriculum to students. It draws attention to what students learn about a subject - not what they retain of the content, but what they understand the study of the subject to be. In the previous discussion I have emphasised that I see what teachers teach as problematic. Correspondingly, I want to problematize what students learn.

Here I want to bring into view what teaching and learning make of the curriculum: the effects of teaching, rather than the effectiveness of teachers. I wish to discern the effects on students' understanding of different ways of representing content. Do different ways of constructing the same curriculum affect how students understand what is to be learnt? In terms of students' learning, the underlying question here relates to what is learnt: not whether or how much the students learn, but what they make of what they are studying.

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This means that it is inappropriate to compare the teachers I have observed primarily in terms of how effectively they have enabled their students to achieve some specified curriculum outcome. It would be possible to evaluate what students have learnt by using some standardized set of tests such as the IEA science achievement tests. This procedure is attractive, in that it would help us line up student achievement with the approach adopted by different teachers. We could say that teachers who spoke about physics or history in some particular way had students who learnt more than others. The problem with a closed approach of this kind is that it does not actually match the student's learning with the teacher's teaching. The comparisons which it enables assume that what varies is not what is taught, but how well it is taught. What is to be learnt is treated as unproblematic. Following his discussion of the differences between the two reading teachers, quoted earlier, Doyle argues that what is taught cannot be taken for granted, and therefore that "effectiveness is theory-bound":

An achievement measure, in this case recall of the text, reflects a theory of the content and thus defines the grounds for deciding effectiveness. In fact, there is some evidence in Green et al, that both teachers were effective in doing what they set out to do: the students learnt the content as represented. (Doyle 1986: 370; my italics)

Hence the inappropriateness of standardised testing as a means of discovering what has been learnt. As Doyle indicates, there is an assumed identity between what the test tests and what the teacher teaches. If we are to see what the student makes of what the teacher has taught, any test we use must be open-ended enough to be shaped by the student in terms of his/her expectations.

This may seem obvious, but it is rare to find a study which takes what is to be studied as problematic.

Studies of effective teaching, which focus on teaching practice, have tended to assume that there is common ground about what needs to be taught. Effectiveness is expected to produce student learning: effective teachers are compared to others in terms of how much their students have learnt, and more effective teachers are expected to produce more learning. Tobin, Fraser, Gallagher and their associates, for example, observed the teaching of teachers nominated to them as effective, in order to discover what practices were worth recommending to help other teachers to become more effective (see Tobin and Fraser (eds) 1987, Tobin et al., 1990).

Even where the focus of the investigation is stated in terms of what students have

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learnt and how they go about their learning, what they ought to learn is frequently taken as given. Both novice/expert and constructivist analyses can be seen to adopt this position.

Novice/expert studies focus on the differences between the problem-solving procedures employed by the novice and by expert; these differences are taken to indicate procedures which the novice should be led to change. Chi, Feltovich and Glaser (1981), for example, report that students tend to skip from observing the surface features of the problem to deploying formulae to arrive at the required conclusion, whereas experts classify the underlying structures of a problem and describe the relationships between the variables before invoking any mathematical statements. Psychologists Chi et al., like the physicist Fuller (1982), conclude that students will solve problems better if they learn to use expert-like procedures, which are taken to be both desirable and correct.

Constructivist investigators, by contrast, have argued that learning science involves the incorporation of meanings, and that students should be regarded as makers of meaning (see eg Pines and West, 1986). Their research programme seeks to “uncover student frameworks” (Driver and Erickson, 1983: 40). Studies in this tradition attempt to develop catalogues of the different ways students understand some particular phenomenon. Interviews with students (the “interview-about-instances” strategy) are used as the basis for inferring these alternative frameworks. The expectation is that a teacher who is aware of the possible ways their students will think about a given concept will be better placed to challenge and change their views.

The defect of these approaches, from the point of view of the present research, is that they define what the student does or thinks from the expert’s perspective. McClelland’s (1984) trenchant critique of constructivism draws attention to this difficulty. He argues that children’s ideas about physical relationships, far from constituting an alternative conceptual framework, may be hazy and undifferentiated; questioning children about concepts which are not salient to them may elicit deceptively systematic results.

How, then, can we determine what students have learnt; that is, what changes there have been in their apprehension of what is to be studied? I suggest that for this purpose it is useful to look closely at what students actually do when they tackle a specific task, rather than merely to ask them to describe how they go about it and

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what they see as being involved in it.

This conclusion seems to be supported by recent research into how students see their learning and the discipline they are studying, and how these views are connected to the learning context in which the students find themselves. Ramsden’s work is useful here. First, his findings support the idea that there is a connection between what students do and their perception of the learning context: students adopt an approach to learning (transformative or reproductive) as a response to what they understand to be required in a particular context, so that the student’s approach is a function of a situation rather than a characteristic of the student (Ramsden, 1988; see also Trigwell and Prosser, 1991, Biggs 1993). Second, they suggest a need to explore what students actually do and how they understand the requirements of actual academic tasks. Ramsden has not directly investigated the link between descriptions and practice. Part of the background to the present research project, in fact, was a somewhat anomalous finding from Ramsden’s later work on the relationship between students’ approaches to study and their assessment scores. In that study, in which I participated, it appeared that while students who identified with a "surface" approach to study regularly performed poorly, students who

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1 This work has consistently drawn on students’ descriptions of their learning environments, rather than investigating their experiences more directly. Trigwell and Prosser (1991) recommend that further research investigate actual contexts and content-related learning outcomes in more detail. They write:

"[T]he qualitative differences in learning outcomes variable... provided an indicator of the structural aspects of students' descriptions of their course. Future research may usefully focus on the referential (or content related) aspects of the descriptions... [Another issue] which we believe may be worth pursuing is the effect of context on the relationships at an individual level. What is the effect on individuals of one context which encourages deep approaches and another which encourages surface approaches?.. [M]ost of the previous research has examined student perceptions and evaluations of the learning contexts, but most (including the studies reported in this paper) have not provided substantial descriptions of the context... Future research may well focus on the effects of different contexts (with substantial descriptions of the contexts), and not just on perceptions and evaluations of such contexts. In future research, it is this set of relations between approaches, perceptions and outcomes which we believe is most important for practice and requires substantially more research." (263)
identified with statements reflecting a "deep" approach did not necessarily do well (Ramsden et al 1988). This anomaly may have been the result of the way the students were assessed; alternatively, it may have been that students who aspired to a "deep" level of understanding did not always achieve it. Survey and interview data were not enough to determine what these students actually did when they were studying, and how they interpreted the requirements of the tasks they were set.

The work of Marton and other phenomenographers offers an analytical method which is oriented to the learner's perspective and practice. Marton argues that the outcome of learning is most appropriately expressed in terms of the learner's conception of the phenomenon: "learning is always the learning of something". A phenomenographic analysis of what is learnt involves forming categories to represent how the learners have structured the material. These categories are derived directly from the students' responses to a problem. Marton and Svensson argue (1979: 480-481) that this approach allows for apprehension and understanding of how the learner interacts with the context, and enables the researcher to appreciate how qualitatively different learning outcomes are arrived at, in terms of the learner's own conceptions. It should be emphasised that the context here includes the actual task.¹

As well as observing what happened in the classroom, therefore, I asked students in each of the classes to describe what they did and how they went about it, and to tackle some open-ended problems in their discipline.²

At the beginning and end of the year, the students responded to a set of tags prompting them to describe what they aspired to in studying the subject, what they did when they were studying, and what they did in class; at the end of the year, I also asked them to describe what the subject had been about. This task elicited explicit statements about what the students were studying, which formed the basis

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¹ As Säljö and Wyndhamn (1988a) elegantly demonstrate, students' perceptions of what is expected of them in relation to a particular task can have a striking effect on how they structure their response. This point is discussed further below.

² Appendix 3 gives the text of the tasks and prompts I used. The teachers in the case study very kindly allowed me to administer these tasks in class time, so that virtually every student attending class completed them.
for an analysis of their conceptions of what was to be studied.

In addition, I asked the students to tackle open-ended problems in their discipline - open-ended, so that the issue was not whether they arrived at a correct answer, but what they discerned to be the appropriate way of tackling the problem, and what relationships they saw in the situation described in the problem. A similar approach was successfully used in relation to mathematical ideas by Säljö and Wyndhamn, in the studies I have cited above; by Marton, in relation to students’ ideas about learning; and by Bowden and his colleagues, specifically in relation to students’ ideas in physics.

In Physics, I asked the students to respond in writing to a set of qualitative problems, described as "physics problems". The problems used were framed in a similar way to past extended-answer questions in the Year 12 VCE exam, for which all the students in the study were preparing. They were selected from a group of twenty problems used in the Conceptions in Physics project (see Bowden et al, 1992, dall' Alba et al 1993, Ramsden et al 1993, Walsh et al 1993). The questions are sufficiently open-ended to be accessible and challenging to students with a range of prior experience. Each problem calls for students to discuss an everyday situation in terms of principles and ideas which seemed likely to appear early in any senior school Physics course. In the previous research they had been used in an interview format with both Year 12 and first year university Physics students; for this research, they were trialled in pencil and paper form with students completing Year 12. In every case a range of understandings was elicited. The two pairs of problems chosen for the study each included one problem turning on Newton’s Third Law, and one involving relative velocities. All the students had had experience of mechanics problems involving forces and velocities in Year 11.

These problems were administered in a cross-over design. At the beginning of the year half of each class did one pair of problems, and half the other; at the end of the year, they all did all four problems. I reasoned that this would enable me to control for any effect of familiarity, and at the same time make it possible to see whether students changed their approach to a particular problem.

My purpose in getting students to tackle these problems was two-fold. I wanted to find out how the students understood what was required: what they focused on about the problem, in attempting to provide an answer to it. In this aspect of the analysis, their answers could be understood as manifesting different conceptions of

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physics. Secondly, I was interested in the images of physics principles which their responses displayed. My procedure here followed the model offered by the Conceptions in Physics project, though my analysis was conducted independently of their findings.

In History, I devised two exercises, modelled on a diagnostic exercise developed by Peter McPhee for first year students at the beginning of their study of history at the University of Melbourne. The exercises required students to read a brief passage from an historical text, and then to answer a set of open-ended questions. Because the four classes in the case study had no common topic in Australian History, the extracts were deliberately set outside Australian History. One, an extract from Hinton's *Fanshen*, focused on the changes in women's role in Chinese society following the Communist Revolution, as exemplified by a conflict between a woman and her husband where the woman successfully insisted on her right to attend public meetings (Hinton, 1972). The other was an extract from Garrioch's *Neighbourhood and Community in Paris, 1714-1790*, in which Garrioch discussed the function of public quarrels, illustrated by an animated reconstruction of a dispute between the wife of a public writer and a pawnbroker (Garrioch, 1986).

I asked students to do these exercises primarily to discover what they attended to when they read an unfamiliar historical text. In both cases the questions I asked were designed to give students an opportunity to reflect on the argument propounded in the text; to identify the structure of this argument; to speculate on the outcome of the story and the purposes of the writer; and to locate the extract within a more general frame of reference. In analysing the responses, I again adopted a phenomenographic approach, looking to see what the students focused on in reading the text, the frame of reference they used, and their positioning of the author in relation to the events and arguments propounded in the text.

There remains the problem of significance. Measuring what students learn in a particular class necessarily involves relatively small numbers of students over a relatively short period of time. This gives rise to statistical problems with sampling, variability, and reliability. Students come into class with previous experiences and expectations, which are likely to vary both within and between classes. Within any particular class, students are likely to have more or less relevant experience of the subject, to be more or less motivated, more or less interested, more or less oriented to the way in which any particular teacher presents the study of the subject. They are unlikely to respond in a uniform way to the approach of a particular teacher -

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indeed, if they did, standard assessment practices would be unable to discriminate between them. Given this degree of variability, there are likely to be too few students in any one class to constitute a sufficient number for a statistically reliable result. Additionally, there is the problem of continuity and the time frame for change. We know that at least in relation to scientific ideas, students typically sustain the same beliefs over a long period of time (see the research summarised in West and Pines, 1985, and Scott, Asoko and Driver, 1991). It is, however, logistically difficult to mount a longitudinal study of the effect of a particular teacher on his/her students' learning. The structure of secondary schooling in Victoria, and arrangements for allocating staff and grouping students, make it unlikely that the same teacher will have the same class for more than a year - though just to confuse the issue, if we choose to focus on a single year, we are likely to find that there are some students in some classes who have already been taught by the teacher being observed. The cross-over before-and-after design I adopted was an attempt to control for such differences in the starting points of different students and classes.

In view of the limitations I have described, I offer the results of these exercises as a starting point for understanding the kinds of learning which went on in different classes, rather than as a definitive measure.

Study at Year 12 level

Why select Year 12 as a point of entry for the project? There are features of Year 12 study which create difficulties for research. Year 12, the last year of post-primary study in the Victorian school system, culminates in an assessment which is the student's gateway to tertiary study; it is a sensitive period for teachers and students, and one where teachers say they are under pressure to produce results and therefore may not teach quite as they would like. There is little elbow-room in the timetable, and it would be inappropriate for a researcher to involve students in discussions which do not bear directly on the work they are expected to do for their course.

My main reason for choosing to focus on Year 12 study, despite these apparent disadvantages, was that it offered a common curriculum. In a project which investigates the notion that teachers develop their own readings of the curriculum it is obviously important that the curriculum is itself held constant. At the time of my fieldwork (1990-1991), curriculum in the Victorian school system was school-
based, within Ministry of Education guidelines (booklets called Curriculum Frameworks) within which teachers were expected to plan their units of work.\footnote{This description applies to the curriculum current at the time of the research; in 1997, when this account was written, there were signs of movement towards a substantially more centralised curriculum.} Year 12, the final year of post-primary study, was the only year level where there was anything like a common curriculum: a majority of Year 12 students studied four or five of the so-called Group 1 Higher School Certificate subjects, which were centrally prescribed and externally examined.\footnote{In 1990-91 there were four Year 12 certificates on offer, of which the Higher School Certificate (HSC) had the largest number of enrolments, the others being the Schools Year Twelve and Tertiary Entrance Certificate (STC), the Tertiary Orientation Program (TOP), and Technical Year 12. Group 1 HSC subjects were externally examined and almost all counted towards tertiary admission. Group 2 HSC subjects, which were less commonly taken, were internally assessed, and were differentially treated by the tertiary institutions. In 1992 a new Victorian Certificate of Education, an amalgamated and revised curriculum for years 11 and 12, replaced all four certificates; pending its introduction, the four certificates were notionally under its umbrella from 1990 onwards. In 1990-1991, however, the old HSC curricula were still followed in Physics and Australian History, as I describe here. They were replaced in 1992 by common "study designs" in all approved VCE subjects at Years 11 and 12.}

Although there was still some leeway in the curriculum for the two HSC subjects I selected, and some internal assessment, both subjects had a common core on which students were externally assessed. In Physics the bulk of the work was on a body of theoretical principles, dealing with classical mechanics, light, waves, electricity, and atomic and nuclear physics.\footnote{Study of the HSC Physics course was expected to be spread over two years, and teachers varied in the way they divided topics between Year 11 and Year 12. The topics mentioned were all taught for the first time in Year 12 in the schools I visited. Even where topics in the course were introduced at Year 11, however, they were likely to be reviewed in Year 12, if only because they were included in the examination.} In Australian History the designated common core of the course was made up of the concepts and skills which students are expected to acquire from their study of it, not by a commonality of content.
students were asked to study three "core" topics, chosen from a list of seventeen, ranging from the history of Aboriginal life in Australia prior to European settlement to Australia's experiences in the two World Wars of the twentieth century. In Physics, then, it was possible to identify topics which would be touched on by all schools at some point in the year (eg circular motion, simple harmonic motion, nuclear physics, electro-magnetic fields); in Australian History, while no single topic was taught by every teacher, all teachers were expected to deal with the "core concepts".

The established status of the Year 12 course is also important. I am proposing that at any given time teachers will be culturally positioned in different contexts, and hold different ideas about what it is important to teach, so that the same subject will be constructed differently. It is easier to see whether this is so if we look at what teachers do when they teach an established subject, rather than an innovation which they are only beginning to introduce. Both Australian History and Physics had been in place for a decade, with an apparatus of briefings for new teachers, sets of past examination papers, and examiners' reports and feedback meetings. Diversity in the context of these external pressures seems likely to be particularly significant.

These observations were timely. Since the moment of my study, curriculum change has been introduced across the schooling system in Victoria. As in other schooling systems around the Western world, there has been pressure on teachers to accommodate to a new and more prescriptive curriculum and more tightly specified learning outcomes. This study opens up some of the implications of different ways of reading and rendering curriculum.

Finally, and at a more general level, study at Year 12 has a wider social significance. Students continuing into tertiary study draw on their schooling to make choices about what they will study further. For other students, Year 12 is the final year of their formal engagement with academic study. If, as I have argued, the school is a significant cultural site, all these students will carry into the adult community images of history and the humanities, physics and the sciences, which will colour their career choices, and which may well persist over a lifetime.

**Why Physics? why Australian History?**

Before concluding this discussion, I want to explain why I have chosen to focus on the study of Year 12 Australian History and Physics.

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Part of my intention in considering two subjects, rather than one, is to make it possible to see whether teachers' ideas can notionally be generalised as ideas about "school knowledge", or whether they are indeed discipline- or subject-specific. For this purpose it is important to take two subjects which are reasonably remote from each other. Physics and History are a familiar pair of subjects, frequently offered as representative of the sciences and the humanities respectively (see for instance Holley 1974; Becher 1989a, 1989b, 1990). Until relatively recently it was usual to see them as a contrastive pair, with the law-like, observational knowledge of physics set against the socially-oriented and contingent knowledge of history. Work on the social construction of scientific knowledge and the potential significance in science teaching of the history of science has reduced the distance between them at a theoretical level,¹ but as school subjects they attract different populations, employ different discourses, and enjoy dramatically different status.²


2. During the 1980s Australian History was a popular non-compulsory Humanities subject in the Victorian HSC, taken by a high proportion of female candidates, proportionately as many as boys taking Physics. It did not have equal status and students taking it did not attain equivalent marks. At Victorian universities, Physics was a required subject for the prestigious faculties of Medicine and Engineering, and had traditionally been granted higher marks and more As than History subjects (20% of candidates in Physics were typically awarded As, compared with 8% in Australian History). Raw examination scores were "standardised" to produce these distributions by a complex procedure which involved taking into account students' scores on other subjects they were taking. An analysis of the distribution of raw and standardised marks over the five years 1986-1990 shows that Australian History marks were normally distributed both before and after standardisation, whereas what appears to have been a standard distribution of raw scores in Physics, across the marking categories A to F, became a roughly rectangular distribution across only five categories (ABCD and Fail). Underpinning this alteration in the distribution was a correlation between results in the four "hard science" subjects (Chemistry, two Maths, and Physics), which were frequently taken together (Teese 1989), and which had a common quantitative basis and some common topics. All four had a similar rectangular distribution of marks, whereas other VCE (HSC) subjects had a normal distribution. See the Victorian Curriculum and Assessment Board Annual
One measure of this last point is the share of research attention they each attract: there have been innumerable studies of students' learning in physics, but only a handful dealing with students' learning in history.

My reason for selecting physics, in particular, is this bulk of research, which indicates that there are some unresolved problems in the teaching of physics. Over the past ten years studies of students' science learning have repeatedly found that a considerable proportion of students retain concepts of scientific relationships which conflict with the scientific principles they have supposedly been learning. White (1988) reviews the literature current at the time of my observations, which included studies of student conceptions in relation to light, optics, heat, energy, electricity, gravity, force, motion, acceleration, and magnetism.1

Centres of research such as the Children's Learning in Science Project group in Leeds, the Learning in Science Project group in New Zealand, and the Science Education group at Monash University in Melbourne, have focused largely on tackling this problem through raising teachers' awareness of how children learn science. The prime idea being advanced has been labelled "constructivism". As expressed by its leading exponents (eg Driver and Ericksen 1983, Driver and Oldham 1986), this theory holds that knowledge is constructed by the individual. Children spontaneously develop (or "construct") explanations for the natural world; teachers need to be alert to the existence of these unspoken theories, and present new material in such a way that children are enabled to rethink them. Proposals to amend what teachers do when they present material have been developed and trialled by both the CLISP and LISP groups, but so far the results have been disappointing. The indications are that in trial classes children's enthusiasm for

---

Reports of Examiners for details of results by subject. These differences in outcomes were historically fixed - they have persisted in the Victorian system virtually unaltered since at least the late 1970s, supported by a mythology about the capacity of the examination system to discern students' underlying intelligence irrespective of subject studied. Physics is regarded as "harder" than history. See VISE circulars no 4, July 1979, and no 45, October 1983, for the basis of the standardisation procedure, and Masters (1986) for a critique of its assumptions.

1 Duit maintains a bibliography of research into physics learning, available on the PhysLrnr website <ftp://physlrmr.idbsu.edu/pub/physlrmr> (Reinders and Duit 1998).
science may have increased, but their grasp on the principles being taught has not improved (see for instance Osborne 1982, Kirkwood and Carr 1988, Johnson 1988, Baird et al 1991).

Reflecting on this problem, Baird et al (1991) suggest that science teachers are bound by a monistic conception of scientific cause which has made it difficult for them to apply a pluralistic, relativistic conception to their own development:

Conceptions of the nature of successful teaching as law-governed and generalizable need to change to ones which view it as developing in a constructivist manner through a process of individual reflection on personal life experiences... (Baird et al, 1991: 181)

The suggestion here is that science teachers apply their notion of scientific knowledge as law-governed and generalizable to their own practice, in a way which makes changing their practice relatively difficult for them. The project team interpret this observation to indicate that science teachers need to become more aware of the processes of teaching and learning. It seems to be taken for granted that science teachers will think about scientific knowledge as law-governed and generalizable, even though this conception of scientific knowledge would seem to be dissonant with the conception the researchers are using themselves.

In this study, as in several others (eg Johnston 1988, Cronin-Jones 1990), the teacher’s conception is interpreted as a barrier to learning. My project reverses this perspective, looking instead at physics as the teacher teaches it. In relation to what students have learnt, this offers a starting point in what they have been taught.

At the time of my fieldwork, there was no corresponding mass of concern about student learning in history, or Australian history, though Halldén had undertaken some pioneering work observing early secondary classrooms (Halldén 1983, 1986), and Shemilt had evaluated the History 13-16 project (Shemilt 1980; see also Boddington 1984). There had, however, been considerable debate about what ought to be taught in history. In England this focused on the national curriculum, which was being developed at the time and which appeared likely to take the form of a tightly specified knowledge-based structure (cf Samuel 1989, Little 1990). A more low-key debate accompanied the development of the VCE Study Design in History in Victoria, which adopted a conceptual approach; in interviewing teachers I detected a rumbling of discontent with the focus on concepts and method which dominated the old Group I HSC curriculum. I would argue that the teaching and learning of history deserves more research attention, and that teachers’ ideas about it.
are worth opening up for discussion.

I turn now to how teachers described the study of these subjects.
CHAPTER 3
What is your subject about?

I have proposed that the teacher's work intrinsically involves structuring and interpreting the subject for the student, and that how teachers do this cannot be inferred directly from the curriculum. Rather, the delivery of the curriculum - what students are taught, and how they are asked to learn - is critically related to the teacher's conception of the subject and how it is learnt. This chapter explores how teachers represented the study of physics, and the study of history, in the context of Year 12 VCE (HSC) Physics and Australian History.

The word "subject" here faces two ways. A subject may be seen as located within the discipline, or intellectual tradition, to which its name refers. From this aspect, the study of a particular history or physics curriculum means learning what it is to study history or physics: students are inducted into the discourse of the discipline. At the same time, a particular subject, or course of study, brings students into contact with the discipline as embodied in a particular curriculum, at a given level and with particular assessment requirements. Thus the process of implementing (or re-presenting) curriculum requires a turn from the study of a discipline, broadly conceived, to the study of a syllabus. If we apply Bourdieus's notion of the contested field to the determination of this particular syllabus, we can see conflict over curriculum content as part of the struggle by which the discipline is defined. The participants contest the curriculum as a representation of the study of the discipline.

I therefore begin my discussion of each subject with an account of the contextual demands which the teachers of the subject had in common: current debate about the subject, the course guide, assessment requirements and examination questions, and the expectations of the examiners as expressed in their annual reports. I want here to develop a reading of the focus of the syllabus to which teachers were working, as expressed in the course guide and the examination. What was to be studied? How was it to be studied? What kind of knowledge was being proposed, and what was involved in students attaining it? My account of this context is neither representative nor privileged; it stands as an introduction because all the teachers I interviewed operated in this context, though they did not necessarily interpret it as I have done, or in the same way as each other.

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I then turn to the material from my interviews with Year 12 Physics and Australian History teachers, and analyse what these teachers said about the study of their subject. How did they characterise knowledge in physics, or history? How did they represent the relation between their students, and this knowledge?¹ In this part of the discussion, I develop broad categories, based on what teachers focused on in describing what was to be studied, and the verbs they used to express their students' relation to it. In later chapters I consider in more detail how these representations were embodied in what the individual teachers participating in the case studies had to say about the study of their subject, and the way they constructed learning for their students.

In the last section of the chapter, I discuss differences and commonalities between the representations of knowledge and learning, as I have categorised them, between the physics and history teachers.

I discuss physics and history separately, following the same pattern for each. First, Physics.

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¹ As indicated in Chapter 2, these interviews were semi-structured. See Appendix 2 for the detail of the interview protocol to which I worked.
The study of Physics

What would you say your course this year has been about? (It might help to imagine that you’re telling a friend what your Physics teacher has most wanted you to learn.)

Me: Hey Glyn, Mr _____ wants us to learn the entire contents of this bloody huge physics book and do all the questions twice.

Glyn: How nice, Phillip! (School P2, Phillip, T4)¹

Reviewing developments in the teaching of physics in Australian schools up to 1988, de Laeter (1989) concludes that

senior school physics in Australia has often been taught from a mathematical perspective with little attempt to relate the subject to the real world. Problem-solving may in fact often be no more than inserting values in formulae (de Laeter 1989: 453).

According to de Laeter, the hands-on, experience-based exploratory learning which was prominent in the rhetoric of the Nuffield schemes did not penetrate teaching practice in Australia.² The main changes to traditional schemes of work were conceptual reorganisations, based on the US PSSC courses of study, which "influenced how physics should be taught, rather than what should be taught". Intensive observation of teachers in some Western Australian schools led Tobin and his colleagues to conclude in the late 1980s that Australian science teaching was short on reflection and discussion (see eg Tobin and Gallagher 1987, Tobin et al. 1990).

There was, however, a good deal of lively debate throughout the 1980s, not only about how physics ought to be taught, but also how the subject should be defined. There were academics in teacher training institutions in Victoria, as elsewhere, who focused particularly on the teaching of science, and the need for teachers to become

¹ I identify each school by a number and each teacher and student by a pseudonym. The prefix H stands for History, and P stands for Physics. In this chapter quotations from teachers are from interviews, and the student quoted was responding to a question in the exercise he completed in Term 4 (T4).

² Similar findings for Canada are reported in Ben-Peretz and Menis (1986), who surveyed a large population of science students in Canada in 1985; they conclude that “the most prevalent conditions of learning are the most traditional”.

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aware of the understandings their students brought to the classroom. Of especial relevance to the Year 12 Physics course with which we are concerned, an early publication in a sequence of studies by Richard White and his colleagues reported the difficulties of a 1980 cohort of Monash University science students, most of them successful students of this course (see eg Gunstone and White 1981). White and his colleagues concluded that the course was not ensuring that students understood what they were doing. Partly arising from this work, but also connected with concern over the low proportion of girls enrolling in senior school science subjects, a network of interested teachers and academics discussed issues relating to girls' involvement in science, especially focusing on means of giving girls appropriate experiences and making scientific concepts in physics and chemistry seem relevant to their concerns. At the same time, other Monash scientists (prominent among them the Dean of the Science Faculty, Peter Fensham) were arguing for a redefinition of science as a school subject. Rejecting the positivist notion of science as an accumulated body of truths, they advocated a new, broadly based course in physical science which would explicitly bring into view the purposes and functions of scientific study, and its social implications. Although such a subject was accredited and made available as a Year 12 study in Victorian schools, it was not recognised for tertiary entry by some prominent local universities, and never attracted a high enrolment.

These debates point to some different ways of reading the purpose and content of physics as a school study. In itself, this suggests that the Year 12 Physics curriculum was at least potentially problematic. As I shall show, there are indications even within the curriculum documents of conflicting views about what should be taught and how.

**The Victorian Year 12 Physics course**

Compared with the Physical Science subject I have mentioned, the Physics subject which was current from 1980 to 1991 was a conservative option. When it was first accredited by the Victorian Curriculum and Assessment Board (VCAB) in 1980, it was very like the PSSC-based course which it replaced. The core content, to be covered in eighteen weeks of study, was described in terms of a series of topics under the general headings of Mechanics, Light and Waves, Electricity and
Magnetism, and Atomic and nuclear physics.\footnote{Mechanics: Straight line motion, forces and energy, gravity, projectiles, circular motion, simple harmonic motion, momentum (including Newton's Third Law); Light and waves: rectilinear propagation, reflection, concave mirrors, refraction and dispersion, convex lenses, particle model for light, waves in one and two dimensions, wave model for light, the photoelectric effect, electro-magnetic radiation; Electricity and magnetism: DC circuits, electric fields, magnetic fields, electro-magnetic induction, AC electricity, household electricity; Atomic and nuclear phycis: structure of the atom, radioactivity and X-rays, nuclear fission.} Work on the core was assessed internally on the basis of students' performance on practical exercises and tests (20% of the final assessment), and externally on the basis of students' performance on a multiple choice and calculation-based paper (50% of the final assessment). Work on two optional topics, chosen from a list of eighteen, was to take an additional nine weeks, and be internally assessed (30% of the final assessment). Internal assessment was standardised against external assessment by bringing the mean and standard deviation of internal assessment scores to match the mean and standard deviation of the class's external assessment scores.

This course was slightly amended and reaccredited in 1987. The main modifications in the reaccredited course involved the application of physics principles to "everyday phenomena". Suggested examples and applications were appended to each theoretical topic, and extended answer questions were introduced to the examination. Figure 3.1, on the following page, illustrates the way in which topics were presented.

This presentation moves from theoretical topic to theoretical proposition, and thence to appropriate examples. The logic of this sequence was followed by the textbooks commonly used in teaching the course. Everyday applications were represented as examples in a context of the exposition of theory. The focus is on a series of theoretical propositions within a body of established knowledge.

\footnote{Patrick KA (1998) \textit{Teaching and Learning: the construction of an object of study}}
<table>
<thead>
<tr>
<th>Content</th>
<th>Explanatory notes</th>
<th>Examples and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.1.6 Simple harmonic motion (SHM)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential energy stored in a spring.</td>
<td>The trigonometric equations of SHM are not required.</td>
<td>spring systems</td>
</tr>
<tr>
<td>Simple harmonic motion.</td>
<td>Students should know that SHM occurs when the resultant force can be described by $F = -kx$.</td>
<td>vibrating systems (including molecules in solids)</td>
</tr>
<tr>
<td>Use of the relationships</td>
<td>$T = 2\pi \sqrt{\frac{m}{k}}$ and $V_{\text{max}} = \frac{2\pi a_{\text{max}}}{T}$</td>
<td>car suspensions</td>
</tr>
<tr>
<td></td>
<td>is expected.</td>
<td>musical instruments</td>
</tr>
<tr>
<td></td>
<td>Students should be familiar with the general shape of the $x$-$t$, $v$-$t$ and $a$-$t$ graphs.</td>
<td>mass measurements in free fall situations (eg Skylab, Salyut 7, Space Shuttle in orbit)</td>
</tr>
<tr>
<td>Students should be able to use the principle of conservation of energy expressed by</td>
<td>$\frac{1}{2}mv^2 + \frac{1}{2}kt^2 = \text{constant.}$</td>
<td>balance-wheel (spring) based clock system</td>
</tr>
<tr>
<td></td>
<td>The approach to SHM via the projection of uniform circular motion is not required.</td>
<td>pendulum-based clock system</td>
</tr>
<tr>
<td></td>
<td>Analysis of pendulum motion as approximate SHM is not required.</td>
<td>playground equipment</td>
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<tr>
<td></td>
<td></td>
<td>spinning wheel, potter's wheel</td>
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<tr>
<td></td>
<td></td>
<td>treadle sewing machine</td>
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<td></td>
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<td>pistons</td>
</tr>
</tbody>
</table>
This reading is supported by the course booklet's description of the purposes of the course. This description implies that students intending to pursue the study of science were properly concerned with pure theory and did not need to attend to "everyday applications". The explicit introduction of everyday examples in 1987 was represented as appropriate in the context of demands that the course be made relevant to students for whom it was a terminal course - those who would not go on to the tertiary study of physics.

The course is designed to satisfy the needs of several groups of students, including those not intending to follow specifically science-based studies or careers, and those intending to do so. To meet the needs of these various groups, the course attempts to cover a range of physics sufficient to give some understanding of common everyday phenomena, technology, and related issues of public concern. In addition, the course is designed to enable some insight to be gained into the nature of physics as a discipline. The course is thus one in physics, rather than in applied physics or technology, but the content has been chosen with its application to everyday phenomena clearly in mind.

Note the distinction between "physics" and "applied physics or technology".

The objectives set out in the course description booklet confirm that the main focus of the course was on teaching students to handle and apply established concepts. Overall, these objectives suggest that the object of study and students' relation to it were regarded as transparent.

The six objectives were sequenced so as to move from concepts to practical applications:

1. to develop in students a knowledge and understanding of concepts of physics appropriate to study at this level.

2. to develop in students an awareness of the relevance of physics, particularly to common phenomena and to technology.

3. to develop in students the ability to enquire about, propose, discuss and communicate ideas of physics relating to concepts and problem situations, particularly those relevant to common phenomena and to technology.

4. to develop in students the ability to use the language and conventions of physics and its accepted methods of analysis.

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5. to develop in students the ability to design and carry out appropriate practical experiments in physics.

6. to develop in students an appreciation of the development of the concepts and theories of physics, the role of scientists in this development, and of the continuing development of the subject.

(VCAB 1987a)

In these objectives, physics is represented as a body of knowledge, distinct from the "common phenomena and technology" to which it can be applied (Objective 1). It is an entity with its own history (Objective 6). Its language and conventions constitute an independent system, unrelated to the meanings students may attach to them (Objective 4). Students are at arms length from this knowledge. They are to acquire a limited amount of the knowledge of physics, and they do not contribute to it (Objectives 1 and 3). They must learn to "use" its system of meanings, and work within its conventions (Objective 4). Though the notion of "development" suggests that students' apprehension of the concepts in the course is not automatic, there is no indication of the process by which it was to be "developed".

Turning to the requirements of the examination, we find that "theoretical understanding," was primarily assessed by multiple-choice or calculation-based questions which asked students to solve problems with a missing variable. The course booklet described these questions as "very similar in style to previous examination papers in this subject, dating back to 1966"; they were said to test the student's knowledge and understanding of concepts in physics and his/her ability to use the language and conventions of physics (objectives 1 and 4), presented in relation to common phenomena and technology (objective 2). "Up to five" additional extended answer questions (counting for about 10% of the final mark) were introduced in 1987; these questions were to test candidates' capacity to expound and explain physics concepts (objectives 1 and 3). The paper was said also to include some assessment of objectives 2 and 6, but it is not clear how this was to be achieved.¹

In the annual examiners' reports, physics theory was regularly represented as a body of knowledge which was to be mastered through emphatic repetition, rather

¹ Objective 5, relating to practical work, was left to teachers to carry out and assess.

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than as understandings which were to be achieved by interpersonal effort. Examiners reflecting on the performance of students in 1987, for instance, commented:

The understanding of Newton's second law (ΣF = m a) seems deficient. This has shown up constantly over the last couple of years and was indicated in a number of questions. Perhaps teachers should emphasise more strongly that a resultant force produces an acceleration, and that if there is no resultant force there is no acceleration. PSSC placed great emphasis on the concept of 'unbalanced' that is resultant force, and this emphasis might have been lost. Newton would certainly turn in his grave if he realised that even 400 years after his death, students still believed that a resultant force was necessary to maintain motion!

(QQ 19-20) These questions tested candidates' ability to handle simple force-vector situations, and their understanding of Newton's laws. They were intended to be among the more demanding questions on the paper... Question 20 was correctly answered by 34% of candidates. The most common incorrect response was clearly chosen by candidates who thought the forces must be in balance. This showed a lack of appreciation that because the mass was accelerating, there must be a resultant force on it.

(VCAB 1987a Physics: 3, 5)

Similarly, examiners in 1988 related an apparent improvement in students' understanding of the difference between a travelling wave and a standing wave pattern to teacher emphasis:

The difference between a simple travelling wave and a standing wave pattern (which is the one-dimensional interference pattern produced by two identical travelling waves moving in opposite directions though a medium) has been poorly understood in recent years. The very satisfactory response to these questions (35-37) therefore was most pleasing, and it is obvious that teachers are emphasising this point - an understanding essential to later understanding of more complex wave theory.

(VCAB 1988a, Physics: 4)

It should perhaps be pointed out that examiners could only discern students' "understanding" in this context from their choice of the correct option in each multiple choice question. "Understanding" here is measured in terms of the student's capacity to answer correctly. Even open-ended questions were assessed in this manner (one mark being allocated for each "correct point" listed).
examination as rendered here can plausibly be read as principally concerned with the effective handling of definitions and the corresponding formulae.

There was a significant shift in the Examiners Report in 1989, with the appointment of a new Chief Examiner. In particular, there was a greatly increased emphasis on qualitative understanding, contrasted with the manipulation of formulae. Further, the attainment of this qualitative understanding was represented as problematic. Newton was no longer likely to turn in his grave when students did not understand his First Law. Rather, the 1989 examiners' report concluded that

it is likely that no degree of effort by teachers will completely eradicate the pre-Newtonian concept that a force is required to keep a body moving... There are many questions that give evidence of the fact that although candidates can recall and use the formulae that are part of physics, they do not understand the concepts behind them... It is not the examiners' role to indicate the techniques that might help in transferring the concepts and depth of understanding to students; however teachers should be aware that the examiners will continue to devise questions that will test the understanding that students have of physics, and will not deliberately provide the option for candidates to plug in numbers to standard formulae.

(VCAB 1989a, Physics: 2. Emphasis in original)

Though this report still spoke of "transferring" concepts and depth of understanding, it represented the process as problematic rather than simply requiring more emphatic presentation by the teacher. Further, it clearly distinguished between recalling and using formulae, and "understanding the concepts behind them". Compared with its predecessors, this report embodies a different, more active conception of the relationship between students and the material of the Physics course.

Even within the course description, the framing of one of the options points to a tension between different ideas of what was involved in the course. This option, the Extended Experimental Investigation, was the first of the eighteen options available in the course. It required students to plan, execute and formally report "an extended experimental investigation in physics appropriate to Year 12 level". Work on Option 1 involved students in practical work in a way which differed significantly from what was required for the core, and the practical work they had to do was given quite a different meaning.
In the core curriculum, teachers were responsible for setting and evaluating practical work, but the course description provided extensive guidance and suggested assessment criteria. The three most highly weighted features of students' prac performance in the core were to be "a good understanding of the applicable theory", effective report-writing, and capacity to analyse and interpret experimental data and results. In all, thirteen marks out of twenty were to be allocated to these three criteria, two marks to accuracy, and one mark each to awareness of constraints on accuracy, safety, ideas about experimental design, efficiency, and groupwork. Practical work was expected to illustrate particular theoretical principles - a list of appropriate tasks for each topic was provided in an appendix to the course description.

In Option 1, by contrast, the objective of practical work was to explore and evaluate hypotheses which the student had formulated (either alone or with the teacher's help), and a significant part of the task was to devise an appropriate experimental design. In favour of this option, it was said that "for many students [it] will provide the only opportunity for realising a number of the stated objectives for Physics" (italics in original). In terms of the course objectives:

**Objective 3** This exercise may be one of the few times, or more likely the only occasion, when a student will be asked to propose a real problem situation and invited to outline a specific method of solving it. *It must be admitted that most class and laboratory time is normally given to understanding the concepts and constructs of the subject,* leaving very little time for an experimental exercise of this nature which will ensure that the student discusses and enquires into ways of solving a simple research problem...

Furthermore, such an exercise will very likely be the only experience the student may have during an entire school career of communicating ideas and findings by means of a formal report.

**Objective 5** This course will give students possibly their only opportunity to select a research exercise, develop their own experimental design, identify the problems they encounter, decide how these may be circumvented and analyse the data they assemble. This unique experience aims to help students to become better at doing physics rather than to teach them more physics.

**Objective 6** Most of the developments in science have been based on experimental research. In the laboratory, time is given to experiments which are essentially 'structured learning exercises' or 'self-demonstrations' in which carefully designed apparatus is provided, which limit the 'wrong' paths of investigation and steer students towards the ideas which the teacher hopes

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will emerge. *This research exercise may very well be the only personal experience of real science in action* that the students encounter in their entire secondary education.

(VCAB 1987a: Option 1, pp 22-23. My italics.)

These references to course objectives imply a critique of the "normal" way of construing the course. Objective 3 is read to imply that students ought to have experience of developing a proposition for investigation, Objective 5 to imply that they should design and execute the corresponding practical work. These are objectives which the "core" work is said not to fulfil. Work on this option is described as "doing" physics, rather than learning physics - it constitutes an experience of "real science" which opens up the possibility that students will begin to understand science as an activity, not just as a body of theory. It will be recognised, of course, that these arguments were composed by the author(s) of the option, who hoped to persuade other teachers that it was worth doing. Nevertheless, they communicate a clear image of the orientation of work in the Physics "core" towards "structured learning exercises" focused on "the concepts and constructs of the course", together with a counter-view that there should be more to learning science than this.

I do not suggest that by including this option the Physics course embraced a radical internal discontinuity. The author(s) of the option did not reject the model of "learning physics" which was represented in the core part of the course, and the option itself called for hypothesis-based investigation in a traditional empirical style. Within the framework of the declared objectives of the Physics course, however, this option's shift of focus towards scientific practice offered students an object of study which differed significantly from the object of study in the core part of the course, and positioned students as investigators rather than as recipients of knowledge. The availability of this option indicates a divergence of view about what ought to be involved in the study of physics, and different approaches to studying and teaching it.

How, then, did teachers of this subject represent what their students were to study?

**Teaching Physics**

Three conceptions of the study of physics were visible among the teachers I interviewed. Broadly, they involved seeing physics as the management of algorithms, physics as a body of theory, and physics as a means of understanding the natural
world. As shown in Figure 3.2, each of these conceptions embodied both a representation of physics as an object of study, and a representation of what is involved for students in studying it.

Figure 3.2 Conceptions of the study of physics

<table>
<thead>
<tr>
<th>What is to be studied</th>
<th>How students relate to it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of algorithms</td>
<td>Cover, use, do, work out</td>
</tr>
<tr>
<td>Body of theory</td>
<td>Recognise, apply, sort out, simplify</td>
</tr>
<tr>
<td>Natural world</td>
<td>Feel, see, rethink, re-interpret</td>
</tr>
</tbody>
</table>

The first category of teachers focused primarily on mathematical relationships and the manipulation of variables. They talked about students' ability to manage formulae and apply them to experimental results - common verbs were "cover", "use", "do", and "work out". The study of physics was distinct from the student's own understanding of the world.

I don't want them to trust it and expect it to teach them everything and them to chuck out their own way of thinking, in fact I don't suppose they could do that - they can keep what they know themselves and what they know in physics in two separate compartments, and if they want they can build bridges between them, establish links - otherwise it would be like joining a religious sect. (Mr Murray, P5)

Experimental outcomes were evaluated in terms of the student's grasp of the formulae involved. Describing a circular motion experiment, for instance, one teacher commented:

They had a weight on the end of a string and they were trying to measure how long it would take to go round, whether it spun horizontally above their heads or at an angle. They had a table of results to fill in and they were asked to measure certain things and use the results to develop some relationships. (I asked: And did that work?) (He said) For some kids, yeah. (What do you do when it doesn't?) I usually get the kids to try and explain in their report why they think it doesn't work. (And what sort of explanation did they come up with?) Well - a lot of kids rig their results so that they do work - so - (What do you say when they do that?) Well,
if they're smart enough to rig their results so as to make the thing work, they know what they're talking about. (Mr Turner, P6)

For more able students, practical work might not even be necessary:

Pracs are good in terms of the observational craft, they don't enlighten or persuade. Some students enjoy manipulating the equipment, and you can sometimes associate problems with prac work, but I don't really try and draw problem-related conclusions myself... Basically pracs for students are cookery - follow the recipe, take the readings... In physics, theoretical and practical people are quite separate. I'd like them to start to see links between variables when the do pracs, but they usually do their prac work separately from their theory and I leave them to fit in those ideas themselves. (Mr Allan, P7)

What do you see as the role of prac work? It's very important to reinforce the other theory... Sometimes I'd do the prac before the theory, to work out certain concepts... That means the kids actually see what happens, rather than me just drawing it on the board, so I can then say, Okay, now I'll draw what we've seen on the board, and they're happier to accept that - when you come back and talk about the experiment they'd be happier to accept it. Some kids are happy to absorb theory and use a theoretical relationship to solve problems, whereas other kids want to know why, can you prove it, can you show us. One of my brightest students didn't worry at all about pracs, he was more mathematical, but the other kids mostly need that reinforcement. (Mr Evason, P8)

The task of discerning relationships is referred to the table of results; observation of what has actually happened has become relatively unimportant. The teacher's central task was to enable the students to "use a theoretical relationship to solve problems".

Problem-solving in science is not discovery, it's rearranging information to make a useful answer... When you're working out a problem there's a conceptual box you're diving into, that's how it's approached, something that needs to be worked out, but it's rearranging rather than making... They have to identify the principles which are operating in the problem, and use the relationships which are operating between the variables, eg for speed, it's always time divided into distance, they can extract that information according to the principle, and that ratio represents your speed - if they're given the speed and the distance, they could use the relationship to determine the time... (Mr Allen, P7)

The relationship between physics principles and the natural world was irrelevant to this activity. Understanding was defined in relation to the use of formulae.
One case showed he didn’t understand what he was saying, looking at the relationship between acceleration and force, you had to know that relationship to answer the following question, but he got one question wrong and the other right, he had to have been using his prior knowledge.
(Ms Brown, P4)

Understanding, for this teacher, was signified by familiarity with the formula $F = ma$.

Teachers whose views fell into the second category focused on physics theory as an explanatory system. They emphasised its power, economy, and coherence, and talked about inducting students into scientific practices of observation and experiment.

(Could you tell me how you go about introducing a new topic?)

Sometimes I start with a little demonstration, then go back to the beginning. I'd say, Let's look at some examples of physical phenomena - not worry about why - just look at them and think That's surprising and amazing. Or I'd say, There's a whole set of concepts (say speed, acceleration) which you can use to solve some rather interesting problems. Sometimes you need to expand the basic concepts first, say before you can look at satellite motion, why Jupiter has the period it does rather than some other period...

(How much do you see it as your responsibility to make sure they understand?) It's a lot of my responsibility to try and see that the fundamental concepts, the physical laws, get across to them, for instance, the law of conservation. If a student doesn't understand what that means, I haven't made it clear. Applying the law of conservation of momentum to a particular situation in a test is a different thing - but I need to make it very clear what the laws are and what their consequences are.

Many many things in physics are not obvious - for instance, if you think about how long it takes a ball to get to the top of its flight, and how long it takes to come down, it's not obvious that the two times have to be the same, one journey could take longer than the other. So in teaching say Mechanics you have to ask students what they think, then, Why did you get it wrong? What does a physical law tell us that means we can get it right? If you build up the physics, sort out the problems, you can see why it happens the way it does. Physics theory takes you beyond your first superficial try. If I hadn't bothered to go further than that commonsense reaction, I wouldn't have got the correct result. (Mr Richards, P9)

Understanding, for these teachers, involved grasping the concepts of physics. When Mr Thompson said

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It's hard for them to get their minds round. If they understand it doesn't mean they believe it - it's important they believe it. (Mr Thompson, P4)

the contrast between "understanding" and "believing" suggests that he was aiming at more than mastery of an abstract system. What students were to understand and believe, however, was physics theory; he was not talking about how his students understood or interpreted the natural world. This reading is consistent with his attitude to prac results: he was one of the teachers who had no objection to students rigging their results ("they get as much out of it backwards as forwards"), because it meant they worked through the observational implications of the theory.

Although they talked in general terms about the usefulness of the concepts of physics in explaining events in the physical world, these teachers saw the body of physics theory as the object which students needed to understand. They represented the application of theory as relatively unproblematic, using words like "follow", "see", "recognise", "apply", "handle", "need", "pick out", "sort out", "build up". "If you build up the physics... you can see why it happens the way it does". Speaking of the models which physics offers for everyday events, one teacher said:

I want them to recognise situations that have been described to them and apply a model. Physics is about modelling, they have to be able to see that a car going down a hill is equivalent to a block going down a plane. (Mr Matthews, P2)

Here the student is asked to abstract the essential features of the natural world in the context of solving a physics problem. He (in this case) is to focus on the pared-down model, rather than on the everyday event:

Say they have a problem in circular motion, they have to work out how fast the bucket has to move for the water not to fall out as it goes overhead. They come up with complicated pictures showing the rope, the sides of the bucket - I'm flabbergasted, it's too complicated. We're not interested in the sides of the container or the surface of the water. The problem is, we want the floor of the bucket to be in contact with the water at all times - so we need the forces between the water and the bucket. I don't draw the water as a circle (I could, but that would confuse them), I make it look slightly waterlike, and I draw it a little away from the floor of the bucket so that you can see clearly the origin of the forces in the picture... You need a schematic diagram so that in the midst of the confusion they have something familiar - one thing pushing on another. (ibid.)
Another teacher emphasised the simplicity of relationships in physics:

If you draw a graph, and it doesn't show a fairly simple relationship, something's wrong - either the observations from which you generated the graph were inaccurate for some reason, or there was no relationship between the variables. (Mr O'Brien, P10)

Although they drew on their students' experiences to illustrate the principles they were teaching, these teachers did not see it as their task to identify or change their students' understanding of the everyday world.

Finally, a third group of teachers focused on physics as a means of understanding or predicting occurrences and relationships in the natural world. These teachers talked about trying to get students to re-interpret their apprehension of physical relationships in the light of physics theories. They emphasised the physicality of relationships in physics:

I try to involve the students in actually feeling circular motion - put themselves in the object going round, ask about the actual forces pulling them around. (How?) Hold each other's hands and swing around the classroom... I want them to get up and move around, touch and feel, so their ideas about Physics, their conception of force and acceleration, is something that can be felt. You hear teachers say, it's like when you go round a corner in a car. I like to actually say, Let's get into a car and do it. The same with circular motion.

So...

I'd say, Okay, a bit of exercise today girls, we're going to do a communal exercise. You two are going to be friends today, in pairs - and I'd make them hold hands - they go giggle giggle - I get them to get up and actually try to swing one another around, then we discuss what forces. (Pulls my hand) What forces are actually acting on you? Which direction are you accelerating? They should know that the net force and the acceleration act in the same direction. (Mr McNamara, P11)

These teachers spoke of trying to get students to enter into the meanings of the principles they are being taught, not just to manipulate them as a set of abstract symbols; teaching students to understand their experience in terms of physics concepts.

This is close to the constructivist project discussed in Chapter 2. The enterprise of learning physics was seen as intrinsically problematical, in that students were likely

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to interpret physical relationships in non-Newtonian terms; to this extent, a notion of competing theories was incorporated in these teachers’ view of learning.

I like to ask questions which bring physics principles to bear on everyday experience and seem to be at odds with it, and then force the student to rethink how they interpret their everyday experience, so that ultimately the principle does make sense - they "see" it. One of the things I most enjoy about physics teaching is these moments of puzzlement when I can see on their faces, there’s the student thinking, There’s something wrong here, and trying to work it out. You actually get that sense of puzzlement because of the conflict between the principle and the commonsense view. (Mr Nelson, P1)

They have already had experience of all the things we do, in the past ten years, and they’ve already got their own theories, generally they’ve got the wrong idea - so to counter that you have to carry their ideas to extremes. Very early in a particular topic I’ll ask them to make a prediction. I present the situation, everyone writes down their answer, then I go round the class and each student reads out what they’ve written. I insist they actually do it, to begin with someone might say, I agree with him, and I say, Is that what you’ve got written down there, I agree with him? and they have to read out what they’ve actually written. And then they’ll all have this wrong idea, and it will come out over and over again, and they’re thinking Good, I’m right, and there might be one student who has got the right idea, all on their own - so the kid with the Physics answer is the loner. So then I’ll pick one of the child science answers, and I’ll lead the kid on, and eventually you can see that that way of thinking about it produces something ridiculous, it falls down, and then I’d go on to another one, and eventually we try the physics answer and you can see it works. I do that five or six times a year. Say with force, I’d ask What keeps a bike going? and the child science answer would be, the person riding it. Then, how about a car? (the motor) a golfball? (the golf club? - but that’s miles away...). So then I say, the only questions you have trouble with are the ones someone else asks. And I change the question - What keeps it going? turns into Why doesn’t it stop? Once you get the right question then you can work out the right answer. (Mr Schmidt, P9)

These teachers focused on their students’ understanding ("they’ll all have this wrong idea"). They used verbs such as "feel", "see", "rethink".

Although they might describe students’ ideas as constructed, most of these teachers spoke of the Year 12 curriculum as a body of established knowledge.

You could have a fascinating discussion about modern physics, but there isn’t much modern physics in the course - it’s too difficult - we spend two years teaching them the physics that was discussed two to three hundred years ago. It’s not like biology where you’re teaching them

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current events, they learn about IVF, we're not at the forefront of knowledge, and the students
know it's not the latest up to date stuff. But it does apply to the actual world, it has everyday
applications, which Einsteinian physics mostly doesn't...

With physics, what I am really doing, I want them to discover an understanding of the physical
world, but I want that understanding to be consistent with what has been discovered by
scientists over history - I'm not only interested in self-discovery. I have discussions with
humanities teachers about their approach, but in physics it isn't as important that the individual
finds out what she thinks and believes, I wouldn't be satisfied if they discover what they think
and believe about electronics, the discoveries have to be factually true. (Mr Nelson, P1)

Those few teachers who characterised physics explanations as contingent, rather
than absolute, did not see this characterisation as something they needed to teach.
They did not nominate the process of constructing physics theory as a central part of
their message. In practice, their objective was to get students to re-interpret their
experience in the light of "factually true" physics explanations. While these teachers
positioned students in relation to the natural world, as the overt object of study, the
intersubjective task of the classroom was to refashion students' understanding of it.

These different readings of what needed to be learnt in relation to the particular
curriculum of VCE (HSC) Physics seem to constitute the study of physics
differently. However, the extent to which the conceptions I have identified were
made visible to students remains to be explored. It is, I think, important and
interesting that even while they espoused a broadly constructivist point of view, the
third group of teachers did not dispute the objectives and assessment methods used
in the VCE (HSC) Physics exam. Given the context of the examination and the
teachers' own assumption that they are aiming to get students to discover what is
"factually true", it seems possible that students may understand the object of study
offered here in rather different terms. On the one hand, they are challenged to offer
and evaluate their own interpretations of physical relationships, so that their
understanding is under scrutiny. On the other hand, the interpretations that they
should ultimately achieve have been fixed; they are known to the teacher, they are
recorded in the course textbooks, and they will define correctness in the exam.
Since students must be brought to approximate the understandings of classical
physics, the notion that they are to study the natural world and achieve insight into it
may look like a sleight of hand.

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The study of History

What would you say your course this year has been about? (It might help to imagine that you’re telling a friend what your Australian History teacher has most wanted you to learn.)

It has been about important events in our past. The Australian Aborigines, national identity and European settlement. It has been a very enjoyable course. (H3, Demetrios, T4)

Unlike the Physics course, the Australian History course which was introduced in 1980 represented something of a break with tradition. It was to be based on the study of historical concepts, rather than narratives or themes. This was "the new history", intended to give students a command of concepts and ideas, and therefore an understanding of the processes of studying and writing history, rather than a compilation of undigested facts. The developers of the course drew heavily on the experience of people concerned with the English Schools Council History 13-16 Project, with visits from people like Henry McIntosh and the History 13-16 Project evaluator Denis Shemilt, and return visits to England by people concerned with the Victorian course. Suzanne Mellor, who wrote the new course, and became its Executive Examiner,1 commented that "what was happening here was a part of a worldwide alteration to the way history was envisaged".

The Schools Council History 13-15 Project had initially attempted to define the discipline of history in terms of its structuring concepts. This enterprise was inspired, at least in part, by Bruner’s famous challenge,2 and paralleled other curriculum development projects in science and social science. However, the project team concluded that the diversity of approaches, ideologies and methodo-

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1 Mellor was a central figure from beginning to end of the course. As well as being Executive Examiner throughout, she was involved in a series of videos for students, edited texts which became prescribed reading for the course, updated topic reading lists in a regular column in the History Teachers newsletter, addressed meetings of teachers new to the course, reported back on the previous year’s exam, and even edited a crammer. In one of the videos, she can be seen leaning forward confidentially, saying to her student audience “When you write your essay for me at the end of the year...”

2 “We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development.” (Bruner 1980/1960: 413)
logies in use by historians meant that there was no body of theory which could be used to structure an "honest" course in history. Rather, historians worked with a common set of concepts about the past. These concepts became the basis of the project history course. The course thus trialled a new way of approaching the study of history in schools, focusing on central historical concepts such as evidence, change, and time. As the means of becoming aware of these concepts, students investigated a series of detached topics, including Anglo-Saxon burials, the murder of the Princes in the Tower, and the suffragette movement in Edwardian England. Shemilt wrote that the project team

modified the question "What History should be taught?" to "What History should teach" and answered "The nature of the subject!" (Shemilt, 1980: 80)

The main aim of the Schools Council History 13-16 course was to enable students to acquire an understanding of the assumptions built into the processes of studying the past; the particular content to be studied was declared to be relatively unimportant.

The developers of the new Victorian Australian History curriculum identified their course with this approach. As Mellor put it:

The content was optional ... The vehicle for the objectives could be any range of content - there was no reason why one set of content would be more useful than any other ... The core of the course was the concepts, and the topics were only the vehicle for the concepts ... I'd expect planning to start from the concepts. (Mellor 1990)

According to Mellor, these propositions were fundamental to the organisation of the Victorian Australian History course, and supported the argument of the course designers with VISE that there was no need to specify core content areas, since the subject was based on a set of concepts which were common to all fifteen "core" topics and "options". These concepts, clearly derived from the History 13-16 project, were evidence, empathy, historical imagination, values, time, change, causation, and motivation; study of them was set in a framework of course objectives which the VISE History Committee agreed should apply to all the new Year 12 History courses.¹

¹ These were knowledge, comprehension, evidence, interpretation, values, expression, and historical thinking.

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In place of the old survey course, covering the span of Australian history from 1788 to 1946, teachers were now to choose three units from a set of fifteen, ranging from Aboriginal culture and social organisation prior to European settlement to a study of the impact of the two World Wars on Australian society. The units were expected to be chosen so as to inter-relate in terms of the concepts of the course - Mellor again:

At the beginning people were expected to give a proper justification for their choice of topics, in terms of the concepts and the objectives - we did a lot of inservice on that - we felt it mustn't be 'because we had the books' - but any justification for linking the three topics should have been okay. There was a lot of talk about how some topics went together more than others, and the subject committees had views on combinations, but it turned out that teachers could find an acceptable and valid notion for any combination - because the concepts were so integral to all of them, if you wished to study this period, or this topic, whatever, you could find a way to justify it. (Mellor 1990 - interview)

In the new course, it was argued, the content was merely the vehicle for the concepts which the course sought to teach.

The "new history" was contentious, both in England and in Australia. Some teachers maintained that the study of history was valuable in itself: that it was important to study particular episodes or relationships, or for students to be familiar with the sweep of the history of their own country. In England, conflict between the "Montagues of theory" and the "Capulets of fact" (Arkell 1986) persisted in history teaching journals throughout the 1980s, and culminated in the approval by a Conservative Secretary of State of a content-based National Curriculum. Some teachers saw the teaching of concepts as inappropriate: secondary school students, it was said, were developmentally unready to attain the level of conceptual understanding demanded by the History 13-16 course. In response to this concern, Shemilt argued that students of the new course, compared with students of conventional courses, achieved a better understanding of historical analysis, even if they did not master concepts such as evidence or causation at a highly sophisticated level (Shemilt 1980a, 1980b). Nevertheless, history teaching journals continued to carry articles suggesting ways of teaching these difficult concepts, "empathy" in particular.

In relation to the Victorian Australian History course with which we are concerned, there was dispute about the primacy of the core concepts, their relationship with the content of the course, and the extent to which the examination actually focused on

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mastery of the core concepts. Some teachers argued that any course concerned with teaching concepts had to communicate them via historical detail. One said, for instance,

The Chief Examiner says that concepts are the coathangers and the content is just the clothes you hang on them - she says we all teach too much content. I've had a number of arguments with her about that over the years. The concepts need to emerge from the content, the students need to know something before they can get anywhere. (Ms Webb, H3)

Other teachers took the view that in practice the Victorian course actually required students to achieve specific content knowledge, at the expense of their command of historical processes:

Say a kid gets really interested in World War II, and takes that on, they could really find it interesting and develop a series of techniques, the art of the historian - but if there's no question on the exam paper at the end of the year where they could use that, they're stuffed. You have to have knowledge of Australia's commitment, involvement, change - they have to learn the basic facts and figures, you're bound by the course.
(Mr West, H2)

Mellor commented,

The present teaching generation - the course is now over ten years old - on the whole they generally don't remember all that argument, there is a more conservative teaching population than there was ten years ago, and they're not especially switched on by the notion of concepts, they also have no recall of how significant it became in the situation of choice of topics.
(Mellor, 1990 - interview)

Before analysing these and other representations of what the course involved, I want briefly to consider the requirements expressed in the official course description and examination papers.

The Victorian Year 12 Australian History course

In the Victorian Australian History course, despite Mellor's emphasis on "underlying concepts" and unlike the History 13-16 course, the syllabus and examination referred explicitly to students' acquisition of content knowledge. As I have indicated, the framework of the subject was laid out as a hierarchy of objectives: over-arching objectives, which were shared with other Year 12 History subjects; the common concepts linking all the Australian History topics and option
studies; and some additional concepts.¹ The "central objectives" included both "knowledge" and "interpretation", and each topic involved both "objectives" and "content". At the level of individual topics, students were directed towards statements which structured the topic material for them: a set of specific objectives² and a set of content statements.³

Additionally, an appended set of sample examination questions indicated for each topic "what is regarded as one of the main thrusts",⁴ and it was "expected that teachers will use these questions to help them interpret the core topics". While students were to achieve their own interpretations, teachers were expected to use the examiners' insights into "the main thrusts" of each topic. These sample examination questions in the course description signposted particular perspectives which students were expected to address, just as the actual examination questions would.⁵ The interpretations offered by the examiners were treated as privileged.

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¹ Identity, patterns of belief, economic activity, social interaction, and power.

² eg in Topic 3.2, European settlement and the effects on Aboriginal society, the first topic objective called for "students to be able to describe the range and complexity of frontier relations in different areas and at different times, and to appreciate the specific causes of those relations".

³ eg (also in Topic 3.2), the first content summary reads: a. The general European view of Aborigines and the rationalisation of dispossession. The Aborigines as savages, lowest on scale of civilisation, no religion, no improvement of the land. The Europeans as agents of progress, civilisation and Christianity. The Aborigines' legal rights in theory and practice.

⁴ The question for Section 3.2 read: "‘Nineteenth century observers argued that disease and the falling birth rate were major factors in the decline of the Aboriginal population, while violence was only a minor factor.’ To what extent do you agree with this 19th century assessment of the causes of the decline of the Aboriginal population in the 19th century? Why might 19th century observers have argued this way about the decline of the Aboriginal population?"

⁵ The external component of the assessment for Australian History consisted of a two and a half hour examination. Two questions were set on each topic; students were required to answer three questions, one on each of the core topics they had studied.

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A question set in 1989 on topic 2, European settlement and the effects on Aboriginal society, illustrates the process. The question read:

'Those aspects of European society which were attractive to Aborigines in the 19th century were major contributors to the disruption of Aboriginal society.'

What aspects of European society were attractive to Aborigines in the 19th century?

To what extent do you agree that those aspects of European society which were attractive to Aborigines were major contributors to the disruption of Aboriginal society?

Examiners were instructed to refer to two course texts, and to use as discriminators the degree to which students:

1. identify a range of aspects of European society which were attractive to Aborigines
2. demonstrate why Aborigines were attracted to these aspects
3. show how these aspects of European society contributed to the disruption of Aboriginal society
4. identify the contributors to the disruption of Aboriginal society
5. use specific evidence from the whole of the nineteenth century
6. suggest how both degree and type of disruption changed over the period
7. recognise the significance of "major"
8. make a judgement about the quotation

(Instructions to Australian History Examiners, 1989 - duplicated)

The question gives students the task of explaining "the disruption of Aboriginal society"; they are expected to refer to different types of disruption, only one of which is specified in the 1989 question (violence and disease were nominated in other years). Examples, drawn from the whole of the nineteenth century, are to be classified in terms of type and extent of disruption.

Such requirements framed the work which was appropriate in the classroom. One teacher commented on the constraints she felt:

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I'd love to spend time on the Myall Creek massacre for instance, we never have time to do it properly, you could give it two weeks: there's lots of material, you could look at the evidence, run a course case, have some valuable role-playing games, but there's just no time to do that, and in fact I just end up telling my students what happened at Myall Creek, that's not good teaching practice, but you have to do these things to get through. (Ms Miller, H8)

As Ms Turnbull put it, students "have to be prepared for the questions that may be asked on the paper". Her account of her experience as a first-time teacher of the subject, quoted in the preface, illustrates the framing process:

Looking through the course outline and past exam papers I saw the idea of what it meant to be successful was important - I wanted the students to understand that at different levels, they needed to be able to define it...

A crammer, actually edited by Mellor, suggests that teachers were indeed expected to discern and communicate particular interpretations, which are represented as undeniable. On the one hand, Mellor urges students to reach their own conclusions:

History is written, it does not happen, so pretending you're 'telling it how it happened' is to pretend to leave you out of the action. Yet it is your version, so you must be prepared to acknowledge your part/role in this version of history, and to recognise its relationship with other versions of history. You are part of that debate, whether you admit it or not... Why do you think certain events, people, societies behaved or occurred in the ways they did? What explanations can you offer? (Mellor 1986: 4, 7; emphases in original)

On the other hand, she proffers insights which are characterised as "unchallenged and fundamental". The tone is authoritative:

Unchallenged and fundamental to your understanding must be the concept of land as it applied to the Aboriginal people (40) ... You should be beginning to understand that the contact between the two cultures was not always violent (54) ...

What you are concerned with is the fact that a colony was founded, it was a convict settlement, it was British and by the early 1820s it had become a multi-faceted society (61) ...

You can trace through these fifty years the learning process by which some middle class liberals were forced to realise that the complete freedom of the employer destroyed the freedom and human dignity of the employee. At first government intervened only to protect women and children; by the end of the century various pieces of legislation such as factory laws, early
closing laws, wages boards and mining regulations protected some groups of male workers also. *Note* the factors involved in this learning process (106-107).

(*Italics mine*)

These propositions do not merely suggest how a topic might be understood in line with "core concepts" such as "time" and "change". The italicised phrases point to a taken-for-granted perspective on the topic under discussion: one which was not explicitly available in the course description, though (as we have seen) it was formulated in the end-of-year examination.

The course description and the examination, taken together, suggest that students needed to be familiar with particular interpretations and subject matter, as well as with the concepts which the subject matter was to illustrate. Despite Mellor's insistence that "history is written, it does not happen", the examination required students to engage with a particular view of given historical themes, and to command evidence relevant to quite tightly specified perspectives.

Let us turn now to what teachers said about this subject.

**Teaching Australian History**

The Australian History subject I have described was common to all the teachers I interviewed. Formally, they were all teaching the same subject. The point I now want to consider is what they described themselves as teaching: not how they read individual topics, but how they spoke of history as an object of study.

As with the Physics teachers, the Australian History teachers I interviewed spoke of their subject in very different ways. Broadly, they fell into three groups, summarised in Figure 3.3. First, there were those who emphasised the delivery of the material, presentation, and technique; for these teachers the subject matter and students' relation to it were unproblematic. Secondly, there were those who saw the writing of history as contentious, but whose first objective was to get students to cover the ground and accumulate information in an orderly manner. Finally, there were the teachers who emphasised the involvement of their students in the construction of interpretations.
Figure 3.3 Conceptions of the study of history

<table>
<thead>
<tr>
<th>What is to be studied</th>
<th>How students relate to it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material remnants of the past</td>
<td>Cover, become familiar, look, do</td>
</tr>
<tr>
<td>Body of knowledge</td>
<td>Master, accumulate, recognise, come to see</td>
</tr>
<tr>
<td>Development of interpretations</td>
<td>Feel, change, connect, imagine, construct</td>
</tr>
</tbody>
</table>

Teachers who saw the subject as unproblematic focused on their own role in delivering it to students. History as described by these teachers was fixed by the course.

I don't have any big philosophical reason for doing the 1920s, except that it bridges the two world wars, and also we're asked to pick adjacent topics. It's rather a nebulous decade, with a lot of social history. They like that, they like looking at fashion, music - it gives them the social dimension which doesn't exist in the other topics.

(Mr Chambers, School H12)

This comment identifies Australian History, as the object of study, with what is prescribed in the course description ("a lot of social history ... which doesn't exist in the other topics"). History is equated with the material with which students needed to become familiar.

The process of familiarisation was described in straightforward terms: "I tell them what each historian says"; "I try and explain it ... I try and discuss it". It involved the teacher in posing questions, covering the ground, getting through the material, showing or throwing it to students, getting students to work through procedures.

The prime objective is to cover the material and prepare kids for the exam. The new course is very narrow, it doesn't give the scope I'd really like. We do National Identity and Consciousness, the wars, and the 1920s - that's not exactly a comprehensive coverage of Australian History.

(Mr Chambers, H12)

Verbs were unproblematic: "give", "show", "look at", "see", "do".

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The option is Violence in Australian society. They can do anything, they could do the aborigines, they often do the Eureka Stockade ... (Mr Chambers, H12)

They do test-like practice essays as well as research-type essays, they'd do nine or ten of those in a year. I like them to do research-type essays, to develop a confidence and competence in writing in the required style in relation to the end of the year ... (Mr Thomas, H5)

The kinds of experience which these teachers described with enthusiasm involved observing, visiting, and seeing. One teacher said,

The arts side of history I try to get over is empathy... That starts to come with the 1920s topic [which followed study of the two World Wars]. They have primary material on the lifestyle. We watch the Channel 7 Waterfront, that's terrific for images, and we look at the flappers. You can begin to get some empathy across when you really hammer it up - I had a girl in another school whose grandma came in and talked about life in the swinging set. They get the lifestyle stuff from the documents, and even more so with the documents from the Depression. (Mr Quinn, H6)

Excursions, in particular, were seen as helpful in enabling students to get an imaginative grip on what they were studying:

(What do you see as the value of outings?) The kids like to see things - say the corvette at Williamstown which was made in World War II, it was designed and built in Australia. They remember it and then they're more inspired with an interest in the actual manufacture that went on during the war. The All In push makes more sense to them - the concreteness is useful. (Mr O'Brien, H5)

Similarly, videos

help show them the period... There are documentaries on some of the leading figures, like Curtin and Bruce, there was one from the ABC including interviews as well as newsreel footage, it gives them an idea of the individual's history to tie in. I'll stop the video and refer to points they need to watch for... I'd ask questions like, "What does this tell us about Hughes?" "How did this help us?" They liked the video on the 1920s, the sort of comments I got back were "It was good", "Helpful", "Isn't Bruce ugly". (Mr Chambers, H12)

Material remnants of the past were particularly significant for what they showed - "What does this tell us?" Meaning was represented as being immanent in the object itself.

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Students' difficulties, according to these teachers, arose from idleness or lack of interest, lack of knowledge, passivity ("the weaker students don’t get to grips with it"), and "a desire to write narrative essays that tell you everything they know". These are attributes of the students, rather than the subject.

If the students do their assignments thoroughly and faithfully, they should do reasonably well, because it forces them to cover the contents of the course. (Mr Chambers, H12)

Implicit in the comments of these teachers was a view of history as concrete, perceptible, knowable.

The second group of teachers distinguished between information which students needed to possess, and the process of interpretation, which they saw as a subsequent stage. They emphasised the student’s role in "covering" and "getting" information.

I do hope that they’ll take away the idea that history is a debate, but realistically most of them will settle for content rather than contention. That comes about because the year is so full, we can look at things in terms of contention as much as we like, but until they have a data base to use as evidence they’re not operating historically, and it takes an awful long time to get that data base. That’s the problem. (Mr West, H2)

At the beginning of their study, students needed to accumulate facts - "early in the topic, I work on the basis that they have no prior knowledge", said one teacher. At the time of our interview in October, she said,

This is the time of year they really need to sharpen their analytical skills and focus on the processes, you hope they’ve got all the content under their belt. (Ms Miller, H8)

Study was described as a developmental process.

First I do basic easy things, I call them vegie notes, easy textbook extracts, lists of dates, so they build up a framework of basic knowledge - they can’t interpret or analyse without basic knowledge. ... I give them handouts, they even do some colouring in, there’s chalk and talk ... A lot of them aren’t very mature, some of them are pretty dumb - you can’t expect them to understand concepts like debate over conscription etcetera, they’re very difficult, only the best ones will be able to grapple with those ideas, but they need to have the basic knowledge, which has to be explained to them.

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After that I start on the more complicated notes, things that take up debate - that's what history's about ... I have material for each topic ... I want them to use their imagination ... I use questions to force them to think about the issue that's being discussed and to say something to get them thinking. (Ms Jamieson, H9)

Once students had acquired sufficient knowledge, they were in a position to interpret it.

Students have to learn some information - what's then required by me and by the examiner is for them to work out an idea about that, and then support it. (Mr James, H10)

These teachers talked about interpretation as a distinct process which was applied to knowledge, ("until they have a data base to use as evidence they're not operating historically"). Students had to be brought to the point of being able to do this for themselves; typically, the teacher modelled it for them first.

These teachers spoke of "showing", "explaining", "pointing out", and "challenging".

I think it's important in a subject like history that events are brought to life and linked with contemporary events - for instance recent events in Eastern Europe, I've been pointing out to them how they connect with what they're studying ... They're getting closer to university - you can challenge them with ideas about what is a good society ... The kids can start to see that events have causes and effects, on individuals and as far as the wider society ... I want to open up the subject so that they can see things that have happened in the past have had a profound effect. (Ms Jamieson, H9)

Unlike the teachers in the first group, these teachers emphasised the development of understanding. It had to be worked on; it could not be taken for granted.

[We watch] Kid Stakes, which is an Australian silent film made in the 1920s, shot in Sydney, in Woolloomooloo and also at a house at Potts Point. I tell them this is a real window on the past, watch carefully all the sights in the film and you'll see things you'll never see again, slummy houses, children with terrible teeth - a whole world that we're studying that doesn't exist any more. That starts them thinking about the ideas and concepts. (Ms Jamieson, H9)

As a historian, I'd want them to have the feel of the period, an understanding of the period, know how it's affected us today ... We were lucky this year because it was the fiftieth anniversary of the beginning of World War II, and I got a lot of students to bring in their copies of the Age magazine, with its accounts of people's experiences. We read through them for

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ages to get a feel for the period. It's really important for kids to avoid generalisation - they tend to say things like, "In the Second World War all the women worked on farms"... I try to get them to understand that people's experiences vary greatly. (Mr James, H10)

I have to cover the ground and ensure that students are in command of the material ... I frame the problem and try to get students to see that there is something about how events developed which needs explaining, then I show them a way of finding an explanation ... In what I provide, I try to show that they can't accept anything at face value, for instance if I'm quoting what some bishop had to say about the character of the emigrants, I'd tell the students they need to ask who was this person, why was he saying such things, what effect would he have - students shouldn't be over-impressed by his role, they should see him as speaking for a particular group from a particular perspective ... It takes up to six months of teaching for students to recognise what's going on and join in. (Mr Kyriacou, H12)

Typical expressions for the student's relation with the subject were "look at", "recognise", "come to see", "understand", "see the structure", "see points of view". Students were, as far as possible, to come to share the teacher's understanding. Interpretation by the student was deferred until they had accumulated a body of information. Here historical knowledge is represented as something to be acquired, looked at, contemplated, recognised, and discussed.

The defining feature of descriptions by the third group of teachers was that they represented studying history, from the start, as a process of developing interpretations. They focused primarily on what their students did - how they were approaching their material, what questions they were asking of it, how they related the elements to each other.

I want to make history seem accessible - not as a great big body of knowledge to be acquired, but interesting, exciting, offering lots to think about, to do with people and what life's all about... I always assume they know something before they start... When I started teaching I was insistent on getting the facts into them, but now I feel that isn't how they learn... They can still [early Term 2] find it hard to read a text and pick out the main points which are being made from the mass of detail. At this stage what I want them to do is to build up a picture. (Ms Webb, H3)

I divided them into pairs, they had to conduct their own research with one or two figures from the period... and they had to come back and report, each of them would be an expert, sharing their knowledge with the class... I spelled out beforehand that the topic was to be defining success. It would have been useless to do research without knowing that... If I'd taken them

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through it, they would have understood it, but they wouldn't have been able to work through it themselves, they wouldn't understand it as well if I'd just expounded it. (Ms Turnbull, H11)

The hardest thing as a humanities teacher is to get students to think outside the straight content, to get the student to use the content as a vehicle for understanding wider issues... (Mr Finlay, H13)

Although these teachers tried to prepare their students to cope with the propositions put forward by the examiners, they did not represent them as privileged. Grappling with and developing accounts of the past was seen as a common enterprise in which the teacher and his or her students shared; one commented:

[We look at] historical bias, what's behind it and why we do it, what we get out of it - so that kids can see that history's not an absolute, it's something that people can have different opinions about, that each one of us is subjective, there's no such thing as objective history. (Ms Parbo, H1)

Here the teacher's own thinking is problematized.

In their study of history, these teachers wanted their students to "think", "connect", "imagine", "feel", "change", "grow". The teacher was to support them in these processes.

[In relation to Life on the Goldfields] it was hard for them to find and grasp the data - I wanted them not to focus on me as a source of knowledge, but for them to be confident that if they wanted to find something they would be able to find it for themselves... At the end they shared their information and joined up their notes. This time, though I didn't ask them to draw conclusions, they concluded that life was in fact not wonderful but was in fact rather difficult - so they were able to make observations and draw conclusions for themselves, nothing major or profound, but I was pleased about that. (Ms Turnbull, H11)

Many students start off by wanting unqualified descriptions - all factories or all workers - and they find it hard to see that what is true of some may not be true of others. Ideas like change, or local differences, are difficult for them to get hold of. Not writing "all" [which she had emphasised in a lesson] may seem relatively trivial, but I see it as a major advance in how they are thinking. (Ms Webb, H3)

Students' difficulties were represented in terms of "how they are thinking". Another example:

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(What difficulties do they have with analysis?) They tend to see things in black and white -
they want "the truth" rather than understanding that perhaps there's no right or wrong answer,
just different forces at work. (Mr Finlay, H13)

These teachers did not necessarily make explicit to their students that they saw
knowledge as contingent or constructed (though one of them did). Rather, this idea
was implicit in the way they described and engaged with their students' learning.

**Summary**

The subject matter addressed by these teachers was distinctively different, and their
conceptions of it varied along different dimensions. Initially, I expected that the
more unproblematic verbs ("cover", "do") would associate with a view of
knowledge as factual, whereas the reconstructive verbs ("connect", "imagine",
"rethink") would associate with a view of knowledge as problematic or constructed.
As we shall see from the chapters which follow, there is some substance in this,
though it does not fit quite neatly. There were epistemological differences between
the history teachers: while they saw the object of study as constituted in accounts of
the past, they represented these accounts differently, as given, as intrinsically
patterned, or as constructed. Teachers of physics, however, brought into view
different aspects of physics: the mathematical system of equations which physicists
have developed, the models which physicists use, and the natural world
relationships which they describe. In both subjects, there was an intelligible
connection between how teachers described what was to be studied and the words
they used to indicate how students were to relate to it.

Figure 3.4, overleaf, summarises this analysis, and shows where the case study
teachers were positioned in relation to it.

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Figure 3.4  Teachers’ conceptions of the study of history and physics

<table>
<thead>
<tr>
<th>What is to be studied</th>
<th>How students relate to it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>History</td>
</tr>
<tr>
<td>Management of algorithms</td>
<td>Material remnants of the past</td>
</tr>
<tr>
<td><em>Ms Brown</em></td>
<td><em>Ms Farmer</em></td>
</tr>
<tr>
<td>Body of theory</td>
<td>Body of knowledge</td>
</tr>
<tr>
<td><em>Mr Matthews</em></td>
<td><em>Mr West</em></td>
</tr>
<tr>
<td>Natural world</td>
<td>Development of interpretations</td>
</tr>
<tr>
<td><em>Ms Konstantinidis, Mr Nelson</em></td>
<td><em>Ms Webb, Ms Parbo</em></td>
</tr>
<tr>
<td></td>
<td>Cover, use, do, work out</td>
</tr>
<tr>
<td></td>
<td>Cover, become familiar, look, do</td>
</tr>
<tr>
<td></td>
<td>Recognise, apply, sort out, simplify</td>
</tr>
<tr>
<td></td>
<td>Master, accumulate, recognise, come to see</td>
</tr>
<tr>
<td></td>
<td>Feel, see, rethink, re-interpret</td>
</tr>
<tr>
<td></td>
<td>Feel, change, connect, imagine, construct</td>
</tr>
</tbody>
</table>

The next step in the study was to follow through with a selection of the teachers to see whether these different conceptions were visible in the teachers’ classroom practice; in particular, whether, as expected, they could be seen in what the students were asked to do and what they ultimately learnt. How did the case study teachers construct the study of their subject? How did they bring their students into relation with it? What did their students make of the subject? The next four chapters explore these questions.

Let us look first at the four Physics classrooms.

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CHAPTER 4
Teaching Physics

Chapter 3 analysed a range of conceptions of Physics, and what was involved in learning it, as expressed by a number of Physics teachers. This chapter focuses on the four Physics teachers whose classes I observed: what they said about the study of Physics, and how they constructed the study of their subject for students in their classes.

In developing the case study part of this project, I approached teachers who had described the study of physics in rather different ways when I interviewed them. In terms of the three perspectives I have described above, Mr Nelson exemplifies the focus on students' understanding of the natural world, Mr Matthews exemplifies the focus on physics as a body of theory, and Ms Brown exemplifies the focus on formulae. Ms Konstantinidis, to whom I referred briefly in the Introduction, expressed conflicting orientations; her struggle illuminates all three perspectives. In relation to each teacher, I begin by discussing in more detail what s/he had to say about the study of physics, interpreting the language they used - their images and metaphors - as a source of insight into how they constructed the study of their subject. I go on to explore the connection between these representations, and the teacher’s classroom practice.

In order to provide a common point of reference, the lessons I analyse here all dealt with the topic of simple harmonic motion, which was a topic all four teachers introduced for the first time at Year 12. For the purposes of this study, simple harmonic motion is of particular interest, because it involves reputedly difficult applications of some of the mechanics principles which are at stake in the qualitative problems which I used as a before-and-after test. How students interpreted these problems at the end of the year, which will be presented in Chapter 6, can be read in the light of the way their teachers presented the principles involved in contexts such as this.

In simple harmonic motion, for instance the vibration of a guitar string, an object oscillates at a constant frequency across a point of equilibrium in the centre of its motion. The defining feature of this motion is that the net force on the object is towards the centre of the motion, and increases in proportion to the distance of the

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object from this central point.\textsuperscript{1} The main characteristics and graphic representation of this motion constitute the simple harmonic motion topic within the mechanics section of the VCE Physics course. The description of the topic which is laid out in the official curriculum document is followed closely, but not verbatim, by Storen and Martine (1987), the text used in all five classes. Simple harmonic motion is treated in Chapter 10, towards the end of the mechanics section. Storen and Martine give a definition, some examples, a set of equations, and a set of graphs describing the motion in terms of force, velocity and acceleration, against displacement.\textsuperscript{2} They show a relationship between simple harmonic motion and circular motion and look at the motion of a pendulum (both elements of the topic which have now been excluded from the Year 12 curriculum)\textsuperscript{3} and they finally provide an energy analysis, followed by some worked examples. At the end of the chapter thirty-three problems are given for students to work through (answers, but not explanations, are provided at the back of the book).

The importance of simple harmonic motion in the Year 12 curriculum has diminished in recent years, because some elements of the topic have been dropped. Because of this change in the curriculum, the teachers in the case study had different views of the importance of the topic, and how they taught it is particularly interesting as an indication of the relationship between themselves and the curriculum. They in fact treated it differently, both in the amount of lesson time they devoted to it and in the issues they focused on in the lessons.

\textsuperscript{1} As the force increases, the acceleration of the object increases. Its acceleration is zero at the point of equilibrium and at a maximum at either end of the motion. Correspondingly, its velocity is greatest at the point of equilibrium and zero at the ends of the motion (where the object changes direction). The motion can also be described using an energy analysis, whereby the work done in starting the motion is seen to produce potential energy which is converted to and from kinetic energy as the mass moves.

\textsuperscript{2} These are straight-line graphs. The course description does not mention them; it does mention the sinusoidal graphs of displacement, velocity and acceleration against time.

\textsuperscript{3} Because the motion of a pendulum bob is curvilinear rather than straight line motion, its acceleration involves change in direction as well as change in speed. The motion is more complicated to describe than straight line simple harmonic motion, which is the topic in the current curriculum.

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How did the teachers in the case study introduce simple harmonic motion? How did they bring their students into relationship with the topic? What features of the motion did they focus on? How did the students respond, and where were the points of tension - the comments or questions which were ignored or ruled out by the teacher? What kind of framework was set up for further study of the topic?

A lesson plan for these teachers might look surprisingly similar. Three of the four set an object in motion for their students to look at, and used it to develop some ideas about the character of the motion. Mr Nelson, who had attached to the ceiling a pendulum and a row of springs with weights hooked on to them, set the weights bobbing and the pendulum swinging; Mr Matthews set up an air track so that a glider oscillated to and fro between two springs; and Ms Brown first walked up and down to illustrate the to and fro characteristic of the motion, and then set a weight bobbing on the end of a spring hung from a retort stand. What happened next?

My account of what happened in each lesson is expressed in the present tense, rather than freezing what happened in the fixity of the past tense: because it suggests that we are watching the lesson as it develops, the present tense communicates the improvised nature of teaching. I do not mean to suggest that any lesson these teachers give on the topic would follow the same pattern. Quotations from my fieldnotes show a change of speaker by S for student and T for teacher. Omissions are indicated by a row of three dots, uninterpretable words by a pair of brackets. Actions I observed, and utterances which I heard, but which the teacher seemed not to hear, are enclosed in brackets. Where students were identifiable, I use a consistent pseudonym.

Ms Brown: Quickly going through it

Ms Brown was one of a number of teachers who mainly spoke about manipulating variables within a theoretical system. Her description of her practice focused on getting through the necessary theory. Her role was to rehearse for her students the information they need, to lay it out ready for use, and her criterion for success was that her students should be able to use it appropriately, so that she called on them to speak up when they can supply the necessary steps in solving a problem. This emphasis on going through what they need to know was associated with a sense of being under pressure, having to “cover the ground”, “quickly go through the main points”, “quickly summarise”.

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Ms Brown began by saying that she wanted her students to achieve understanding, but this aspiration was counterpoised by her appraisal of the demands of teaching to the exam.

*What would you like your students to carry away from their study of Year 12 Physics?*

An understanding of the physical world around them. That would involve looking at the world around us and performing a lot of practical activities to explain why things happen - magnetism, light, forces, energy, motion. So it's basically performing experiments... Primarily I would like them to understand the principles of physics, but we have a very demanding course, we need problems as well, though the course outline is related to describing the world around us...

Ideally when we look at a particular topic I like them to begin with an experiment so they can derive the principles from that work. Realistically that doesn't always happen.

(Interview)

The opposition between these purposes is shown here in the contrastive language: “would like, but”; “ideally.. realistically”. At the end she commented, in similar vein:

I try to relate physics to everyday life, but I've got to equip them as best I can for the exam.

The rhetoric of Ms Brown's aspirations contrasts strongly with her account of her practice, which is dominated by a sense of urgency. In class, Ms Brown quickly “goes through” or “goes over” the “main points” of the theory. Her account of her teaching focused on the process of working out physics problems (the stuff of the exam), just as her description of physics emphasised quantitative relationships.

If they couldn't do an experiment, I'd introduce a topic with an example, say with nuclear energy, I'd discuss the principles (they'd all done chemistry so they had a basic understanding). I would summarise the basic points and give them an example on the board, then give them problems to do. It would be rare for them to spend time on problems in class, but we would go through the problems...

The problem reinforces the relationship between the variables so they look at the concepts and familiarise themselves with the formulae required. The examples used are everyday examples, so hopefully - you can't check on this - if they see the situation in everyday life they can try and solve it in the way we go through it in class.

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It was her role to display relevant concepts and formulae. The desirable connections with experience were for her students to make privately, as they worked through the problems in their text - solving problems in class did not involve picturing experience. As Ms Brown described it, what was required was summoning to memory equations which contained the unknown variable along with variables for which values had been given:

I say, Well, what am I going to do?... They've given us mass, velocity, diameter, we have to work out the force. I say, what's an equation that links all those things together.

This process of supplying the required equations is visible in her account of guiding her students through a circular motion prac:

At the beginning of the class I quickly went over the major points...

We usually run out of time at the end of the prac. In the next lesson we just quickly discuss what we went through and what we discovered...

(She then set circular motion problems for those who had finished collecting data.) At the end of the lesson I went over the answers to the problems, then I wrote up a quick summary...

Before actually writing up the prac there were more circular motion problems, which were set and then discussed in class. At this point, as we have seen, she expected her students to be able to supply the relevant equations and direct her in working through the problems:

I say, Right, what am I going to do? You have to help me. They might say, You're the teacher, but I say, Well, what am I going to do? They've given us mass, velocity, diameter, we have to work out the force. I say, what's an equation that links all those things together.

And they say (hopefully), \( F = \frac{mv^2}{r} \). But we haven't got \( r \), they've given us the diameter.

So they need to know that \( r = \frac{d}{2} \), they have to tell me - I put it on the board even if it's wrong. I put whatever they tell me, and say, Is that right? Then they might argue among themselves. Generally they'd get the right answer.

During the week she gave her students to write up the prac, therefore, she had instructed them in the formulae involved and led them through several relevant problems. By the time the students handed in their prac reports they knew what formula they should have arrived at.

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What did they have to write up? They answered questions I suggested from the list in the book, and drew conclusions for themselves - then they'd show me what they'd discovered. It's important how they write up their findings. There are quite a few second language speakers in the group; they have to have the major points in their conclusions and often their conclusions aren't adequate. I tell them to write everything down that we've discussed, words, equations, diagrams...

In fact they all put down the relationship [ie the formula required], but their statement of how they got it is their own.

Ms Brown treated her students as problem-solvers on a footing with herself. She guided them through the equations they will need to deploy, and she displayed a correct path through a problem, as a joint enterprise between herself and the students who have managed it, so that other students would learn by example:

I'd start by asking, Did you have any problems? I check through by number - some of them might say they'd had difficulty with say no 3. I jot down all the clues [variables for which values have been supplied] on the board, then get them to look to see what the question's asking us (some of them don't know this and therefore can't find the answer). I discuss what the question's asking and they'll tell me, the ones that don't know usually keep it to themselves... If they say they don't want to answer I don't press it, I don't want them to close up...

Despite her initial emphasis on her students' achieving understanding of the natural world, Ms Brown focused on the material she wanted to communicate - on the formulae which her students needed to learn and which she asked them to reflect back to her.

Ms Brown spent several lessons on simple harmonic motion. In this first lesson, she introduces the topic by asking the students to make some observations.

T Let's make a start.

This lesson we'll be looking at simple harmonic motion. You'll be required to take a few notes down, and I'll give you a demonstration. It's fairly straightforward, if you listen you'll grasp the concepts this time.

Edward What's simple harmonic motion anyway?

T (walks up and down - nb she has misplaced part of the equipment she wanted to use, and cannot do one of the demonstrations she had planned)
Ms Brown asks her students to observe the details of the motion, but almost at once she directs their attention in a way which leads into an energy analysis. Her initial question about the effect of dropping the mass could generate a description of the motion of the mass, or of the final extension of the spring. Rather than commenting on what John says about the motion of the mass, however, she insists that the students notice the extension.\footnote{The student has said “up and down and side to side”, and in what follows she supports this prediction as a good observation, although it is inconsistent with the definition of simple harmonic motion as a linear motion.} This extension is important in an energy analysis, as constituting the initial work done on the system. The force/acceleration relationship which characterises the mechanics of the motion is left to the end of the lesson, and is actually omitted from Ms Brown’s initial dramatisation of the to-and-fro nature of the motion.

Now she drops the mass.

\begin{itemize}
\item[\text{T}] Every prediction was correct. It’s bouncing, there’s some to and fro movement, and there’s some extension. It’s a repetitive motion, up and down. When something does this, you’ve got repetitive motion, up and down, side to side, we call that…
\item[\text{Ss}] (in chorus) Simple Harmonic Motion!
\item[\text{T}] Is it going to stop? It’s still going up and down.
\end{itemize}
Ss  It has to - there's friction, air resistance.
Edward  In a perfect situation it would just keep going, wouldn't it?
John  You put energy into it when you let it go.
S  The potential energy is being converted into kinetic energy.
T  What's potential energy?
S  There's elastic potential energy stored in the spring.
T  When it's high up it has gravitational potential energy - high up in relation to the earth - the spring is displaced, work is done, a force is applied downwards, in the same direction as the displacement.

When work is done, is energy present?
When you're changing one form of energy for another, work is done.
We're going to be looking at this situation - the total energy.
John was saying that potential energy was lost. What do we know about total energy?
Ss  It's the same.
T  It's crucial that there's no friction - if it's an isolated system with no external force, it would continue to move forever and ever Amen.
Ss  Aaah

We move straight into considering the motion from an energy perspective.

Ms Brown commends the class for being observant, and turns to the business of writing up notes. It is her practice to provide the students with a summary of the points made in each chapter of their text.

T  ...Now take down some notes, and I'll refer back to the demonstration.

I'm going to refresh your memory on terms. Chapter X. We'll be working through it in nearly the same order as in the book.
S  Is this going to be short notes?
T  Very short - I know you don't like long.
Edward  She cleaned two boards.

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T (starts writing on lefthand board.)

SIMPLE HARMONIC MOTION (SHM)

S Simple melodic...

S Why do they call it harmonic?

T It's like a harmonic series - it's connected to the Sound option () - we can have a quick look at harmonic series and Martin can play his guitar.

(Writes: Simple harmonic motion is the motion in which one object moves back and forth, up or down (ie oscillating)

(Edward Up and down shouldn't it be Miss?

T Yes, that's right (she corrects it))

(she continues to write)

over the same path, eg a pendulum, guitar string, a mass on a hanging spring etc.

S What about a piano string?

T Yes, there are too many examples to list them all.

Who can define a period? (There are titters)

It's the time for one complete revolution or cycle. The female cycle is the same idea, it's repeated - that's why it's called a period - that's why you were laughing.

The students are giving her definitions close attention (cf Edward's correction). They copy down what she is writing. She emphasises that a feature of the motion is that it repeats itself exactly. This is the feature which she emphasised in her original walking-to-and-fro demonstration.

T It has to come back to its original position.

S What about the pendulum in the Museum - do they have to boost it every now and then?

Jeffrey It's not a perfect system

S In a stairwell

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We should have a look at it - we might go there on an excursion now the bans are lifted.

I'm just going to write down in point form the things you need to know.

writes

Motion which repeats itself is PERIODIC, where the time required for one oscillation is the period. One oscillation is when it moves back and forward, back to its original position - like laps of the track.

Edward Or the earth around the sun.

T One cycle - once around the track, up and down the pool.

Edward Bit stupid.

A discussion on factors affecting running times and air flight times follows - does it make a difference if you are aligned in the direction of rotation of the earth? Ms Brown says they make allowance for wind.

T You have to look at your frames of reference.

Edward Einstein talked about that.

Martin You won't go faster because the Earth takes the plane with it.

T You'll look at that at University.

S I don't do maths. You need maths at university.

T Don't do maths - maths is crazy - well, I don't mean that - but some of the people I knew who specialised in maths at university were a bit crazy.

She sets the issue on one side. They turn back to the notes on the board.

T (writes)

The object is displaced from the rest position, and the object oscillates naturally, depending on the forces acting on it.

Edward If it completes a full period, has it been displaced?

T It's not displaced from its original position - but at the original position no work is done, at the instant when one cycle occurred.

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Work is a scalar - vector times vector gives a scalar - this is a force vector times a displacement vector. Work is a scalar - work is done when force and displacement are in the same direction.

Martin

If work is done on the way down and the way up, shouldn't it be twice the work?

Some confusion is evident in this section of the lesson. The students are puzzling over the conceptual relationship between work and displacement. Ms Brown shares their puzzlement: the answer she gives them derives from a formula defining work, and is counter-intuitive.\(^1\) Here the formula is being used to settle the argument in principle, not to clarify what is going on in the motion - the idea that the net force changes throughout the motion has not yet been introduced.

T

Energy can still be transferred - potential energy is converted to kinetic - but work is done - at the point of return there is no displacement and therefore no work done.

Tung

But within the body Miss, work is being done.

T

But at a microscopic frame of reference work is being done.

(There is an announcement preceding the end of the period - not relevant)

(writes)

Energy changes are occurring - gravitational potential energy when it is released is converted into kinetic energy when it is moving and heat (friction) when it stops.

just wait till you get this down.

(writes)

The forces present during SHM have a resultant effect on the object and restore it to its original or equilibrium position.

[Edward]

When you say heat due to friction... That's only when it's a non-perfect - in this situation.

\(^1\) As Martin suggests, the quantity of work done is incremental, and is not negated by the return to the original position.
Tung offers the conversion of energy to heat, within the body, as a way of understanding what work is being done. Edward disputes this, because it would be an effect of friction, which is not intrinsic to the motion. They are still not convinced that no work has been done at the end of a cycle. At this point the students are pressing Ms Brown with questions about energy transfer in the motion. She resists the pressure, and turns back to her notes on the board, where she is beginning to outline the mechanics of the motion. There is a discrepancy between what they want to do and what she allows.

T

This force is called the restoring force.

Martin

What do you mean by equilibrium, Miss?

T

The rest position - there are three different words to describe it.

(writes)

SHM occurs when the force is proportional to the displacement in the opposite direction.

ie \( F \) is proportional to \(-x\)

or \( F = -kx \)

where \( F \) = the restoring force

\( x \) = the displacement from rest

\( k \) = the force constant for the material.

[All these are written as vectors]

I'll show you what I mean by this statement here because it seems to be contradictory but it's not - I'll just show you what I mean by a diagram.

Ms Brown is preparing to draw a diagram of the forces involved in the motion, so as to identify the variables in the equation \( F = -kx \). Her description of the forces is not linked to the students' observation of the motion. Martin's question about equilibrium focuses on an ambiguity which directly derives from his observation of the initial demonstration, where she held the mass rather than allowing it to extend the spring: he is uncertain where the equilibrium position is supposed to be. In the discussion which follows he and two other students try to get this clear.

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Edward Where's Y, is that the box?

T It's at the point Y.

(Murmurs)

Looking on the second board - (she reads the definition)

What that means, if we have a look at the diagram, if the object is first at position X - I've just drawn one of those cycles.

Tung Are the two forces the same?

T The applied force must decrease.

Tung When you measure the two forces will they be the same?

Cameron Why is x little?

T x is the displacement.

Just to show you () for the direction of x. Look at your books - 10.3 and 10.4 are better than this, I've tried to copy it - it shows us the spring without a mass, the extension with a mass attached. Once the mass is allowed to oscillate, it oscillates between points x and y. When there's an extension

Tung That's displacement

Tung again expresses confusion about how to measure the displacement of the mass. Ms Brown does not respond, but Cameron offers an answer to Tung’s earlier questions about the relationship of the forces involved:

Cameron The rest position is when the force of the spring equals mg.

T Yes, it could be so.

It is proportional to -x because the direction of the force changes.

T This is its rest position.

(Tung Displacement at rest is zero.)

T The amplitude is the distance from the mean position to x. The amplitude is from the original extension of the spring.

Here Ms Brown seems to refer to the amplitude of the motion they were watching her demonstrate - she is using the original extension of the spring as the starting
point for the measurement. Throughout the lesson, she defines the point of equilibrium as being at the centre of the motion, and talks at the same time about a rest position where the mass is held, which seems to be at the bottom of the spring before it was extended by the mass. These descriptions are not consistent.

S      I don’t know where to take zero.

T      Where you’re holding it - not moving - that’s going to be its rest position. For units you can use cm or m - when you’re working in forces you can convert metres to Newtons.

(Talk about the force constant - it depends on the material the spring is made of - there would be a difference between springs, and it depends on the material, but it will have a constant value for any given spring.)

T      Any more questions?

We’ll leave it there - we’ll look at the energy transfer with SHM motion of a pendulum in great detail tomorrow. You will need a calculator and a pen or pencil, make sure you work through carefully.

Students continue to express confusion about how to identify the rest position.

This lesson seems to me to be consistent with Ms Brown’s description of studying physics. The main focus of her attention is the diagram and the formulae associated with it. She focuses on connecting diagrammatic representations and formulaic propositions, which are equated with principles. These relationships are presented as definitional and logical (“if you listen you’ll grasp the concepts this time”; “I’ll show you what this means, because it seems to be self-contradictory but it’s not”). When students ask questions about the diagram, she attends to them, and works with them to make sense of what is displayed, calling up definitions and formulas from the text to help in the process (for instance in response to Martin’s question about whether work is done in the motion). While her answers are definite, they are not authoritative, and the students occasionally correct her. She positions herself as leading the students in their collective task of working through the textbook exposition.

The moments in this lesson when students’ questions are ignored or set aside occur when they try to connect the demonstration they have seen with the diagram and definition on the board. Martin, Cameron and Tung, in particular, seem actively to be interpreting the diagrams she has put up in relation to the motion they have
observed. Early on, for instance, they puzzle over the work done in the motion, which Ms Brown has characterised as zero (by derivation, since the net displacement is zero). Later, they work their way through a set of questions about the forces and displacements involved in the motion. Tung asks about the force in the motion, and whether it changes. Cameron proposes that "the rest position is when the force of the spring equals mg." Ms Brown ignores these questions ("it might be so", she tells Cameron), and passes on to the next section of her exposition. While she models for her students a process of logical thinking in relation to the theory they are learning, she restricts the scope of the theory to what is contained in the text.

Mr Matthews: We’re just going to look at it in a simple way

Mr Matthews was quoted as an exemplar of the conception of physics as an explanatory system. He said very little about how his students understood his subject, but a good deal about what they needed to be able to do. He focused strongly on the practice of physics: not just the use of the language, but also the hands-on work of the laboratory and the deployment of models and equations.

I want them to be able to look at something, some sort of problem they haven’t seen before, and make some intelligent deductions - how it works, whether it’s the sort of thing which is likely to work in a particular way.

In the sixth form we teach a sample of the kind of things that can happen - at the same time they’re learning some more subtle skills - how to be a bit sceptical, make a first guess at calculating something (how long does it take the moon to turn round the earth?) - to have some way to make a kind of guess.

(Interview)

“To have some way to make a kind of guess.” This idea ties up with Mr Matthews’s reflections on what is involved in working through physics problems. He identified the critical move as abstracting the features of the situation which are needed to build a model:

There are quite a few periods when they do problems, and I encourage them to talk to each other about how they’re doing them, in that way physics is quite different from maths, because of the modelling - they don’t have trouble remembering the formulas, the problem is the jump from

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describing the situation to the model - not just knowing which formula, but knowing which bit goes where. I sit up the front and help them sort out which formula applies and how. They need guidance - if they get stuck, they can't unstick themselves, but I make a rule that they must attempt a simplified picture before they come and see me.

Mr Matthews pressed his students to recognise (rather than apprehend) physical relationships - to detect the same structural features in a variety of different situations. "Physics is about modelling, they have to be able to see that a car going down a hill is equivalent to a block going down a plane." Ideally, this is not simply applying a formula to a problem, but identifying essential features of the situation which the problem describes, and matching the formula to them.

I want to get them to a satisfactory stage, where they can recognise situations that have been described to them and apply a model.

Problem-solving, as Mr Matthews presents it, is a process which ultimately enables students to apply, and then to generalise, what they have learnt.

It transfers over to other things, the idea of finding the essential or important features - life in real situations is very complicated. If you look at bikes, say, there's circular motion, friction, linear motion - if you want to get started you have to pick out and simplify it so you can see the pattern - you can simplify different things and use the same sort of techniques, the bucket and the block of water drawing can be inverted and used to represent the person at the top of the ferris wheel (they don't need limbs or head, a block on a line will do). The students get skilled at seeing the essential features, sorting out what's going to be an important feature.

The route to this skill was repeated practice. Mr Matthews presented himself as a great believer in "number-crunching", plugging a formula into one problem after another until the process began to make sense.

I've got a bit of a theory that the students who don't understand haven't done enough formula stuffing, and they can't have a good intuitive understanding without being quantitative about it as well...

The weaker students firmly believe that the formulas are gospel, like the tablets handed to Moses, really true - not many of them realise it's an elaborate modelling process. Understanding comes slowly. To start with they want a recipe, how to do problems - many of them increasingly learn the recipe. It's exciting that some get past that, but they have to get through that step first. Often people write courses with the idea of avoiding rote learning, but I
believe it's a necessary stage in understanding - once you've done it, you have more brain free
to think about it...

He denied investigating his students' ideas:

If they do it wrong there's usually a whirlpool of ideas going round and round in circles. I never
try to work out what they're thinking, I try to get them to think about it the right way. It's
best not to stir those muddy waters.

The critical point was not whether the students trusted the formula, but whether
they could use it.

When Mr Matthews introduced a new concept, then, he expected his students to
begin to work with the relationship almost at once. He described the stages by
which he introduced an idea - say circular motion - as being fairly stable: first a
plausibility analysis, in which he reminded them of what they already knew and
went on to expound the basic principle, then an experiment, finally a mathematical
exposition which was the prelude to some time spent solving related problems from
the text. Of the introductory lesson, the word he used repeatedly is "persuade":

I start off talking about it in a very general way. I talk, they listen - I draw out the idea that
circular motion isn't natural, I take a constant force. I use ideas from the previous year (without
friction things go at a constant speed in a straight line - I remind them of this); then I point out
that there must be a force that holds the object in the circle. It requires a fair bit of persuasion.
I don't name the force, some people do, but I refer to it in terms of the actual force involved,
say friction, or the tension in the string. Then after I've persuaded them, the next step is doing
an experiment - they won't all have understood it - to show that you need a bigger force for a
bigger object or a tighter curve. Once they have an idea of the relationship they're looking for,
one they start talking about how to measure the force required, say to swing things round your
head, we get some relationships with speed, mass, the inverse of the radius.

What is at issue here? What is the point Mr Matthews wants to persuade his
students of? He seems to want them to accept that for an object to move in a
circular path, a force must be acting on it. The main response he wanted from his
students, however, was in terms of measurement: "once they start talking about
how to measure the force required..." His students were expected to get an idea of
"the relationship they're looking for". The experimental stage was then basically
confirmatory:
The major function would the the verification of some sort of relationship which they've learnt about... In the 60s they were expected to stumble on the laws of physics, but mostly if you leave them to do the discovering they discover the wrong things... Playing the scientist takes time, it’s an inefficient teaching strategy, we need to present them with the theory and the data - there’s a large body of knowledge that you have to get across.

Two important features of the relation Mr Matthews constructed between his students and the study of physics emerge from this description. First, how students apprehended the relationship between the force and the motion was not inspected - as we have already noted, the emphasis was on how they used their knowledge of it. Secondly, the student was represented as active in getting hold of this knowledge. The project was a joint effort (“we get some relationships with speed, mass...”). Mr Matthews spoke of his students as would-be scientists, whom he was inducting into the practices of science.

It’s often said that most people aren’t going to be scientists, but I hope quite a number would be scientists, or at least do a science related thing, so I want them to have the relevant experiences of being scientists.

This idea underpinned his description of other elements of the course. He said of the Extended Empirical Investigation option, which all his students did: “Experiments are an important part of science, and we make them into scientists for a while, make them sweat it out.” Other features of scientific activity he picked out related to the wearisome details of hypothesis-testing. Scientists have to “collect a lot of boring data”, so

I sometimes get them to collect a whole lot of data. I take the meteorology option, and I get them to track a balloon with home-made theodolites, they go out every morning to track it and measure the temperature...I also get them to collect data on different radio-active sources, I get them to read the count rates every minute for ten minutes, then add another layer of lead, and repeat; they'd collect three or four pages of notes. I don’t think you should protect them from the boring repetitive part of scientific observation, though they seem to enjoy it (laughs).

He made a point of insisting that the data they collect was accurately observed and recorded, and any discrepancies investigated and explained, rather than concealed:

I insist they plot the points in ink - I don’t want to see any dots of liquid paper - they must record their actual observations. They’re not to blame for what the observations are, it can be
the vagaries of the equipment, but their task is to see what they can do with them and construct the best relationship they can.

Mr Matthews’s construction of his students as scientists paralleled his treatment of their relationship with the body of knowledge he wanted to get across: his primary concern was with his students mastering the skills involved, learning what to do and how to do it.

Mr Matthews taught a sequence of lessons on simple harmonic motion. He introduced the topic with a demonstration which involved each student in timing the motion of a glider suspended on an air track between two springs. He said to me,

I usually start simple harmonic motion by expounding the principles, but there’ve been a lot of talk and a test in the past few lessons and I felt they needed some hands-on stuff. They may be great big boys, but give them a stopwatch and they’re in the palm of your hand.

The assertiveness of the group is particularly noticeable at the beginning of the lesson, when Mr Matthews was setting up the air track. Their questions suggest that they feel at home with the activity and are already trying to work out what it is all about. Throughout, there is a sense that they are expected to be familiar with the situation and the terms involved. As we shall see, Mr Matthews speaks of frequency, period, mass, force, tension, displacement, amplitude, the size of the motion, in a way that suggests he expects the students to know exactly what he is talking about; he does not ask questions to check that they know the definition of any of these terms.

(Class goes into lab. T hands out prac sheets)

T Get yourself a chair and make sure you can see the air track.

(Hands out stopwatches)

I’ll give your tests back in the other room.

(Sets up air track - this takes five minutes or so. Boys wriggle and chatter, play with stopwatches.)

S Are we just going to have fun with these things [stopwatches], or what?

S Are you getting the air track ready?

T Sorry for all this messing around.

S What are we going to do?

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T: A demonstration.

S: Sir, it's (glider) on an angle.

T: Now, just nearly ready.

S: Nearly.

Mr Matthews now introduces the motion. He focuses on clarifying the essential elements of the motion which the students are to observe, so that their observations are framed for them by his questions:

T: The motion we're looking at is vibration - simple harmonic motion. It's called simple because it's as simple as you can get, with simple springs. It's called harmonic because it's a back and forth motion. Just look at the motion. (He sets glider going)

S: Can't even see it.

T: Now, we wanted to get rid of gravity, then all you can see is the forces making it move. Why does that move like that?

Michael: No friction - when it goes that way it has a spring pulling it back - the force gets less as that gets greater - and so on on the other side.

T: Dead right, I couldn't have put it better myself. You have to pull it back to start it, then it overshoots because it's moving, it slows down, stops, then moves back again, and again it overshoots. The middle is the equilibrium position, and it eventually does end up there. The motion is complicated, it gets bigger, smaller, stops - you couldn't analyse it with a ticker timer.

These remarks begin to get at the detail of the motion: the effect of force (mentioned by Michael) on velocity (as developed by Mr Matthews). He rules this area off for the time being as too complicated.

T: We're just going to look at it in a simple way, the frequency and period, not its speed - we want an overall result, how rapidly does it vibrate. We're going to keep everything on the level, we'll change the mass and vary the spring - we won't make that too complicated, we'll just double and triple the springs.

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A model of the motion is emerging. The frequency of the glider's oscillation is to be considered in relation to its mass, and the force exerted by the springs. Before the students time the motion, Mr Matthews asks them what they expect will happen.

T What do you expect the effect of increasing the mass to be?
Ss It will slow it down.
T Yes, it will be more sluggish to accelerate and decelerate.
What about doubling the spring?
Michael It'll make it faster.
The effect is to be quantified.

T We don't know if it will double the speed, but it should double the acceleration.

But first, the possible effect of the size of the swing is to be got out of the way.

T First we'll look at how the size of the swing affects it.
(S (mutters) It doesn't.)
T (tells story of Galileo)
The story of Galileo is important, and characteristic of Mr Matthews's teaching: he repeatedly reminds students that their investigations follow, and in a sense are modelled on, those of earlier scientists whose findings they are replicating.

T Now, I'm going to give it a small displacement. Can you see what Galileo saw - big swings are the same as small ones?
S It's a constant mass and constant everything else.
T Yes, if you double the amplitude you double the force, the acceleration, the speed - it covers a bigger distance, but it goes faster, so it might be exactly the same time.

The student here is speculating that the constant frequency, or period, is predictable, because there has been no change in the experimental conditions ("constant mass and constant everything else"). Mr Matthews's "yes", like his "couldn't have put it better myself" earlier, is followed by a considerable modification of what the student has to say. Although the mass is constant, he says, the force is not constant, because the spring has been extended further. He
wants students to reach the conclusion, which he has already suggested in his Galileo story, that the amplitude is not important, but he points out that this is not because the conditions of the experiment are unchanged (as the student is suggesting) but because one change has caused another.

The findings for displacement are not to be reported with the other prac results, which perhaps suggests that they are not as important, but they are given as much time in the lesson.

That would mean we don’t have to have a fixed amplitude, any old one would do.

Everyone get organised - you need a pen, your prac sheet, and something to put the prac sheet on.

A few practical things to help you. It’s hard to count from the middle, when it’s going fastest, it’s simpler to do it at the end. Don’t time it just for one oscillation, do it for twenty and divide. Remember it’s zero, not 1, when you click to start. I’m just doing the donkey work here. I’ll only give it a small displacement - it nosedives and digs in if you move it too far - say 3 cm, it’s actually 3.5, don’t tell the Russians.

(Off it goes)

The time you write down you’ll have to divide by 20 so you’ll have to leave space to divide it by 20.

Okay, the next one will be 6 cm. (Off it goes again)

Don’t get hypnotised by this, will you.

Now, it’s actually ended up at about 3 - we hope it will be the same.

This is 9 cm, well, I’m actually starting at 11 (S Oooh). You’re quite right, I shouldn’t start... If I use this string I should be all right. (Off again.)

(Looks at student results)

That’s as equal as you can expect to get - you’ll have to divide by 20.

(Turns off machine.)

It looks as though the amplitude doesn’t take effect. Galileo saw the candelabra swinging, with the small and big swings keeping time - that

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story may be apocryphal, he didn’t like experiments. But yours is better, gravity isn’t messing us around.

Now for the real work of the lesson.

T  The next thing is to increase the mass. What will happen to the period?
S  It will increase.
T  Yes - I’d drop physics completely if that didn’t happen. But what will the relationship be? If we double the mass, will we double the period?

Again he draws their attention to the quantitative relationship.

The mass you were working with was .257 kg - you can use the last of your readings as your first data for this section.

(S  I reckon he’s going to lie to us.)
S  Does the mass of the spring count?
T  Yes it does a tiny bit, but it doesn’t all move - you have to ignore it.

We’re not going to bother with amplitude from now on, we’ve proved that doesn’t make any difference. Use your last reading as the first entry here - choose whichever one you like the look of. (Weighs total mass) We’re hoping for .357 mass .310! Don’t like that, it’s got to be faulty.

Ss  (grizzle and moan.)
T  (fetches another scale) .214. (Checks weight of the original glider) That’s hopeless .136. That first one was .136. Then I’m going to add this weight on to it - .236.
(S  It’s about time.)

This student is the one who was confident that amplitude would make no difference. He is impatient to get to some positive findings.

T  Now, we’re convinced by that first preliminary experiment that the amplitude doesn’t matter - it’s a negative result, but it’s very handy - we can throw the ruler away. This time we’re expecting something a bit lower.
S  Turn the vacuum cleaner on. (to charge the air track. T does)
Thank you - when you're ready! (He sets the glider in motion.)

Oh, I've got 12.6 - I don't trust this thing.

Human error - could be some reaction time there.

(start to count) 12... 11.95... 12.6... (Noisy discussion)

I can hear a buzz that suggests 12 secs might be about right.

Aha, I got 12 this time.

(turns off air. Loads an additional weight.)

The next mass is going to be .337.

Now, listen fellas, Geoff, as it slows down you'll have to be a bit more precise. it looks like it's motionless for about half a second, it will become more critical as it slows down.

Do you get about 14? (Various answers))

Last one, another 100 gmer on there. .437 I suppose we're looking for. You've still got one space, haven't you? The mass is actually .436 - it's supposed to be .437.

What's it about? [ie the approximate value of other students' last observation])

When we double the mass, is it halving the time?

No

Boys, could you stop talking please?

When we doubled the mass, did we double the time?

No

So it's not as simple as we thought - it's not just a simple f=ma thing.

15.85 - yeah (T checks his wristwatch) 15.81... I got exactly the same.)

(TURNS OFF AIR)

The final phase of this lesson involves generating a set of observations using one, two and three springs.
Now, don't try to analyse these yet, look over the page.

We're going to change the spring constants - you know how to do it - 17 for each spring, double that, gives 34. Now, why don't you use the last time you got, and we'll keep the mass. This time we're going to double up the spring constant and make it 68 - you're all convinced it will go faster.

Do we have to take your word for it sir?

No, we'll do it. Quiet please. Starting at about the same amplitude, the force's double, the acceleration will be double at any instant - shouldn't that halve the time? Well, I wonder.

Twice in a row I got 11.15.

This is getting beyond a joke (checks neighbour's readings) What you get? Sir, can you do it again?

Anyone still going?

Now, a spring constant of 3 springs, 3 * 34 whatever that might be, you work it out.

Rightyo, here we are (it's very quick). By george, it has speeded up.

8.8 9.5 9.1

Do it again! (It's still going but the movement is slight)

I don't understand what you mean, do it again - do you mean increase the amplitude?

9.5 Not exactly 8.2 8.2 9.1 Yeah, it's nine.

All now adjourn please. Analysis of this is really fun. Stopwatches before you go, I need them back.

The class moves out of the lab where they've been watching the air track, and back to their normal classroom. It is very close to the end of the period.

(Return to classroom. All talk noisily about other things. T cleans the board.)

Let's give out the test.

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Unless you really know what you're doing about log graphs, hold your horses until next time for the analyses. I'll give out the tests plus some answers. (He does)

S  Homework? (But T does not set any.)

T  Chapter 9 problems please. We're on a get tough campaign against people who don't hand in problems. When you've given me your problems, off you go.

In each section of the prac, Mr Matthews has generated the hypotheses which give meaning to the students' observations. He has worked alternately on clarifying the hypotheses being investigated, and achieving accurate observation. Because it is Mr Matthews who develops the model for investigation, he can restrict the features of the motion they are looking at to a fairly simple set: "We're just going to look at it in a simple way, the frequency and period, not its speed - we want an overall result", says Mr Matthews. The messiness of unrelated observations is avoided, the detail of the motion as the mass moves from one end to the other can be excluded. This is consistent with the conception of model-making, paring down observation to essentials, which Mr Matthews expressed in the interview discussed in Chapter 3.

The connection between the students and the model Mr Matthews develops for them is made through the business of detailed observation. The physics student Mr Matthews is constructing enters into the study of physics as a process of determining and measuring relationships between quantities. The student's findings are not expected to produce surprises about the general nature of the relationships ("I'd drop physics completely if that didn't happen"), but to confirm them. The declared object of the students' work is to quantify the relationships involved, which means their observations need to be careful and precise. This process of investigation is represented as the key element in the lesson: "I'm just doing the donkey work here", says Mr Matthews, untruthfully. The main points in the lesson when there is resistance from students in fact come when they are anxious to get on with the process of observation. Mr Matthews's students are preoccupied with achieving an accurate set of results.

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Mr Nelson: Structuring experience

Mr Nelson was quoted earlier as an exemplar of the conception of physics as a way of understanding the natural world. He talks about linking real-world experiences with the way theoretical principles can represent, pattern and connect experience of the natural world:

I’m all the time trying to build links. Students seem to want to keep things separate, they’ll learn off a string of formulae - I don’t like formulae, I teach them about relationships. They don’t necessarily see the overall pattern, for instance with electro-magnetism, we’ll start by looking at magnetic fields generally, electric current, forces on electric current and individual charges in the magnetic field. Then we recall that when we made a conductor in the electric field, it generated electric current. All those things are interconnected, and I show them the pattern of how they’re connected, and then I show them how you can see exactly the same pattern with gravitational force and gravitational force fields.

(Interview)

The emphasis here is on the interconnectedness of theory and its power to make observation intelligible. Mr Nelson continually emphasises the importance of understanding principles across situations and topics. He barely mentions formulae or problem-solving, which loomed large for most teachers (and constitute the stuff of the Physics exam); he stresses that he wants his students to see the basic theoretical relationships which the formulae express.

In relation to the focus of his lessons, Mr Nelson represents his role in terms of getting his students to understand.

I don’t see myself essentially as a scientist, I’m a communicator, a facilitator in learning, my job is to decide on the best way for the students to learn a concept...

His description of his lessons suggests that he sees his students’ learning in terms of an interplay between experience and reflection, in which his role is to structure the experiences, provoke the reflection, and ultimately provide an overview of the relation between theory and observation (“Fifty percent of the time I’d be teaching for content - that’s the time constraint in the course - expounding and explaining the body of knowledge, very like a lecture, though hopefully in an interesting way”). He sets up “hands-on” experiences, and challenges his students to interpret them:

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Mostly I'd introduce a topic with a structured ten-minute exercise - with girls you need straight confidence-building hands-on stuff, not just textbook theory but something you can handle. For instance, when we introduce forces, we don't talk about it, we do it. A force is when you push or pull, right, so two girls have to come out the front and one pushes the other. What did you feel? What did you feel? We put them on trolleys and they push each other round the room. Or I put a drawing pin on my desk and ask one of them to push down on it - why don't you want to? It's smaller than you, you're pushing on it - Oh, it will push back? What will that depend on? - and there you are, Newton's Third Law. There's no point in just talking about it - you need a bit of drama and showmanship...

The meaning of the experience is developed largely through questioning, and again the focus is on the students' understanding, getting students to make their ideas explicit:

I put a lot of emphasis on hands-on learning experiences, to help discovery or reinforce the theory or raise questions. Some are just reinforcement, so they'll know the answer already, others may introduce a topic so they'll be asked to look for things without knowing what they're supposed to be looking for or what they're meant to see. So for instance when we look at waves, I might set up springs or ripple tanks and get the students to observe the waves with various different conditions, wider diffraction, changes in wave length, frequency, slit width, obstructions. They don't know what they're meant to be looking for, but they have to record what they see, and then they all share their results and we have a discussion; then they'd write up their observations out of class. During the class I'd draw from their observations and build up a picture, and propose some applications (does sound behave the same way? can we test that?) I try to avoid telling the students what they should have seen, or they'd sit back and wait for me to do it - sometimes I won't settle answers to difficult questions until they've all taken their stuff home and written up their results...

He expects and invites his students to declare their doubts and to ask questions when they do not follow, or when their ideas conflict with his.

When we're reviewing the previous lesson's work I'll ask questions and name students, not just volunteers. So for instance in relation to today's lesson I might ask someone to describe what they understand an electric current to be - that gives me a chance to see what their understanding is, and it also gives them a chance to think about their own level of understanding. Then I'd ask another student to comment on that answer. Or I might ask someone for a mathematical definition of electric current, or the relation between electric current and charge, or what happened, what did you do yesterday and what did you see.
Mr Nelson’s central metaphor throughout these comments is to do with seeing: how and what his students see. He focuses on changing what they observe, that is, the way they structure what they see. Physics theory here is read as structuring perception. Mr Nelson’s concern with how his students interpret their experience, and his account of physics as centrally to do with understanding experience, can be seen as intimately connected.

Mr Nelson had a double period at the beginning of this topic, to which he devoted altogether seven lessons. Most of the first period was devoted to extracting observations and ideas from the class:

T On Wednesday you’ll be having a test on projectiles and uniform circular motion, and I want you to hand in your written answers to Q15 from past exam papers.

(Projects a sketch of a girl sighing PHYSICS!)

(Sets up equipment: 2 springs and runner on the air track. There are already two weights on springs and a pendulum hanging in the front of the room. He sets them bobbing and swinging.)

You don’t need to anything to write with just yet - use your powers of observation - eyes and ears all tuned into your wonderfully powerful brains.

Up the front you can see a new form of motion. There’s a very strong connection between these and circular motion - think about the similarities and the differences. What can you see?

(The class had just finished the study of circular motion.)

Ss They’re all moving.

Fair enough, but be a little more specific. One at a time - let’s build up a pool of observations.

The velocity is changing.

Is that a similarity or a difference?

Claire Similarity.

T Yes, it’s changing direction and magnitude.

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Here Mr Nelson chooses to elaborate on how the velocity is changing. We’re not sure how Claire saw it changing - possibly only in direction.

Sue They all follow a cycle.

T OK - they’re all repetitive. That’s a very good observation. Both circular motion and all these are periodic, they repeat themselves. That’s one of the strongest similarities. Any others? You have the power to come up with a body of knowledge that tells us things about these motions - you need to link it back with what you’ve already learnt.

Nellie They’re all attached to something.

T What’s that something doing? What’s the purpose of the string?

Bonnie Providing force.

T There’s probably more we can get out of this.

The next student recurs to the question of changing velocity.

Sue Are the speeds changing? They seem to stop at the bottom, accelerate towards the top, stop at the top, and speed up again going down.

T Is that a similarity or a difference?

Sue Difference.

T Yes.

Kellie-Ann Are they all accelerating?

T Do you think so?

Kellie-Ann Yes.

T I’ll say, you’re correct, and you tell me why?

How can you answer the question if they’re accelerating?

Sue There must be a net force

Rhonda Is this harmonic motion?

T Why do you ask that?

Rhonda That’s the next topic
T: Why would you make good politicians?

Rhonda: Answer a question with a question.

We did it at summer school.

This discussion has lasted for twenty minutes. Observations are coming slowly and reflectively, with lengthy pauses for thought. After his opening question ("What can you see?"). Mr Nelson's comments and questions come in response to students' observations. He is holding back his contributions, leaving the floor open to the students (eg "There's probably more we can get out of this").

Sue: Do they travel a certain distance for a certain speed?

T: I'm not sure what you mean.

Sue: It slows down as it's shorter - it takes the same amount of time irrespective of distance.

T: The oscillation takes the same amount of time. That's valid. You've done the first stage in an important step of scientific thinking - observing, you know a little bit about velocity and distance, then you said, I think. What's the next step?

S: Test it.

T: We'll be testing that this afternoon. It's part of a process which really is the process of science, building on past knowledge, careful observation, and now thinking - you've discovered half the things in the brief note I've prepared - they're in your mind already.

Mr Nelson now breaks off the discussion and writes up some theoretical notes.

It is called simple harmonic motion - it's generally in a straight line, so it's linear, not in a plane like circular motion. Where a mass oscillates a between two extreme positions, and x is the equilibrium position, if it is displaced from the equilibrium position and released it will return towards the centre.

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1 This strategy would, of course, be invisible in an analysis which proceeded by counting types of question.

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(Writes on board) If you feel it helps, sketch that down - you might need some reminders.

Ref: S & M ch 10 - read it.

(drawing)

Really, this is just terminology. (Something impatient about how they all picked up their pens and started writing.)

\[ x = \text{displacement from the equilibrium position at any instant} \]

\[ A = \text{amplitude} \]

\[ F = \text{force on mass (always towards the centre)} \] The force is known as a restoring force and is proportional to \( x \).

\[ T = \text{period} \]

\[ f = \text{frequency} \quad T = 1/f \]

(Hands out prac sheet.)

The discussion finishes with the development of a set of hypotheses. The class suggest a string of questions, following Sue's successful question earlier.

<table>
<thead>
<tr>
<th>T</th>
<th>Let's see if we can generate some other hypotheses. Sue says that the period is not related to the size of the oscillation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noni</td>
<td>What do you mean by displacement?</td>
</tr>
<tr>
<td>T</td>
<td>(explains) DON'T COPY THIS DOWN!</td>
</tr>
<tr>
<td></td>
<td>(Writes)</td>
</tr>
<tr>
<td></td>
<td>Does the period (t) depend on the amplitude (A)? - We're testing Sue's hypothesis.</td>
</tr>
<tr>
<td></td>
<td>Another question?</td>
</tr>
<tr>
<td>Mollie</td>
<td>How does the period depend on the spring?</td>
</tr>
<tr>
<td>Jenni</td>
<td>How does the period depend on the mass?</td>
</tr>
<tr>
<td>Claire</td>
<td>Does the amplitude depend on the force?</td>
</tr>
<tr>
<td>T</td>
<td>(writing) What determines the amplitude?</td>
</tr>
</tbody>
</table>

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Kellie-Ann What determines the velocity?

T That's difficult - it's changing all the time.

Nancy What determines the acceleration?

T (writing) What determines the maximum speed?

Before turning to the prac, Mr Nelson asks a couple of students for their expectations in relation to these hypotheses.

Two main things seem to be going on in this lesson. First, students are asked to attend to the observable characteristics of the motion. Secondly, they are encouraged to develop hypotheses based on their observations; they are repeatedly asked to voice their observations of the motion and to offer ways of describing it. This process is given a considerable amount of time. Mr Nelson does not name the motion they are watching until half-way through the lesson, and he specifically ignores any prior knowledge of this particular motion which his students may have. At this stage he does not offer the class graphs or formulae to summarise the relationships involved; he mainly uses his theory notes to define terms.

The thrust of this lesson and the prac which follows it is thus towards getting students to characterise in some detail, and from direct observation, the motion under study. Generally, Mr Nelson's students seem to provide the kind of question he is looking for. There are, however, points of tension, where students' questions or comments are set aside or ignored, and these moments tend to confirm the analysis of Mr Nelson's position presented in Chapter 3. We have already seen that, as he said, Mr Nelson uses student observations to carry forward the analysis - he is not responsible for the initial framing of propositions about the motion, and indeed he holds back from stating the relationships which characterise it. At the same time, he steers and controls how students are to use their knowledge, and what knowledge is admissible. Heavily theory-laden terms like acceleration are turned back on the user, whereas "changing speed" is accepted. When Rhonda says, "Is this simple harmonic motion?", Mr Nelson overtly - and paradoxically! - turns back the question, interpreting it as evasive: "Why would you make good politicians?" "Answering a question with a question?". Rhonda then says, "It's the next chapter" and "We did it in summer school", but Mr Nelson does not respond to either comment. His attitude to prior knowledge is ambivalent: on the one hand, he praises Sue for "building on past knowledge, careful observation, and now thinking", but on the other hand, he does not let by words thrown in like

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“acceleration” ("Are they all accelerating?"... "I’ll say, You’re correct, and you tell me why") His responses draw boundaries which exclude prior theoretical acquaintance with the topic: whatever students have made out of attending a summer school, or reading the next chapter, is to be set aside in favour of using first principles in relation to their observations.

The student Mr Nelson is constructing walks through the process of observation tentatively formulating hypotheses based on a small set of characteristics of motion. Students with some earlier exposure to the topic are pressed towards acting naive. There is a sense of covert struggle in which Mr Nelson tries to rule out "observations" which are the result of knowing what one ought to be seeing, and his students try to represent expectations of what ought to be happening as the result of naive observation. This struggle can be read as the outcome of the paradox detected earlier, between Mr Nelson’s orientation towards what his students understand, and his attempt to control what they experience and how they interpret it.

Although Mr Nelson withdraws from directly interpreting the motion at this stage, he nevertheless frames the way his students are to interpret it: first by referring back to circular motion as their starting point, and later in the way he receives and modifies student suggestions. In the lesson different students in the class (notably Sue) speculate that the motion they are watching involves changing velocity, a constant period, and a relationship between force, mass and frequency: as Mr Nelson points out in a later lesson, simple harmonic motion is here being considered in terms of Newtonian mechanics, the relationship between force and acceleration. This is in fact the focus of the prac he has prepared and which the students go on to do in the second part of the session.

Towards the end of the discussion, Mr Nelson distils three questions which he sets up for investigation: the relationship between the period and the amplitude; what determines the amplitude; and what determines the maximum speed. Though these questions are indirectly derived from what students have said, they have not been

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1 This class was my own first contact with the theory of simple harmonic motion. Observing the masses bouncing on their springs, and not knowing what to look for, I was not at all sure what I was seeing. I found it difficult to detect changes in velocity between top and bottom, and I felt I would need a stopwatch to know whether the period was constant.

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taken up unchanged. Sue has suggested “it takes the same amount of time irrespective of distance”; this is transformed into, “Does the period depend on the amplitude?” Mr Nelson then abandons the period as the feature of the motion to be explained (though students suggest hypotheses), and he generalises Claire’s suggestion that amplitude depends on force (where the form of the proposition is modelled on his earlier re-statement), to the more open question, “What determines the amplitude?” Two students then turn to velocity and acceleration, and he transforms their questions to “What determines the maximum speed?”, which focuses Kellie-Ann’s suggestion and sets aside Nancy’s question on acceleration. These questions are not specifically addressed by the prac he has prepared, and the results of the prac will only provide data for considering the first of them. The other two questions are more comfortably addressed using an energy framework, which none of the students’ remarks has touched on at all. This set of questions may therefore be considered as framing the students’ study of the motion - which will ultimately incorporate an energy analysis - rather than being a lead-in to the prac the students are about to do.

It is significant that Mr Nelson does not expect that he will necessarily succeed in changing his students’ ideas - significant because it communicates a strong sense that learning is problematical, that his students need time to explore the experiences and ideas he presents. There are contradictions in the demands placed on him as their teacher:

They can’t understand quickly enough the concepts that are being taught, within the rate I have to go to cover the course. They need more time to explore the ideas. Probably by the end of the year a third of the class would understand and the other two-thirds are really having to work hard to try and catch up.

Mr Nelson’s comments here point to a tension between what he feels is demanded by the exam, the source of pressure on time (“the rate I have to go to cover the course”) and what is needed for learning. This tension is visible in his description of his relationship with his students’ learning. Although he describes his students as exploring ideas, he presents them with the ideas they are to explore: the territory

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1 Mr Nelson started the next lesson by asking what students thought the prac had been about, and using their answers to diagram and then graph the relation between force and acceleration in the motion.

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is not unknown or uncharted. Mr Nelson spoke about “children’s science”, student conceptions, but his students are not expected to work like scientists.

I want the students to learn how to enquire. But I don’t believe I am teaching them how to act like physicists. (Do you tell them that?) Not in so many words. But scientists don’t set out with a prac book following steps like students do, they don’t replicate others’ work in the way I do - I’m aiming to enable the students to understand the physical world, so I provide them with structured experiences to help them to understand, whereas the physicist is enquiring about the laws of the natural world.

Because he guides discussion and observation so heavily, and short-cuts questioning when he needs to, Mr Nelson is not a textbook example of a “children’s science” teacher. At times he commented on how teacher-centred his lessons were: highly structured, involving considerable guidance and authoritative pronouncements. Although he continually speaks of what his students see, and their observations are the material he works with, they have the status of offerings to be commended or corrected. His questions are open-ended only in the sense that he will work with the answer he is given. It is always clear to his students that there is something they are meant to be looking for. The nature of the interpretation he wants them to achieve is not open to dispute. Ultimately, there are right answers.

I’m aiming to enable the students to understand the physical world, so I provide them with structured experiences to help them to understand.

This is a key comment. Mr Nelson understands Newtonian physics as achieved theory rather than transparent fact - illuminating, but not intuitively obvious. Because he is so conscious of this problem, he provides carefully thought-out activities which he can use to restructure his students’ perceptions. His orientation towards what students understand problematises the process of understanding. Paradoxically, however, his students are present in his remarks as passive and even resistant subjects. The very extent to which he takes responsibility for their learning seems to exclude the students’ agency.

Seen from the students’ perspective, these are important features of the shape Mr Nelson gives their study of physics. From the students’ point of view, the theory to which Mr Nelson is guiding them is already contained in their textbooks. While Mr Nelson is at pains to alert them to its consistency (and at times its discrepancy)

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with what they themselves experience, his students can be in no doubt that his agenda is to guide them towards already known propositions.

**Ms Konstantinidis: Stacks of equations**

When I first interviewed Ms Konstantinidis, in 1989, she was nearing the end of her second year out as a teacher. I observed her teaching Year 12 classes in 1990 and again in 1991, and I interviewed her again at length in September 1991. In both interviews, Ms Konstantinidis communicates a sense that she wants to share her own understanding of the subject, and her enthusiasm for it, with her students; in both interviews, she puts most emphasis on the value physics has as a way of understanding experience. I start by describing her thinking at the beginning of the period.

By contrast with Mr Nelson, Ms Konstantinidis at this time represents the process of studying physics as straightforward. Like Mr Nelson, she attaches value to students making connections between the concepts they are learning and their own experience, which “makes sense” of physics theory. However, these connections are taken for granted; unlike Mr Nelson, Ms Konstantinidis does not focus on them. The body of theory the students are to acquire, and its relationship with their experience, are seen as essentially transparent and uncontentious. She says, “I want my students to be spot on with the concepts.”

> For instance, with light, I would like them to be able to use ideas like refraction and reflection to explain how we get rainbows... (Interview, 1989)

The process of acquiring these concepts is relatively unproblematical. It doesn’t involve her in transforming her students’ ideas, but getting them to become more accurate in their use of words:

(Is there anything which really means they have to change their ideas?) Not really; their ideas change from rough meanings to more physically accurate meanings. Mostly it’s just a matter of refining how they use terms... It’s hard teaching physics to Year 11s at the outset, they don’t know what to expect; they find it a bit scary being confronted with the new ideas - speed and distance are familiar words but they never really have to think about what they mean. It’s hard to get them to use words correctly.

When she describes her teaching, Ms Konstantinidis talks at some length about how she tries to get her students to make links between the words they are

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acquiring. She describes how she would start a new topic in Year 12 by using the students’ recollection of previous work, to hook points together at a level of verbal recall:

(How do you tackle a new topic?) Write up the heading on the board! It’s not like Year 11 where you can start with some practical observations; I talk about the theory first, then see how it works. For instance, with the two types of reflection (diffuse and regular), we observe reflections and the angles of incidence/refraction, look at types of lenses and the images they form (eg concave mirrors); then I go on to say “Where do you see a convex lens?” (remembering they did this topic also in Year 11), and hopefully they’ll say an eye.

In Year 11, and at points of particular difficulty in Year 12, she uses a concept map:

(What do you do if students seem not to understand?) We write up the problem and then brainstorm all the important words in it - it’s no good just talking about one word in isolation. I try to draw up a concept map on the board, so that the class as a whole summarises what’s been done, and eventually they click that what is described in the concept map is the set of ideas you need for the problem.

It is significant that the project of drawing a concept map is seen as an exercise in summarising relationships, rather than a technique for discovering how students understand them. The concept map makes available the formulae and relationships which students need to solve problems... Ms Konstantinidis expects that students learning physics may have difficulties getting through the work, digesting what’s been taught; she does not talk about problems of understanding.

Ms Konstantinidis emphasises handling physics ideas, not particularly solving problems or re-interpreting experience. Because she wants her students to attach meaning to the terms they’re learning, and connect them to their own experience, the parts of the course she is most comfortable with are those which most readily link with their experience:

The basic concepts I think are most important would be ideas like force, momentum - I want the students to be able to think outside the textbook situation, eg what is happening when they’re thrown forward in a car without a seat belt - to explain everyday things. I don’t like teaching the more abstract topics like electro-magnetism so much - it’s an uphill slog, the students find it unattractive, it’s very abstract, and a lot of the terms are very similar though they have very different meanings. Usually students manage it by solving the problems by memory (from having done fifty of the same kind before); they can’t find anything about it that

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makes sense to them. Nuclear physics is also rather abstract, it's interesting, but it only really relates to chemistry. Electricity though is good to do, especially where it relates to household uses.

On the whole students need something they can identify with, something that grabs them. I like to take it away from "physics" and relate it to something familiar.

At this point in time, Ms Konstantinidis tends to represent theory as a vocabulary of terms and relationships, complete with definitions, which she expects her students to acquire. Solving problems, or explaining rainbows, involves selecting the appropriate terms from this vocabulary and applying them.

Ms Konstantinidis gave only one lesson on simple harmonic motion. This was because she saw it as a fairly straightforward topic which could be got out of the way quickly. Compared with other teachers I observed, Ms Konstantinidis gave relatively more time to option work and less time to the core theory work needed for the end of year exam.

I missed the beginning of Ms Konstantinidis’s lesson, because it followed some private talk with the class about how they were progressing. When I came back into the room there was no evidence of a demonstration, but there was a heading SIMPLE HARMONIC MOTION on the board with a drawing of an object between two springs underneath it, and a definition of the motion. Ms Konstantinidis was saying,

\[
T \quad \text{And because we're looking at a glider and springs, we're also got a restoring force - we know from our work on springs last week that}
\]

\[F=kx\] where \(k\) is the spring constant, and \(x\) is the extension.

(Writes)

\[F=kx\]

\(k\) is the spring constant

What direction do you think the force acts - where does the spring want the glider to stay?

Simone  
In the middle

T  
So we can say, and the force acts towards the centre - that makes sense - because it wants the glider to stay in the middle. Once again, for simple

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harmonic motion, if you're given an Fx graph - one that's a straight line rather than a curved line - how would you find k?

S The gradient.

Simone Rise over run.

T Rise over run. From an Fx graph, k is given by the gradient, rise over run. So if you don't have k, and as you know we usually need k to work out things, the Fx graph gradient gives us k.

All right.

And that's about where we got to last time with springs.

Like Ms Brown, Ms Konstantinidis focuses on developing a set of equations, of which F=kx is the first - this is one the class met the week before, when they were considering energy changes in springs. In Ms Konstantinidis’s class, however, the equations are somehow domesticated. The spring has agency ("where does the spring want the glider to stay"), the calculations follow familiar routines ("rise over run"). Although the class is watching a drawing of a glider, not an actual glider, they are asked to picture what is going on.

Next, Ms Konstantinidis moves to the energy analysis which provides the formula for calculating velocity. Again this is connected with the work the previous week, so the students have fairly recently used the formulae which are needed. She does almost all the talking, they take down the notes.

T Now we need to know about velocity - it's all very well to have zero velocity and maximum velocity and depending on the extension something in between, but we should be able to work out the velocity - so how do we do it?

So put up a heading, Finding velocity.

Looking at the same k graph, the same extensions, at this point the extension is x and at this point the extension is R.

---

1 Ms Konstantinidis retains this formula in the form F=kx, not F=−kx. The negative sign does not appear in the lesson and the reason for it is not discussed.
The way we find the velocity is using the energy stored in the spring.

We know the area under the Fx graph is the potential energy stored in the spring.

For potential energy \( \text{Pot E} = \text{area under graph.} \)

We also know that it is \( \frac{1}{2} kx^2. \)

In this case, we want to know the change when the mass moves from extension \( x \) to \( R \) - to get the thing to move you have to move away from \( x \) - so instead of \( x \) we'll put \( x^2 \) minus \( R^2. \)

So we get \( \frac{1}{2} k(R^2-x^2) \)

Right.

(Ss copy this down.)

And if there's a change in potential energy, what will that correspond to, a change in what?

Simone: Kinetic.

T: Right, kinetic energy.

And how do we work out kinetic energy?

Ss: \( \frac{1}{2} m \)

T: \( \frac{1}{2} mv^2 \)

At the moment that looks pretty horrible, but in a moment we'll get it into a nice equation, well, not nice, horrible, but we can use it.

We need \( v \), and we know that the kinetic equation has a velocity value.

We can work out the change in potential energy so we can work out the velocity.

So just equate the two.

So \( \frac{1}{2} mv^2 = \frac{1}{2} k (R^2 - x^2) \)

We end up with \( v = \sqrt{\frac{k(R^2 - x^2)}{m}} \)
Having set out the formula, Ms Konstantinidis checks that students recall the referents for the main terms.

T \( v = k \) - what is \( k \)?

S Constant

T Spring constant. \( m \)?

S Mass

T Mass - if we’ve got a glider oscillating back and forward, it’s the mass of that.

\( x \) is the distance it’s stretched to. \( R \) is the extra distance.

S Miss, is that just for simple harmonic motion?

T Simple harmonic motion with springs. If you’re told an object is oscillating from this to this, use this.

I’ve got some like past exam questions to do where you have to apply that equation to find velocity.

It looks horrible but when you use it it’s okay.

We can see here that the formula is presented as a means of solving problems for the exam; it is particularised to one specific context (“simple harmonic motion with springs... If you’re told”). Again the problem is domesticated, transformed into something to be handled “a nice equation - well, not nice, but we can use it”. The variables for which equations are needed are considered separately. In particular, acceleration (the rate of change in velocity) is considered quite separately from velocity, and might well be thought an independent quantity.

T We have to get acceleration too, acceleration is easy to work out.

(Writes)

Finding acceleration

Because this is mechanics, we’re always thinking back to Newton.

We know \( a = \frac{F}{m} \)

We’re talking about springs, and we know what \( F \) is equal to in springs.

---

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S \quad kx
T \quad kx. So a = \frac{\text{kx}}{\text{m}}

That's it - okay?

Once again, you might think, why not \( \frac{\text{F}}{\text{m}} \), but we know the force is always changing, the force depends on the extension. If we know the spring constant and the amount it's extended that gives you the force, and you divide by m and that gives you the acceleration.

Again Ms Konstantinidis focuses on how familiar formulae can be used to derive the new formula wanted to find the necessary value, this time for acceleration. There is a bit of a problem with the physics here, because the way Ms Konstantinidis is describing the effect of the spring suggests that there is only one force involved (although there are two springs in the diagram), and there has been no discussion of how the to-and-fro motion is achieved. Ms Konstantinidis's continued omission of the negative sign before the kx suggests that she herself has not focused on this point.

Ms Konstantinidis now turns to the final formula needed, which she does not attempt to derive (the derivation is not required for the exam).

Just one more thing we have to consider.

When you've got a mass like this glider oscillating back and forward - what do you remember was the name for the time taken?

Ss \quad Period.

T \quad So the time taken - the period (writing) for an oscillating mass, we can say, the period can be calculated, ie the time taken for the mass to return to its original position, to complete one full oscillation. It's pretty easy to work out.

What is the symbol for period?

Judith \quad \text{P}

T \quad \text{(hears T) Capital T.}

(Simone \quad I didn't know that! - [She usually knows the answers and is apparently miffed that Judith knows something she doesn't.])

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T  $T = 2\pi \sqrt{\frac{m}{k}}$.

What is $m$?

S  Mass

T  What is $k$?

S  Constant

T  Spring constant.

So they’re the things that deal with springs.

Judith  Is $T$ the symbol for period?

T  Yes, and $f$ for frequency.

(Judith  I said $P$!)

In the next part of the lesson Ms Konstantinidis explains that the class may be called on to calculate the period of a pendulum. This is not actually required by the curriculum, although it used to be.

T  The other thing we look at is the pendulum.

S  Like in grandfather clocks.

T  Yes. Sometimes we have to work out the period of an oscillation for a pendulum.

Is a pendulum suspended on a spring?

Ss  No

T  It’s not a spring, it’s on a string, so you can’t use $k$.

So for the pendulum - I’ll draw a picture of one:

(Draws it)

Does that make sense of what a pendulum is?

S  That’s just an arrow miss showing back and forward?

T  Just an arrow - $l$ is the length of the string.

Ss  Oh
(They write)

T \quad \text{k equals... We don't have k for the pendulum.}

We want to say \( T=2\pi \sqrt{\frac{m}{k}} \). We don't have a spring, we have a string.

So we say \( k=\frac{mg}{l} \).

And what we can do, we put \( \frac{mg}{l} \) in there - so it equals \( 2\pi \sqrt{\frac{1}{g}} \).

T \quad \text{What's l?}

S \quad \text{Length.}

T \quad \text{What's g?}

S \quad \text{Gravity.}

Simone \quad \text{Where'd you get } k=\frac{mg}{l} \text{?}

T \quad \text{I don't know, it's an equation - we've got length then there's a component of weight } mg.

There we've got stacks of equations. We can do a summary of them.

This passage confirms Ms Konstantinidis's focus on developing "stacks of equations" whose function is to help in solving problems for particular unknowns, rather than to elucidate relationships. Questions about how these equations are derived, like Simone's, are set aside ("I don't know, it's an equation"), but the situations in which the equations can be used are carefully specified ("We don't have a spring, we have a string"). In other lessons Ms Konstantinidis talks about them as "our little equation for" whatever is needed. Equations make problems familiar and solvable, and they become comfortable with use ("It looks horrible but when you use it it's okay").

In the remainder of the lesson students begin work on some problems using these equations, with Ms Konstantinidis moving around talking to them. There is no discussion of how to graph the motion, and issues relating to force, velocity and acceleration do not arise.

In my second interview with her, two years later (and after the lesson described above), Ms Konstantinidis spoke about the process of learning somewhat differently. It was no longer unproblematical.

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(What would you say Physics at Year 12 is about - what would you most want your students to have learnt?)

It’s probably different from what I think they should learn.

Ms Konstantinidis is much more conscious of the difficulties involved in getting students to understand the concepts included in the course.

They can understand it in the basic application sense, this is what you apply to get the right answer, but understanding has more to it than that - looking at the broader overview, seeing the subject as having a bit of relevance to their world...

Her description of her practice is very much the same - the concept maps, the emphasis on handling formulae - but she is no longer satisfied with it. She wants her students to share her increasing interest in theory:

You write up notes to lead up to the equation and show why it’s that equation, but they don’t really bother about it, then when you put up the equation, they put a box around it, as soon as they see the equation they forget about the rest of the lesson. I put a box around it too, it’s partly what I do... It’s prescriptive. They’re told what the topic is, given a few notes, then they’re given the equation, they apply the equation to some problems, there’s not really a lot of discussion. Then they do an experiment which sort of reinforces some of the theory...

I try and guide them during the experiment to do it the right way. If they get a result that’s really off-beam, they can redo the experiment, if it’s a little bit off, and some of them always want to do a ‘perfect’ experiment, I say they have to explain why there’s a difference - all that goes in the analysis.

(Do they do that?)

Sort of. Not very well. They might just say it didn’t work, and write out a list of experimental errors, rather than saying the image/distance or the object/distance didn’t coincide, but it sort of does if you put in a line of best fit.

They don’t like looking closely at what they’ve got and what theory tells them they should have.

The frustration Ms Konstantinidis expresses here seems to stem from the detailed work she has been doing for herself on the topics in the course, which has been accompanied by a change in her criteria for evaluating her own and her students’ understanding. She is much more critical of her own level of understanding, and

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she no longer accepts successful use of a formula as a marker that it has been understood:

(Has your understanding changed at all while you've been teaching?)

Yeah, yeah - when I started out I thought I understood it, but now, this is my fourth year teaching Year 12 Physics, I had to go back and review the Year 12 work, and I have a better understanding of the ground work in physics. It was good to learn it again, because it makes sense. It's taken me studying at University, then coming back to it, it's no wonder it's really hard for these girls at Year 12 - all that theory, millions of symbols, millions of concepts.

The mechanics unit is very hard, it's very difficult. I think this year I've got a good understanding of a lot of it, but the first year I didn't understand very much, say about projectile motion, and the equations of constant acceleration. I saw them as equations, Uh huh, I haven't used this one correctly. I go to examiners' meetings, they're quite condescending, they say, "As you know", but I'm sure we don't all know it. You're teaching physics so of course you should know, but it's impossible to have a really good understanding at first.

Ms Konstantinidis was quoted earlier in this chapter as an example of a teacher whose conception of physics fell into the first category, with other teachers who wanted their students to come to understand relationships in the natural world. This quotation suggests that she is becoming conscious of a split in her approach to this task: while she has been focusing on the natural world as the proper object of study, her means of achieving this understanding has been via the manipulation of equations. At the time of the second interview, she is beginning to discern a more problematic relationship between theory and understanding:

(How do you see the study of physics, yourself?)

I really like it - it's hard to get across to the kids, they see it as a means of getting marks. I think it's good fun, it's dynamic, it's all theories, they're not like laws, they're the best explanation for things that happen every day. It's sort of real - you can see how scientists have come up with explanations. If you question things, you can see that the theory you've got is just the best explanation we've got at the moment.

(Interview 1991)

She has been reflecting on the ideas in the course in a different way.

As I've taught it, although the topics are different, I've seen that they're connected by energy, work - sort of like in electro-magnetism and nuclear physics and kinematics - they're sort of

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super-central ideas. I've just started to get an idea of how everything relates - the students have got so many other things to think about. I must have had that kind of idea at the end of last year, I don't know if I mentioned to you, I told the girls to read three of the chapters in their text and write down any words that were in all the chapters to begin to see how the ideas were linked up. Just now, in the past half-hour, this is what I've realised in the past half-hour, it would be good to emphasise that, if we weren't switching over [to the new VCE course].

These comments suggest that Ms Konstantinidis is rethinking her ideas about physics and the way she approaches physics teaching, but that she has not yet changed her practice.

What is the problem?

The teachers in the case study, like the broader group whom I interviewed, differed in terms of how they characterised their subject and how they expected their students to learn it. Their focus in talking about the study of their subject can be seen as important from two contrary perspectives: the student's and the teacher's. From the point of view of the student, considering the teacher's focus helps us see how the study of the subject is constructed, and differences in what and how students are expected to learn become visible. From the point of view of the teacher, considering the teacher's focus makes his/her teaching intelligible: it makes it possible to characterise what s/he is trying to do. Before going on to look more closely at the way the teachers in the case study framed the study of the subject in their lessons, and how their students responded, I want briefly to turn to this latter point.

One way of reading the teacher's focus is to interpret it as an indication of the aspect or aspects of the subject and their students' learning of it s/he treats as problematical, and therefore in need of the teacher's attention. For Ms Brown, and to a lesser extent Ms Konstantinidis, the main requirement seems to be that the course content is displayed to the students. By implication, the problem is that if the content rests within the text, students may never actually encounter it. Ms Brown says,

They haven't got time or skills for reading or note-taking just yet; a lot of students are a bit worried about Physics, and when they come across new concepts they may read the notes but it doesn't necessarily sink in.

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She concentrates on taking the students through the material, rather than trying to find out what they are making of it. Here learning is seen as natural and private; the problematic is whether or not the students will be exposed to opportunities for learning. In Mr Nelson's class, by contrast, the students' learning is not seen as a natural consequence of exposure to the material. His students are expected to disclose how they understand the relationships he is discussing, and his focus is on managing their encounters with the material; the problematic here is constituted in the students' learning.

A different contrast is evident if we compare Ms Konstantinidis, in her second interview, and Mr Matthews. Mr Matthews speaks confidently about stripping off the details of a situation to disclose the structure of the relationships which underlie it. He wants his students to recognise this structure across apparently different situations, and this act of recognition constitutes his problematic; it is this which he wants his students to practise to achieve. His own recognition of the structure is unproblematical. Ms Konstantinidis's is not; rather, she feels herself to be in the situation of the student who has to work the thing out as best she can, using whatever rules of thumb are available. She describes the process of analysing physical relationships differently from Mr Matthews. Her perception of the difficulty of the enterprise - which she formerly represented as rather straightforward - goes along with a consciousness that her students also find it difficult. Mr Matthews represents the connections between theory and physical situation as transparent; for Ms Konstantinidis they have come to constitute the problematic aspect of her teaching.

I conclude that these teachers are grappling with specific and different problems. Although they all work with the same curriculum, they take hold of it at different points, and describe their students' relationship to it differently. Looking at what they teach, it can be seen that these differences connect with the way they construct the study of the subject for students in the classroom.

I turn now to consider how their students understood the study of physics, and what they made of what they were taught.

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Teaching and Learning: the construction of an object of study
CHAPTER 5
Studying physics

In this chapter I consider how the students in the case study classes described the study of physics and the classes they experienced, how they tackled the physics problems I gave them, and how their rendering of physical relationships changed.

A key issue in physics education has been students' failure to rethink their apprehension of physical relationships in the light of the Newtonian principles of the physics they are studying. I argue that this failure may seem more intelligible if we take account of the way the study of physics is constructed in the classroom. If, in the course of studying physics, students are not asked to attend to, investigate or critique their apprehensions of physical relationships, it is surely unsurprising that these apprehensions persist.

Physics, as it was constructed in most of the lessons I observed, did not centrally involve students' apprehensions of the physical world. Although they constructed it in different ways, all four teachers in the case study focused their students' attention on the body of knowledge and practices which they were expected to master. Of the four case study teachers, Mr Nelson was the only one who tried to get his students to rethink their experience in the light of the physics theory they were learning; and even in his classes it was of primary importance that they master the theory required and learn how to use it to solve problems.

My original expectations were that the students would come to describe physics in more or less the same way as their teacher; and that those students who expected physics to help them understand the natural world would be more likely both to focus on physical experience in responding to physics problems, and to arrive at a more Newtonian view of physical relationships. My results show a more complicated and untidy picture.

As I expected, there was a tendency for students' descriptions of physics to come to resemble their teacher's; but there was no clear connection between their descriptions of physics and their approaches to physics problems. Further, those students who did focus on the natural world in describing the study of physics and/or in their approach to physics problems did not necessarily arrive at a more Newtonian conception of physical relationships. Most students, whatever their conception of physics, appeared to interpret physics concepts in a way which was
consistent with their own, non-Newtonian conceptions. Nevertheless, students whose views developed in the course of the year were those who registered that they were expected to think through the relation between theory and felt experience, and to re-evaluate their own views. I conclude that we can understand how the students' conceptions developed if we consider what they saw themselves as studying, and how their teachers positioned them in relation to it.

Conceptions of physics

Broadly, I think it is true that the teachers influenced their students' views of physics.

My principal evidence for this conclusion is the descriptions which students gave of their study of physics at the end of the year, compared with their descriptions at the beginning. On the basis of the focus the students adopted, I discerned three broad categories of response. I classed as "mathematical" those responses which focused on "doing the problems", "doing the work", and learning formulas; in these responses, the physics curriculum was constituted by the textbook, and "doing" physics involved deploying formulae to solve problems. The second category of responses, which I classed as "theoretical", were more broadly framed. These responses focused on "understanding theory", seeing the relationship between propositions within a body of theoretical knowledge. Finally, there were those responses where physics was represented as a means of coming to understand the natural world, applying theory to make natural-world relationships intelligible.

At the beginning of the year, the case study students gave quite diverse responses, and there were no clear differences between the four classes. Across all four

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1 Appendix 3C details the prompts which elicited these descriptions.

2 Using a very similar prompt, Trigwell and Prosser (1991) drew on Biggs and Collis' SOLO taxonomy (Biggs and Collis 1982) to develop a structural analysis of the qualitative outcomes of study. They differentiated between relational responses which described the course as a whole, connecting the areas of study with each other in some way, and multi-structural responses which listed or described different areas of study without linking them. Rather than adopt this approach, I have taken up their suggestion (noted in Chapter 2) that future research explore the referential or content-related aspects of students' responses.

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classes, almost half the students (twenty-three) described physics in terms of problem-solving and "work" from the textbook. Sixteen students focused on theory, and ten on "understanding the natural world". By the end of the year, these proportions had changed dramatically. Fewer students focused on "the problems"; more students wrote about theory and about the "natural world".

Table 5.1 sets out examples of these conceptions of physics and the proportion of students who expressed them at the beginning and end of the year.¹

<table>
<thead>
<tr>
<th>Conception</th>
<th>% of responses</th>
<th>Term 1</th>
<th>Term 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical</td>
<td>Doing the problems, doing the work</td>
<td>47%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td><em>When I am studying Physics, I usually...</em> read over the chapter in the textbook, learn all the formula and try to understand them, and then work on as many different problems as I have time for. (P1, Sue) re-read the text and attempt sample problems. (P2, Steven)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theoretical</td>
<td>Understanding the principles</td>
<td>33</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td><em>When I am studying Physics, I usually...</em> try to combine all theoretical concepts in my mind into an image or portrait. Therefore by seeing how it works I may understand it a bit better. (P3, Louisa) listen to the teacher and try to understand what is being explained rather than copying the written stuff on the board. (P4, Tung)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Table 5.1 and Table 5.2 include only those students for whom responses were available in both Term 1 and Term 4.

*Patrick KA (1998)*
*Teaching and Learning: the construction of an object of study*
Understanding, seeing the application

In studying Physics this year, what I want most is...

to learn to understand how and why things happen, without just taking them for granted.
(P1, Claire)

to get a clear understanding of the physics of things and not only the ability to work problems out using mathematics and subs values into equations and formulas. (P1, Molly)

When I am studying Physics, I usually...

try to understand what the principle is and then see if there are any real-life situations in which these principles occur. (P1, Molly)

try to place a situation with a theory. (P4, Cameron)

Total 49 49

Table 5.2 analyses these changes by school.

**Table 5.2  Students' conceptions of physics: changes over time, by school**

<table>
<thead>
<tr>
<th>Teacher's conception</th>
<th>Students' conception</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematical</td>
</tr>
<tr>
<td></td>
<td>Term 1   Term 4</td>
</tr>
<tr>
<td>Mathematical</td>
<td></td>
</tr>
<tr>
<td>Ms Brown</td>
<td>6</td>
</tr>
<tr>
<td>Theoretical</td>
<td></td>
</tr>
<tr>
<td>Mr Matthews</td>
<td>6</td>
</tr>
<tr>
<td>Natural-world</td>
<td></td>
</tr>
<tr>
<td>Ms Konstantinidis</td>
<td>3</td>
</tr>
<tr>
<td>Mr Nelson</td>
<td>8</td>
</tr>
</tbody>
</table>

*Patrick KA (1998)*
*Teaching and Learning: the construction of an object of study*
This table shows that the most noticeable movement towards agreement with the teacher was in the classes taught by Mr Nelson and by Ms Konstantinidis. A majority of Mr Nelson's students now described physics in theoretical terms, while most of Ms Konstantinidis' students described it in terms of studying the natural world. By contrast, Mr Matthews' and Ms Brown's students ended up almost equally divided between the three categories. In none of the classes, however, was there a clear correspondence between the teacher's view of physics and the students' view. As we shall see, a number of students expressed criticisms and resistances in relation to the physics they were taught.

I turn now to consider how the students interpreted the demands of particular physics problems, and how they represented situations involving some key concepts in Newtonian physics. As described in Chapter 2, I gave them a set of four physics problems. I focus here particularly on the two Third Law problems, which involve the concept of force and its relation to motion, and the concept of acceleration – concepts which we have seen addressed in the lessons described in Chapter 4, in the context of simple harmonic motion. In the physics education literature referred to in earlier chapters, these are key aspects of mechanics theory which students have long been observed to find difficult, and where repeated studies have found that their intuitive observations of physical relationships seem to be disconnected from their learning of physics.

The Box problem consisted of the following diagram and instructions (Figure 5.1):

Figure 5.1 Box problem

Please state Newton's Third Law, and identify on the drawing the pairs of forces involved.

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1 The text of all four problems is given in Appendix 3B.

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This problem turns on the recognition of gravity as an attraction between two masses. Box and earth are accelerated towards each other by the same attractive force; but since acceleration is inversely proportional to mass, only the motion of the box is perceptible.

The Two Boats problem consisted of the diagram and instructions in Figure 5.2:

Figure 5.2  Two Boats problem

Two boats are being pulled together in calm water. What would you need to know to calculate the point at which they will meet?

Newton’s Third Law tells us that it is impossible for the person on one end of the rope to pull harder than the other. The boats will move towards each other at an increasing velocity, accelerated by the force exerted by the rope; the boat with less mass will accelerate more.

Approaches to physics problems

I expected that students’ conceptions of physics would be visible in the way they tackled the physics problems. This was not the case.

The approach which students adopted to each of the problems I gave them appeared to be related primarily to the way the problem was worded; they adopted different approaches to different problems and were consistent across the year in the approaches they adopted. Irrespective of their descriptions of physics, students predominantly adopted a theoretical approach to the Box problem, a natural-world approach to the Motorboat problem, and a mathematical approach to the Two Boats and Ball on Train problems. These approaches are illustrated in Table 5.3, which relates to the Newton’s Third Law problems.
<table>
<thead>
<tr>
<th>Approach</th>
<th>Box on Table</th>
<th>Two Boats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical</td>
<td>For every object's action there is always an equal in magnitude and opposite in direction reaction.</td>
<td>You would need to know the velocity with which the boats are moving together. You would also need the net force on each boat, and the mass of each boat. This means that you can use Newton's second law, ( F = ma ), to find the acceleration of the boats.</td>
</tr>
</tbody>
</table>
|                | (Box on table) Labels: action=mg, reaction; \( F_{1} + (-F_{2}) = 0 \).                                                                                                                                 | Considering that the two boats started at rest, you have  
\[
\begin{align*}
a, u, v, d \\
v &= u + at \\
T &= \frac{v - u}{a}
\end{align*}
\] Actually, I don't really know.                                                                                                        |
|                | (Box falling): arrow from mass, mg arrow down, \( a = 10 \text{ m s}^{-2} \) (gravitational constant) (there is no reaction).                                                                                   | (P4, Mick, T1)                                                                                                                                                                                                                                                         |
|                | (P4, Mick, T1)                                                                                                                                                                                               |                                                                                                                                                                                                           |
| Theoretical    | (fig 1) The brick has a force on the brick equal to mg. The force must also be equally given by the table, in the opposite direction, to keep the brick stationary.                                                | You would need to know if the boats are moving at constant speed or accelerating.                                                                                                                                                                                        |
|                | (fig 2) There are still two forces acting in this picture, however N will not be equal to mg until the brick is stationary.                                                                                      | You would need to know if the masses are equal.                                                                                                                                                                                                                         |
|                | (P1, Eliza, T4)                                                                                                                                                                                             | need to know if one boat had an initial speed.                                                                                                                                                                                                                         |
|                |                                                                                                                                                                                                           | If the two boats had equal mass and they were moving at a constant speed or a constant acceleration with the same initial speed we would know that they will meet exactly halfway. (P1, Eliza, Term 4) |

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Natural-world Newton's Third Law: For every action there is an equal and opposite reaction.

In diagram 1 the box is being pulled to the ground by the earth and the earth is being pulled to the box (equal and opposite). The box therefore exerts a certain force on the table which is transferred to the earth via the table legs. The earth does not move however, so there must be a force acting against the bottom of the table leg equal and opposite to the force of the box.

In diagram 2 the box is pulled to the earth and the earth is pulled to the box. The earth moves only very slightly, however, because of its very large mass. (P2, Martin, T4)

In general, the approaches students adopted to these problems were consistent across time. In Term 1, half the students tackled the Box problem, and the other half the Two Boats problem. Table 5.4 shows the pattern of the approaches these two groups of students adopted in Term 1 and in Term 4, together with an analysis showing responses from all students to each problem in Term 4.

Table 5.4 Approach to Third Law problems, by term: N of cases

<table>
<thead>
<tr>
<th>Approach</th>
<th>Repeats only</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Term 1</td>
<td>Term 4</td>
<td>Term 1</td>
<td>Term 4</td>
<td>Term 4</td>
<td>Term 4</td>
<td>Term 4</td>
</tr>
<tr>
<td>Mathematical</td>
<td>2</td>
<td>2</td>
<td>14</td>
<td>15</td>
<td>4</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Theoretical</td>
<td>16</td>
<td>16</td>
<td>4</td>
<td>5</td>
<td>24</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Natural-world</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>19</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>27</td>
<td>24</td>
<td>24</td>
<td>47</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

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It can be seen that students generally adopted an approach consistent with the wording of the problems. In the Box problem, students were asked to state and illustrate Newton’s Third Law, and in the Two Boats problem they were asked what they would need to know to calculate the point at which two boats would meet. The consistency in this pattern of responses in Term 4, when all students did all four problems, suggests that the differences in approach were related to the problem rather than an accidental effect of the group of students tackling it.\textsuperscript{1}

Given the strong effect on students of the way the problems were worded, it is worth noting that in Term 4 students in Mr Nelson’s and Ms Konstantinidis’ classes were somewhat more likely than the others to use the natural world as the focus of their answers. This is shown in Table 5.5, which analyses the approaches adopted by those students who tackled all four problems in Term 4.

\begin{table}[h]
\centering
\begin{tabular}{|l|cccc|}
\hline
\textbf{Approach} & \textbf{1} & \textbf{2} & \textbf{3} & \textbf{4} & \textbf{Responses} \\
\hline
Mathematical & 21\% & 38 & 34 & 33 & 56 \\
Theoretical & 37 & 38 & 28 & 38 & 66 \\
Natural-world & 43 & 23 & 38 & 29 & 62 \\
\hline
Number of responses & 68 & 60 & 32 & 24 & 184 \\
Number of students & 17 & 15 & 8 & 6 & 46 \\
\hline
\end{tabular}
\caption{Approach to physics problems, by school, Term 4: \% of responses}
\end{table}

These different approaches illuminate the relation between the student, his/her experience, and physics theory.

The "mathematical" approach involved a more or less explicit exclusion of physical experience. Sue’s approach (Two Boats, above) was quite common: students provided a list of variables in the problem, and a set of equations containing the

\textsuperscript{1} There was virtually no difference between Term 1 and Term 4 in the pattern of responses to each problem. Term 4 responses to the two problems were significantly different (chi square = , df=2, p < 0.001).

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variables, and then attempted to bring one to bear on the other. In similar vein, Bill wrote:

\[
  \text{t} = \text{t} \\
  v_1 = \frac{\Delta d}{\Delta t} \\
  v_2 = \frac{\Delta l}{\Delta t}
\]

\[d_1 + d_2 = d\]

Velocity of the individual boats

Time taken for the boats to meet.

By having this information you can substitute the values into \(v = \frac{d}{t}\) for each boat and therefore get \(vt = d\), to obtain the distance travelled by each boat before they meet. (P2, Bill)

In composing this solution, Bill focused on the calculation of appropriate values, rather than thinking about the relationships in the situation - in this case the effect of the force exerted on the boats by the rope between them, which would have to accelerate their motion towards each other.

In some of the responses which I categorised as mathematical there was a strikingly explicit dissociation from the physical situation. Two in particular, both responding to the Ball in Train problem, are worth quoting. Sarah, from Ms Konstantinidis' class, wrote:

Firstly, displacement is the distance from the starting point.

If the ball travelled 2 m in 3 seconds, we can find its velocity by

\[
d = \frac{v}{t}
\]

therefore \(v = dt\)

\[v = 3 \times 2 = 6 \text{ m/s}\]

So the ball was travelling at 6 m/s

Therefore: the displacement of the ball in 3 second interval will be

\[d = \frac{10}{3} = 3.3 \text{m} \quad (P3, \text{Sarah})\]

By this process of reasoning, Sarah reached a conclusion which was inconsistent with the original problem.
While most students did not have Sarah’s difficulty (she inverted the formula she was using), students who treated these problems as formulaic seemed more likely to encounter it. Jerry, in Ms Brown’s class, responded to the ball-in-train problem by saying:

The ball’s displacement can be worked out using equations of motion, or by plotting the information given on a graph. The train’s movement would then have to be taken into account and the final result of the ball’s displacement can be worked out using vector subtraction/addition.

What I have written above is basically the way I would attempt to answer such a question without attempting to analyse or imagine the visual side of the ball being rolled along the train floor would appear. (P4, Jerry, T1 - my emphasis)

By implication, a “physics” answer could mean abandoning commonsense; as we shall see, this was of concern to a number of Mr Matthews’ students. Responses which I categorised as mathematical deployed definitions and calculations without reference to the student’s sense of the physical relationships in the situation; the physics concept was presented as constituted by the formula in which it was found.

By contrast, responses which I categorised as theoretical focused on propositional statements. These students adopted a process of argument, rather than directly applying a remembered formula. Tung, for instance, wrote:

Although the ball is moving at 1.5m/s\(^{-1}\) to the back of the train, this velocity is only a vector quantity relative to the train. But since the train is also moving at the same time at 10m/s\(^{-1}\) in the opposite direction to the ball, the ball’s velocity relative to the ground is different. Similarly, the displacement of the ball relative to the floor of the train is different to its displacement relative to the ground. (P4, Tung)

Something similar, though less successful, can be seen in Bonnie’s account of the forces involved in the box problem. Bonnie wrote:

Newton’s third law states that we exert a force on the objects around us and they exert a force (equal in magnitude, but opposite in direction) back on us.

eg The object on the table exerts a force on the table and the table exerts an equal amount of force on the object but in the opposite direction. That is why the table does not ‘crumble’ when the object is placed on it.

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The forces come in pairs (an action and a reaction force) and they have different effects on the different objects which they act on. These action and reaction forces exist when you touch an object or when a field (eg gravitational or magnetic field) exerts a force on the object (eg the falling box - gravity pulls the object towards the ground). (P1, Bonnie)

This appears unexceptional. However, Bonnie labelled the paired forces on the falling box as follows:

Bonnie's labels suggest a notion of weight as distinct from gravity: she showed gravity acting down on the box, and "weight" acting up. This idea will be explored later in this chapter. I want here to suggest that in privileging the requirement that paired forces needed to be nose-to-nose vectors, Bonnie's drawing shows clearly that she approached the problem in terms of the principles to be applied.

Responses which I classified as "natural-world" focused primarily on physical relationships. Most of them represented these physical relationships in a relatively untheorized way, so that any physics terms referred unproblematically to physical realities. Where these students encountered difficulties, we can discern an implicit expectation that the explanations provided by physics would cohere with felt experience.

In her answer to the box problem, for instance, Jenni's initial proposition was offered as an explanation of a recognised physical state:

With the box resting on the table gravity pulls on the box, but the box pulls back on gravity allowing it to rest on the table.

Here Jenni deployed the "action/reaction" account of gravity to explain equilibrium: the motionless box was one which "pulls back on gravity". How then did she describe the falling box?

When the box is falling towards the ground gravity is pulling on it, which makes it fall. There are no forces pulling back on gravity, so the box falls. (P1, Jenni)

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Underlying this response is a view of gravity as a force exerted by the earth, rather than a relationship of attraction. The notion of objects "pulling back on gravity" was inserted into this view, without modifying it. Jenni explained the box's equilibrium in the first situation by the force it exerts on the earth; she concluded that if the box was falling it could not be exerting this force. Her argument privileged what was observed: if observation shows a situation to be different, it is appropriate for the forces involved to be different.

A similar privileging of the perceived physical situation can be seen in responses from students in this category to the motorboat question, which were particularly likely to be framed in terms of force: the river was felt to push against the boat.

It will take longer when the river is flowing as the boat has to push against the additional force of the water which is flowing in the opposite direction. The boat is getting pushed slightly down stream when the river is flowing so it has to overcome this push as well as getting across the river. (P1, Kellie-Ann)

Another response in this category, this time to the Two Boats question, also focussed on force, this time interpreted in terms of effort, and implicitly likened to a tug of war:

You would... need to know the force at which each was pulling the rope. If B was pulling with a larger force, then the boats would meet at about point Z. If both pulled with the same force, and both had the same mass, then the two would never meet but stay apart as they are. (P2, Denis)

Technical terms in these responses were labels for familiar elements of the problem situation.

A few students in this category expounded the physical situation in a way which made more sophisticated connections between theory and observation. Cameron, quoted earlier, ("I... try to place a situation with a theory") was one of them. In response to the box and the motorboat problems, he wrote:

For every action there is an equal and opposite reaction.

The Box resting on the table has a force which is down. The table also has a force which is up. These forces are equal and opposite. Therefore the net force is zero and therefore the box is resting.
The falling box has also a force which is down. The air resistance force is up but it is not great enough to stop the box falling but is enough to stop it accelerate[ing] after a certain acceleration.

For the motorboat to get to Dock B when the river is flowing, it will take more time to get there than when the river is not. This is because when the river is not flowing the boat can move faster relative to the ground. When the river is flowing a force is taking the boat down the river and therefore the boat will need to take more time. The boat will also have to be at a certain angle to get to Dock B. (P4, Cameron)

Cameron’s answers are confident and perceptive - few other students related air resistance to the force exerted by the box, or wrote of the boat’s motion in relation to the river bottom. Nevertheless, they conceal some confusion. Writing of the stationary box, Cameron argued that the equivalences of Newton’s Third Law explain a state of equilibrium. This implies that force is required to explain motion, which suggests a difficulty in relation to the falling box. When he came to write of the falling box, Cameron did not say whether the force of the box in this case was still equal to the force of the air resistance, so concealing from view the inconsistency between the physical situation and his version of physics theory. His starting point was clearly experiential; he summoned those elements of theory which would explicate the physical situation.

This analysis recalls the paradox which I described in relation to Mr Nelson’s students, who were so ready to see the weight speeding up as it bounced on the spring. On the whole, students provided responses in terms which were adapted to the requirements of the question being asked. Some students who adopted a mathematical approach explicitly ignored their experience in favour of retrieving relevant formulae; but both theoretical and natural-world responses assumed a match between experience and theory. In the theoretical responses, this meant moulding the account of the physical situation to fit the theory; in the natural-world responses, the match was more often simply assumed. Given that the same students gave all three types of response, this complementarity is not surprising. Even those few students who struggled with dissonance of theory and experience generally privileged theory rather than re-evaluating experience.¹

¹ There is an echo here of the repeated A-level laboratory reports on tropism, which so routinely concluded that plants whose growing tips were lopped no longer turned to the light. See Miller (1987).

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Although I was surprised by it, the frequent dissonance between students' conceptions of physics and their approach to the physics problems is of particular interest in relation to the general theme of this study. It is evident that these students, like the students tackling division problems in the study conducted by Säljö and Wyndhamn (1987), were strongly influenced by the wording of the particular problem. The approach they adopted may be understood as indicating their conception of the task, rather than their conception of the discipline. Thus the task can be seen as a significant medium for communicating what is involved in the study of the subject, independent of the teacher's rhetoric.

Students' presumption that theory and their experience should match can be seen as one aspect of the "persistent misconceptions" which are of concern in the physics education literature. I suggest that privileging theory may actually deflect students' attention from any dissonance which they notice. I return to this point below.

Conceptions of physical relationships

Few students in fact gave accounts of the Box and Two Boats problems which evinced a Newtonian understanding of the relationships involved. The next two tables categorise students' responses to these problems in terms of the physical relationships which were salient in them, using a very broad brush for the categorising process - as indicated in the Two Boats analysis which follows, there are some important distinctions within each of the categories I have identified. The frequencies shown in the tables indicate responses from students who addressed the problem in both Term 1 and Term 4.1

I discerned three principal conceptions of force in responses to the Box problem: force associated with the motion of an object; force as applied to a single object; and force as reciprocal between objects. In the first conception, force was discerned only in the second figure, where the box was in motion. Motion was seen as an indicator that force was being applied. In the second conception, the equilibrium situation in the first figure was seen as the result of balanced forces, while the box falling was subject to unbalanced forces. In the third conception, the box was

---

1 It may be convenient to refer to Appendix 3B for the detail of these problems; it is also given earlier in this chapter, Figures 5.1 and 5.2 above.
described as exerting a force on the earth equal to the force of gravity exerted by the earth on the box.

These conceptions are illustrated in Table 5.6, which shows that between Term 1 and Term 4 there was no change in the distribution of responses evincing these conceptions; there were, however, changes in how individual students responded. This is discussed further below.
Table 5.6  Physics of Box problem: Term 1 and Term 4

Conception | Example | Term 1 | Term 4
---|---|---|---
Motion as outcome of force | Newton’s Third Law is the increasing of velocity causes acceleration and an object will not move until a force acts upon it. The box on the table will not move until a force acts on it such as someone pushing it off - the box will drop through the air with velocity and acceleration until an opposing force acts upon it. The box has gravity pushing it down and a smaller force pushing up. (P3, Jane) | N | N

Motion as outcome of net force | The principle of action and reaction is that for every force there is an equal and opposite force. ie if there is a force acting in one direction, then there is a force of equal magnitude acting in the opposite direction. In the case of the box resting on the table, the mass of the box acts downwards and the table opposes this downward force with an upwards force of equal magnitude, which keeps the box on the table, in a stationary position. With the box falling down, when it hits the ground an equal and opposite force will be applied to it, which will prevent it from rising up or continuing its downward motion. ie if the force of the box was > than that given by the ground the box would make an impression in the ground, but if the force given by the ground was > than that given by the box, the box would rise up. (P4, Edward) [My italics] | 11 | 11

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System
Paired forces on different objects
Newton's Third Law states that every action has an equal and opposite reaction. When a box rests on a table its downward action force (a product of its mass, gravity and its height) is cancelled by a reaction force upwards from the table. In the case of the falling box, the earth is pulling on the box and the box is pulling on the earth. (Air resistance should be considered negligible.) The forces are equal, but the mass of the earth makes its reaction virtually immeasurable. (P2, Simon, T1)

TOTAL

24  24

These conceptions of force are similar to those disclosed in other studies (see Driver et al., 1994, for a summary of research findings). No student depicted force as a relationship. Most responded in terms of the relation between force and motion, focusing on the forces affecting the box: on the table where it was conceived as not moving, and in the air when it was conceived as falling because of the downwards pull of gravity.\(^1\)

The relation between force and motion was also visible in the Two Boats problem. As shown in Table 5.7, students' responses to this problem showed significant change over time.\(^2\)

\(^1\) Motion is of course relative to a particular frame of reference: the box and table are both in motion relative to the sun. Responses to the two relative velocities problems, not discussed in this chapter, disclosed that most students found it difficult to think outside a given frame of reference. In the Motorboat problem, for instance, when they were asked to consider the motion of a boat crossing a river, the vast majority of students represented the water as exerting force on the boat and hence pushing it downriver, rather than representing the boat as not moving in relation to the water, but rather being carried with the water so as to move relative to the river-bottom.

\(^2\) Calculated using chi square, \(df = 2, p < 0.02\).
Table 5.7  Physics of Two Boats problem, Term 1 and Term 4

<table>
<thead>
<tr>
<th>Conception</th>
<th>Example</th>
<th>Term 1</th>
<th>Term 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent velocities</strong></td>
<td>* the distance between the two boats (bow to bow)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>The velocity of each of the boats</td>
<td>* the velocity of each boat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time or distance as a function of velocity; time as composition of velocities; ratio of velocities.</strong></td>
<td>If you know these two pieces of information then you can calculate at any time the position of the boats relative to each other. You know that when they hit the distance between them will be zero. If you know the speeds then you can get a ratio of the distance travelled by one to the other. Add the ratios of the speed together and divide into the distance between the two boats to find the distance travelled by each boat until they meet. (P2, Chris)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Independent forces</strong></td>
<td>You would need to know the force at which each person was pulling because if they are pulling with the same force then they would meet in the middle (A). On the other hand, if person (a) was pulling with a greater force than person (b), they would come together at point (B). You would also need to know the mass of the two boats. The mass affects where the boats shall meet because if they are the same (and pulling with the same force) they would meet in the middle. If one had a greater mass it would be more difficult to pull it through the water. (P1, Noni)</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>The force exerted on each boat separately.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motion as a function of force; net force (tug of war)</strong></td>
<td></td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>

* Patrick KA (1998)
* Teaching and Learning: the construction of an object of study
Boats as system
The rope, exerting an equal force on each boat, accelerates the boats in proportion to their mass.

Displacement as a function of acceleration (f=ma)

Ratio of masses (united by tension in rope); concept of "centre of mass".

The distance the boats were apart the time it took for the boats to be pulled together the mass of the boats the force at which the boats are being pulled together

Then we can find the acceleration at which the boats are being pulled together and sub it into \( d=ut+\frac{1}{2}at^2 \) and find the distance they travel in that time. (P1, Kate)

I would need to know the masses of the people and their boat so that they could be put into the formula

\[ x = \frac{Ml}{M+m} \]

where \( x \) is the distance the lighter boat moves to the collision point. \( m \) is the mass of the lighter boat, \( M \) is the mass of the heavier boat and \( d \) is the distance between the boats. The forces acting on the boats will be exactly the same... (P2, Antony)

TOTAL

24  24

Students evincing the independent velocities conception focused exclusively on calculating the velocities of the boats, which they treated as constant. These students did not mention the rope at all.\(^1\) Students evincing the independent forces conception considered the rope as exerting a force on each boat separately.\(^2\) Some of them argued that if the forces were the same the boats would not move at all (a tug of war image). Finally, some students described the boats as a system, united

---

\(^1\) I have categorised this as the lowest level conception, because the students have ignored the effect of the force exerted by the rope, which would accelerate both boats; they would not move with constant velocity.

\(^2\) Some students whose answers evinced this conception actually reached a nominally correct conclusion, based on a centre-of-mass analysis.
by the rope, in which the rope would exert the same force on both boats and they would accelerate in inverse proportion to their mass.

Like the responses to the Box problem, these conceptions involve the concept of force and the relation between force and motion. While the motion of the boats was mentioned by all the students, over a third of the initial responses ignored the effect of the rope in accelerating them towards each other, and most of the other responses considered the motion of the two boats independently. In Term 4, fewer students wrote exclusively about the motion of the boats, and half the students gave answers which depicted the boats united in a system. In the light of their responses to this problem, it can be seen that most students had moved towards a better understanding (in Newtonian terms) of the relation between force and motion.

**Students and Newtonian physics, Term 4**

These two problems asked students to explore the relation between force and motion in different contexts and from different perspectives. I do not interpret their responses as discrepant; rather, I think that one problem discloses aspects of students' views which are not visible in relation to the other. The results reported in Table 5.8 suggest that even in Term 4 most students were still having difficulties with the concepts of force and motion: only five students gave consistently Newtonian responses to both problems.

<table>
<thead>
<tr>
<th>Table 5.8</th>
<th>Physics of Third Law problems, Term 4: N of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Box</strong></td>
<td></td>
</tr>
<tr>
<td>Two Boats</td>
<td>Motion as outcome of force</td>
</tr>
<tr>
<td>Indep. velocities</td>
<td>4</td>
</tr>
<tr>
<td>Indep. forces</td>
<td>8</td>
</tr>
<tr>
<td>Boats as system</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21</td>
</tr>
</tbody>
</table>

*Patrick KA (1998)*

_Teaching and Learning: the construction of an object of study_
Structurally, the relation between the earth and the falling box, united by the attractive force of gravity, can be interpreted as equivalent to the relation between the two boats, united by the rope by which they are being pulled together. Nevertheless, many students focused on quite different elements of the Box and the Two Boats problems.¹

Most students represented force as experienced by different objects separately. Even in the Two Boats situation, it was common for students to distinguish between the tension in the rope and the forces exerted on each of the boats. Gravity was less visible than the rope: very few students recognised gravity as an attractive force between two masses, and almost all students focused on its effect on the motion of the box (the box falls "because there is no pair to the force of gravity").

These ideas can be seen in Linton's Term 4 response to the two problems:

**Box, Term 4**

*Law* Every action has an equal and opposite reaction.

When stationary

\[ N - mg = ma \ (a=0) \]

therefore \( N = mg \)

When falling towards the ground, the block has acceleration.

It has frictional air resistance

and

\[ Mg - N - F_{fr} = ma \] - need to know acceleration.

ie \( F_{\text{total}} = ma \) - crux of most physics.

**Two Boats, Term 4**

You would need to know the tension in the ropes. However, the tensions are the same.

From (diagram) the accelerations can be calculated.

The centre of mass: 

\[ x = \frac{M_1 d}{M + m} \]

ie the centre of mass is \( \frac{M_1 d}{M + m} \) metres away from Boat 1.

¹ cf the strategy reported by Gunstone in Fensham et al (eds) (1994), drawing on the work of Ministrell (1982), in which successive questions and investigations enable students to develop a more Newtonian appreciation of the reciprocal nature of force.

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This is where it will meet.

(P2, Linton, T4)

In these answers, Linton represents force as a one-way phenomenon rather than a relationship. In his Box answer, he conflates mg (the gravitational force experienced by the box) with the weight of the box (the force it exerts on the table).1 This means that his calculation ends up relating to the forces on the box rather than the weight of box on table and the reaction force of table to box. I interpret his response to indicate that he is preoccupied with the net forces on the box, which relate to its acceleration; the relationships in the situation are out of view. Similarly in the Two Boats problem, he focuses on the forces relative to each boat (he writes "the tensions are the same" as if there were two ropes) and generates his centre of mass solution from this point. In fact, none of the students who gave centre of mass accounts of the Two Boats construed the box and earth as a centre of mass situation, and only two of them described the gravitational attraction between box and earth.

In effect, these students maintained an interpretation of physical relationships and of concepts in physics which were mutually consistent. It has been suggested (Pines and West, 1986) that a significant element in students' maintenance of their "naive conceptions" of physics is that they separate the theory which they learn from their own apprehensions of the world. My study does not confirm this idea. While a few students in this study described themselves as doing this, they were students who explicitly abandoned the project of trying to make sense of physics, and represented the task as the manipulation of formulae. Most students deployed physics theory as if it were consistent with their own ideas. Rather than keeping the two systems apart, they wrote as if the physics concepts were entirely consistent with their descriptions of the physical situation. They attached the new ideas they were being taught to their intuitive understanding, which very few of them modified more than slightly.

---

1 This leads him into serious confusion when he tries to describe the forces involved with the falling box. When he invokes the reaction force N, which is the pressure exerted by the air on the falling box, he has no way of conceptualising the force to which it must be equivalent, viz the force which the box exerts on the air (it cannot be the same as mg).

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I turn now to consider in more detail the relation between the case study teachers and their students. Were the students affected, as I supposed, by the object of study constructed for them by their teachers?

**Physics classes and their effect**

The development of the students’ responses to the physics they were studying needs to be considered from two perspectives.

First, it is evident from the responses analysed above that none of the case study teachers began the year with a classful of students tuned in to their approach. The concept of engagement with an object of study suggests a process of negotiation between teacher and students, in which ultimately some mutuality is developed around the object of study proposed by the teacher. From this point of view, one would expect a closer consonance or more defined opposition at the end of the year than at the beginning. The development of this mutuality, which could be understood as a shared view of what is to be studied, would seem to be important in facilitating learning.\(^1\) Did the case study classes develop a shared view of what was to be studied?

Second, there is the issue of outcomes: the impact of the object of study on students’ understanding of natural-world relationships. One might expect that the teachers who emphasised that physics is the study of natural-world relationships would be the most likely to connect with their students’ understanding of these relationships. As Chapter 4 indicated, however, this process was not straightforward. In Mr Nelson’s class, it appeared that students felt a press towards giving theoretically correct answers, even when they were being asked for their untutored observations; while Ms Konstantinidis, though she emphasised the value of equations for solving natural-world problems, did not actually interrogate her students’ understanding of the relationships involved. What relation can we in fact see between the object of study in the different case study classes and the students’ responses to the Third Law problems?

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\(^1\) I connect this idea with the “thought contact” between teacher and students which Alexandersson proposes as important for effective teaching (see Marton and Booth 1997: 175).

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Mr Matthews

As we saw in Chapter 3, Mr Matthews emphasised the importance of modelling the critical features of what was observed, the connection between experience and model being framed by theoretical principles. He wanted his students to master the conceptual system of understanding which physics offered; he argued that the process of making these connections would be supported by practice with quantitative problem-solving, which required students to develop appropriate models of what was going on. At the end of the year, he wrote:

*What has your Physics course this year been about? What has your teacher most wanted you to learn?*

1. Some facts (eg what is photoelectric effect)
2. Some mathematical models (eg how does gravitational force depend on distance between planets) [these enrich the students' lives],
3. A technique for analysing a problem, simplifying it (or 'modelling' it) to get to the bottom of the problem [this is useful in other fields besides physics, it is one of the aspects of 'intelligence']
4. A love of the above, and sufficient competence to do well in the exam
5. A springboard for the more able students to go a long way further in Science.

My observation was that in class Mr Matthews emphasised the activities of "doing" science. The process of model-building, which he described as central, he tended to treat as unproblematic, in that he drew attention to the theoretically relevant features of a problem situation without investigating whether they matched what his students thought was going on.

Mr Matthews' approach generated both resistance and appreciation among his students. A fundamental issue was the meaning of the formula-based activities he deployed: the relation between a formula, the theory it expressed, and the physical relationships depicted in the theory.

Initially, few students mentioned the task of model-building. Most of them described their work as listening to the exposition of theoretical principles, and doing numerous "number-churning" problems; they described the study of physics

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1 This is the complete prompt; it has been shortened in other quotations.

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in terms of problem-solving and working through their text. The object of study in these comments was "the work". When they described their lessons, these students wrote about a series of straightforward activities - taking notes, doing problems, doing laboratory work. What was to be learnt, and how it was to be learnt, appear here as unproblematic.

*In our Physics classes this year, we usually...*

listen to what's being told by the teacher and ask questions. We also do a lot of prac.
Not much note taking (Chris, P2)
listen to what our teacher is trying to say whilst taking notes at the same time (Hugh, P2)
listen to the teacher who explains new topics and writes notes. We also ask questions of him. Other times we do prac, and write them up, and answer questions out of a book (Denis, P2)

The teacher's role was to present the work, and the students' to interrogate him. "Talk" between students was a distraction from this process of exposition:

*In our Physics classes this year, we usually...*

talk and annoy the teacher. But we usually try to get the prac done. (P2, Steven)
read magazines and talk about things, preferably not Physics. (P2, Simon)

There was a tension between this description and Mr Matthews' aspirations.

By contrast, there were four students in this class who wrote about what they were studying in terms of mastering a conceptual system (Michael) and understanding physical situations (Martin, Mitchell and Linton). Of these students, Michael's conception was most like Mr Matthews. In their descriptions of their lessons, Michael, Martin and Linton were distinctive in pointing to an overarching purpose for the activities of the classroom which was consistent with Mr Matthews' description:

*In our Physics classes this year, we usually...*

take notes and do problems to work out the logic behind the theories and equations. (P2, Michael)
discuss physics in terms of mathematical formula and physical concepts. (P2, Martin)
talk about topics, the syllabus, not taking too many notes. Our practice comes from doing problems as we acquire formulas and understanding in class. (P2, Linton)

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Mitchell’s description of his lessons, however, sounds very much like those already cited:

_In our Physics classes this year, we usually..._

take notes from the board, do pracs, listen to explanations of the work by the teacher. 
(P2, Mitchell)

At the end of the year, most of Mr Matthews’ students wrote somewhat differently about their study of physics. Several of them had moved closer to his own view of studying physics. They represented problem-solving as a route to mastering theory, and theory as a way of understanding the behaviour of physical phenomena. The students who continued to focus on formulae and problem-solving expressed a less coherent view of physics, and often appeared to be dissatisfied.

Twelve of the sixteen students who were in class for the second exercise mentioned "doing problems" as a central activity, but in addition, ten mentioned the aim of "understanding the theory" - "why things happen the way they do", as Hugh put it. Some of them explicitly distinguished this aspiration from what they actually did:

_In studying Physics this year, what I want most is...

a deeper understanding of the basic laws of our universe. (P2, Steven)
an understanding. (P2, Mitchell)
understanding. (P2, Philip)

_In our Physics classes this year, we usually...

talk and make fun of the teacher (or not go to classes) (P2, Steven)
waste time (P2, Mitchell)
talk. (P2, Philip)

_Our course this year has been about...

[Our teacher] has wanted us to learn nothing. (P2, Steven)
mechanics, waves, electricity, magnetism, nuclear and atomic physics. (P2, Mitchell)
number plugging formulae. (P2, Philip)

_When I am studying Physics, I usually...

don’t study physics. (P2, Steven)
waste time. (P2, Mitchell)
attempt problems. (P2, Philip)
Leigh expressly identified a conflict between "number churning problems" and "understanding of what goes on around us". His responses suggest an emphasis on doing problems, rather than using theory.

_In our Physics classes this year, we usually..._

do physics prac or problems from the text

_Our course this year has been about..._

The course this year, although focusing on number churning problems was aimed at providing a better understanding of what goes on around us, ie with sound, light, waves, nuclear energy, gravity and circ motion.

_When I am studying Physics, I usually..._

just do problems from the book - Physics for Senior Students [Storen and Martine] or Exam Questions by Topics [Stephanou]. Also learn formulas.

Other students, however, emphasised their attempts to understand physics theory, talked about the application of theory to everyday examples, and used problem-solving exercises to "consolidate" or test their understanding of theoretical concepts.

_Our course this year has been about..._

trying to use physics in everyday examples to show how things work the way they do. (P2, Michael)

The course has been one that explained many points of life that we take for advantage [sic granted], from mechanics to electronics. (P2, Antony)

applying basic physics concepts to real life situations, however some of these real life situations have been very idealised. (P2, Andrew)

_When I am studying Physics, I usually..._

study the theory and then do questions to see if I understand the theory (P2, Michael)

do as many different questions as I can in inconsistent topics, so I have to keep changing my line of thought. (P2, Antony)

do a whole lot of questions to consolidate the concepts learnt. (P3, Andrew)

These students focused initially on comprehending theoretical principles and concepts, as can be seen in Andrew's comment about applying the concepts to idealised real life situations. Chris expressed a similar idea:

_Our course this year has been about..._


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introducing us to physics. Ignoring a lot of reality. Not telling us much and keeping it basic. (P2, Chris)

This approach mirrors, and reverses, Mr Matthews’ notion of modelling and simplifying experience. As we have seen, Mr Matthews spoke of theory as a process of simplification, of constructing a model which represented a physical situation by its pared-down essentials. As he described it to me, he began this process by analysing the physical situation itself. By contrast, his students’ starting point was the theoretical model, whose features were determined for them. Getting the model to fit a particular situation required them to exclude irrelevancies. In this process, it is understandable that they might focus less on the essential features, which had already been identified for them, and more on what they had to exclude from consideration - "ignoring a lot of reality", as Chris put it.

Mr Matthews expected that students would discard their "Aristotelian" ideas and develop more Newtonian conceptions as a result of their extended practice in applying Newtonian models. At the end of the year, however, while most of his students gave relatively sophisticated answers to the Two Boats problem, their explanations disclosed non-Newtonian constructions of physical relationships; only one student gave a Newtonian answer to both the Two Boats and the Box problem. Why was this?

Most of the students in Mr Matthews’ class in fact diagnosed the Two Boats problem as a system in which momentum would be conserved, though not all reached the conclusion that the meeting point of the boats would be at the centre of mass. Half of them wrote of the relation between force and mass in a way which was inconsistent with the centre of mass model.

In responding to the Two Boats problem, for instance, Philip focused on the theoretical model of the centre of mass. He wrote:

\[
\text{Assuming both started from rest therefore their centre of mass has a velocity of zero.}
\]

\[
\text{ie } V = \frac{\Sigma p}{\Sigma m} = \frac{\text{total momentum}}{\text{total mass}} = 0 \text{ because no momentum}
\]

and because momentum is conserved, therefore \(\Sigma p = 0\) at all times.

The position of centre of mass \(x = \frac{M}{m+M}\), closer to boat M, which I have assumed to be the heavier of the two.

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Because $\Sigma p = 0 \implies$ velocity of centre of mass always $= 0$.

Because force is transmitted via a rope, in which tension is constant, both boats pulled with equal force.

By intuition, therefore, the point of collision will be when the centre of mass of boats reach the centre of mass of system. However, the boats are not points, so therefore to find where collided therefore need distance from centre of mass of boats to edge of boat (d) and the boats masses. (P2, Philip)

In this response, the centre of mass solution co-existed with an image of forces exerted independently, in opposite directions, equalised only by the principle of tension. In this particular problem, Philip's solution was not impaired by this way of representing force. It was more problematic, however, in his response to the Box problem:

If force is applied and no acceleration results, then there is an equal and opposite force being applied to that object.

On the table the force of gravity acts and is equal to the mass of the box $\times$ gravity (approx 9.8). This force is being equalled by a reaction force from the table $R$ (there is no acceleration).

However with the falling box there will be no equal and opposite force (unless air resistance is counted) until it hits the floor and this is why it accelerates.

$$F = ma$$

$$F = mg$$

The acceleration of the box = gravity which is about 9.8 ms$^{-2}$

$$Mg = Ma$$

Philip's answer here conflates Newton's Third Law with the Second ($F = ma$ - the acceleration of an object is proportional to the net force applied to it, and inversely proportional to its mass). This conflation suggests that Philip conceived force as uni-directional, exerted ("applied") by one object on another, rather than constituting a reciprocal relationship.

Philip's response is paralleled by another response to the Two Boats problem, this time from Chris, which actually turned on a pleased recognition of theoretical structure:

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The acceleration of the boats and the mass and/or the friction and tension in the rope. The distance between the two boats also needs to be known. \( W = Fd \). You must be able to calculate the net forces involved in pulling the boats together. There are two formulae that may be used, (1) \( W = Fd \), (2) \( F = ma, d, v, u \). The first method seems the easiest so use this one. At least two pieces of information must be given so the third unknown can be calculated. The net force must be able to be calculated because this is what’s do I’M WRONG!!! Ha Ha.

What I mean is, this is a closed system and therefore the momentum is conserved. Therefore the distance that each boat moves and with what speed will be dependent on the mass. The centre of mass shall’nt move in the system. The masses must be given and the speed and the distance between the two boats.

(P2, Chris; my italics)

In this answer, Chris wrote as if what was required was a model which would enable him to operate on the elements of the problem situation. His "I’M WRONG!!!" signalled that he had thought of a better model. Recognising the two boats as a closed system simplified the process of solving the problem. When he arrived at the centre of mass model, however, Chris did not correct his description of the relation between the boats, which is reminiscent of the tug-of-war conception ("the net forces involved in pulling the boats together"). His description of the forces as separate co-existed with his use of the centre of mass model.

Chris’ answer points to a way of understanding the apparent inconsistency in responses by Mr Matthews’ students to the two Third Law problems. Mr Matthews focused on enabling his students to identify a model which would enable them to reach a solution, he did not ask them how they thought the model worked. I conjecture that conceptions of this kind persisted among Mr Matthews’ students exactly because of his focus on model-building and his policy of not stirring the "muddy water" of students’ reasoning.

Mr Nelson

As we have seen in Chapter 4, Mr Nelson constructed physics as the study of the natural world; he sought to engage his students both in observing it and in reflecting on their observations. Of the four teachers, he was the only one I saw exploring, rather than merely correcting, his students’ errors.

At the beginning of the year, as with the other classes, Mr Nelson’s students were most likely to describe physics in terms of "the work" they had to do. However,
students with this view of physics were not a majority of the class. I categorised eight students out of eighteen as focusing on "the work"; four talked about understanding principles, or theory; and six talked about understanding physical experience.

For most of these students, a major feature of their lessons was discussion. Whereas in Mr Matthews' class, students who mentioned "talk" signalled withdrawal from the class, in Mr Nelson's class students who mentioned talk or discussion consistently related it to developing a common understanding.

*In our Physics classes this year, we usually...*

have a general class discussion about the principles involved in what we are studying. The teacher usually makes us try to figure out things for ourselves rather than simply telling us. I think that's good because we learn it better that way. (P1, Nellie)
discuss the theory behind concepts and we try to do some problems to help us understand how to set the answers out. (P1, Bonnie)
discuss problems and talk about the work. (P1, Louise)
have many discussions and try and work out how the physics of problems is done. (P1, Jenni)
have a lot of discussions and do a few problem[s] set and then discuss them in class. (P1, Sandra)
are given a chance to work things out for ourselves, without being handed everything and told to learn it. This is good, because it is easier to learn something. (P1, Claire)
talk about the problems and do examples rather than just copying down notes. This is useful and I learn more this way. (P1, Kellie-Ann)
discuss how certain theories come to be. (P1, Jeanette)
bring up our questions and the teacher lets us think about all the possible reasons before telling us the answer. (P1, Nancy)

The object of study implicit in these comments was frequently "the physics of problems" (Jenni), or as Nellie put it, "the principles involved in what we are studying". Mr Nelson's emphasis on apprehending physical phenomena was experienced by some of these students as a distraction. Some students, like Kellie-Ann, talked about doing problems, and for others problem-solving was a crucial feature of the subject. Kate, for instance, wrote:

*In our Physics classes this year, we usually...*

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derive the formula for the topic from a problem then do other problems and prac so that we can understand how the formula works. We normally do problems relevant to everyday life. (P1, Kate)

At the end of the year, Judith commented:

Our course this year has been about...
I didn’t like the course very much because it’s not very structured and I need discipline to work, also I didn’t like the teacher that much. He knows his physics but he doesn’t teach it very clearly, and I needed a structured, defined class.

In our Physics classes this year, we usually...

took notes from an overhead projector. I had trouble because our teacher wrote too small and I couldn’t read it, and then I had to get glasses due to eye strain. We also watched videos and performed prac’s, but we didn’t go through problems/exercises as a class very much. Our teacher also worked very quickly and so I missed a lot of notes because I couldn’t read/understand the work.

When I am studying Physics, I usually...

summarise my notes and read over them and try to learn the concepts. Usually I can only memorize formulas. I don’t do many problems or exercises for homework or revision. (P1, Judith)

Mr Nelson’s own concern was that he had to move the class too quickly to allow full discussion and exploration of the issues being discussed:

In [teaching] Physics this year, what I want most is...

my students to - enjoy - understand and - achieve.

In our Physics classes this year, we usually...

are usually rushed and have little time for issues and content not directly on the year 12 exam.

When I am [teaching] Physics, I usually...

need to direct the learning process in a fairly tight manner. Student initiative and self direction is minimal which is a pity.

Our course this year has been about...

In this school the physics course is primarily about getting students through year 12 with a maximum score. I also hope that students really come to an understanding of the principles of physics and enjoy the process of learning along the way. (P1, Mr Nelson)
Nevertheless, by the end of the year his students were distinctive, both in developing an orientation towards physics as the study of physical phenomena, and in positioning themselves as active agents in their own learning. As shown earlier in Table 5.2, virtually none of his students now focused exclusively on "the work" as constituting what was to be studied; more talked about "understanding how and why things work or happen". Further, this latter group of students wrote more convincingly than in Term 1 about the relationship between theory and observation in the process of achieving understanding.

Sandra, Claire and Nellie illustrate the changes which can be observed in the responses from Mr Nelson's students. Sandra began the year with a clear focus on the work to be done:

_In our Physics classes this year, we usually..._

have a lot of discussions and do a few problems set and then discuss them in class.

_When I am studying Physics, I usually..._

read over notes and also read any references if they have been given (and occasionally an extra reference if I feel I need it).

_In studying Physics this year, what I want most is..._

the right attitude. I would also like to be able to keep up with the homework set so that I am not totally bored in class because I haven't done it. Hopefully if I accomplish that I will be able to understand all the work. (P1, Sandra, T1)_

In Term 4, she still wrote of "the work", but her account of it had enlarged beyond notes and references; she now talked about interpreting demonstrations, and learning to apply the principles of physics.

_In studying Physics this year, what I want most is..._

to get a reasonable understanding of the work.

_In our Physics classes this year, we usually..._

watch videos, watch demonstrations and talk about the demonstrations, and what they prove. We also took some notes.

_When I am studying Physics, I usually..._

do lots of problems and also read different books to get a different perspective.

_Our course this year has been about..._

learning to apply principles of physics to given situations. Using a logical train of thought. (P1, Sandra, T4)
Claire started with a general sense of wanting to understand "how and why things happen":

In studying Physics this year, what I want most is...

to learn to understand how and why things happen, without just taking them for granted.

In our Physics classes this year, we usually...

are given a chance to work things out for ourselves, without being handed everything and told to learn it. This is good, because it is easier to learn something.

When I am studying Physics, I usually...

find it interesting enough to concentrate and easy enough to do most of it. (P1, Claire, T1)

At the end of the year, she wrote:

In studying Physics this year, what I want most is...

to understand the way things work and why they work.

In our Physics classes this year, we usually...

discuss ideas until we understand them so that it makes it easier to learn.

When I am studying Physics, I usually...

do questions to get the ideas and methods into my head.

Our course this year has been about...

this course has been about understanding how & why things work or happen, more than just rote learning facts and formulae. This is the best way to learn as then it all makes sense, and the theories can be applied to many relevant situations. (P1, Claire, T4)

Claire’s initial enthusiasm for being "given a chance to work things out for ourselves" was expressed a little differently at the end of the year, as being able to "discuss ideas until we understand them", but on both occasions she emphasised her involvement in working through the ideas. The novel point in her responses at the end of the year was the relation she discerned between theory and observable situation. The movement of thought she expressed, from understanding a theoretical explanation of a phenomenon to seeing how the same theory applied to other situations, is just what Mr Nelson said he wanted for his students.

Finally, Nellie. Nellie began the year by saying that she wanted
to be able to fully understand all the principles involved in what we are studying so that I will be able to reason out any difficult question that I may come across in my exams, using the principles of Physics. (P1, Nellie)

I categorised this response as conception B, a focus on physics as a body of theory. At the end of the year, her view of the subject was more developed, and involved a view of what was to be explained as well as the theory by which it would be explained.

*In our Physics classes this year, we usually...*

watch videos or are shown examples of a particular situation and then try to formulate a relationship that exists. We are shown many practical situations as well as taking notes to learn the physics.

*Our course this year has been about...*

It has been about different types of motions of objects put in different situations. Forces have been a major part of the course that cause the different motions. We have learnt about wave motions and the energy of objects. The bulk of the course is closely related to forces and energy that result in different motions of the objects involved.

(P1, Nellie)

Nellie’s generalisation about motion as a connecting theme for the course is interesting; she was the only student in any of the four classes to thematise the course, rather than listing topics from the syllabus.

In Mr Nelson’s class, while most students did not achieve a consistently Newtonian approach to the Third Law problems, most of them made explicit how they thought the equations worked. In responding to the Box problem, for instance, many of them focused on the relationships between adjacent bodies:

The forces of action and reaction acts on two bodies and the two bodies will oppose/push each other with equal but opposite force. (P1, Susie)

Newton’s third law states that if an object applies a force to a second object, the second object will apply a force of equal magnitude on the first object. These forces are opposite in direction, and may have different effects.

When the box is resting on the table, it exerts a force downwards on to the table. The table then exerts a force of equal magnitude onto the box. This force (table on box) cause the box to remain where it is and not fall through the floor. This same principle occurs with the table legs and the ground resulting in a net force on the box upwards.

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In the second picture the box is not in contact with any other object, and hence Newton's third law is not evident. The only force the box experiences is that of gravity and as there is no force opposing this the box falls towards the ground. (P1, Nellie, T4; my italics)

This conception was one which I saw Mr Nelson consistently challenge, and several students implicitly recalled this in their responses:

Action and reaction - if two objects (A and B) interact, then object A pushes on object B with a force equal in magnitude but opposite in direction that the force B pushes on object A.

In the first picture, interaction occurs between the book (sic) and the table and between the table and the book (sic).

In the second picture, although the box and the earth are not in contact, the attractive forces of gravity exists between them, so interaction occurs.

The earth pulls on the box with a force equal in magnitude and opposite in direction as the force that the box exerts on the earth.

(P1, Sue, T4; my italics)

In responding to the Two Boats problem, almost all Mr Nelson’s students started by considering what would affect the motion of each of the boats, and recognised that the force exerted by the rope would accelerate the boats. Of this group, eight considered the force on each boat independently, and eight recognised that the rope would exert an equal force on each boat.

Few students achieved Newtonian answers to both Third Law problems. Four of the five were in Mr Nelson’s class. One was Claire, whose aspiration towards understanding was quoted earlier:

**Box 2**

Newton’s third law: ‘For every action there is an equal and opposite reaction’

ie when two objects interact (either through contact or some sort of field) the force from the first object on to the second object is the same as that of the 2nd object onto the first object.

1 The force of the box on the table is the weight force (mg). This is also the size of the force of gravity on the box. As the box is not accelerating, the sum of the forces on it must be zero, therefore the table must exert a force on the box, equal in size but
opposite in direction, to that weight force. This is known as the normal reaction force (N). Weight force of the table is also counteracted by a reaction force from the ground.

2 The box falls with an acceleration due to gravity of g m/s² (disregarding air resistance). As the box is accelerating, there must be an unbalanced force on it. This is the weight force, mg. Just as the earth's gravitation pulls the box towards it, the box exerts a force on the earth which is equal and opposite. However, we don't appear to notice the effect on the earth, as the force is not large enough to have a significant effect on so large a mass.

Two Boats 2

Disregarding any frictional forces of the water, the only force on each boat would be the tension in the rope. This tension is towards the centre (away from the boat, as this is the direction that the boat will move. Tension is the same at all points on the rope, so the force on each boat is the same. F=ma, by Einstein's second law, and the acceleration will depend upon the mass. Therefore, to know the position that the boats will meet, you would need to know the mass of each boat with person, and the tension in the rope, so that the acceleration could be found and thus the position.

(P1, Claire, T4)

Mr Nelson's focus on how students apprehended physical relationships is very evident in his students' responses.

As we have seen, Ms Brown and Ms Konstantinidis were themselves less consistently Newtonian in the classroom than either Mr Matthews or Mr Nelson. It is perhaps not surprising that none of their students gave consistently Newtonian answers to the Third Law questions.

Ms Brown

As described in Chapter 4, Ms Brown emphasised the pressure she felt to "get through" the course; she spoke repeatedly of "quickly going through" sections of the text, "quickly doing" experiments. Her main concern was to ensure that her students were familiar with the work required of them.

In Ms Brown's class, the activities students mentioned most often were taking down notes or copying from the board; "covering theory"; and "doing" questions.

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problems, and prac.s. In these students’ responses, the subject-matter of the lesson was contained in the textbook. Typical responses:

*In our Physics classes this year, we usually...*

do problems from the textbook and lots of notes from the blackboard. (P4, Terry)

get notes from our teacher on the topic and then we have to do questions from the physics books. (P4, Le)

copy from the board, do questions from the texts, do questions on the board, do some tests and do some prac.s. We also complain about the masses of homework we get. (P4, Edward)

Students who mentioned problems were mostly, but not always, referring to the worded problems in their text which required a mathematical solution. Discussion and efforts to understand were mainly related to problems in this sense.

*In our Physics classes this year, we usually...*

discuss and go over any problems from the previous set of work, then we cover the theory to the next section, thereby leaving the problems to complete as homework. (P4, Elise)

discuss our work in class and suggest any problems we had to the teacher. (P4, Jeffrey)

Students’ comments at the end of the year confirmed this picture of lessons largely spent in copying notes, tackling problems and "doing" experiments.

*In our Physics classes this year, we usually...*

listen to the teacher and write notes down on our book. (P4, Georgio)

completed option prac.s, prac.s, some time was devoted to completion of written options. a few classes involved questions to be completed during class and the majority of the time classes consisted of instruction about the physics theory and approaching questions. (P4, John)

have done work relating to the course. (P4, Edward)

study and take down notes on the core work, or participate in practicals for assessment. (P4, Jerry)

The students in Ms Brown’s class generally portrayed the relation between the student and the teacher as one where the student was receptive of instruction.

*Patrick KA (1998)*

*Teaching and Learning: the construction of an object of study*
A group of more ambitious students, however, wrote of "the topic" and "the theory", and related their problem-solving activity to that:

_In our Physics classes this year, we usually..._

go over notes to the topic we are studying, then we are given a set of questions to complete on that topic, and later discuss any problem we have with the topic we are studying. (P4, Michael)

revise the theory of a particular chapter in Physics and begin writing questions from text book and other books in order to understand the theory more thoroughly. (P4, Mick)

do many problems and hard work. Some practical work and a lot of discussions and debate, if we do not understand. (P4, Cameron)

Early in the year, these students consistently asked questions which went beyond the frame of the lesson Miss Brown was giving. In the lesson on simple harmonic motion described in Chapter 4, for instance, they asked questions about the relationship between work, displacement and heat/energy loss, which as we have seen Miss Brown tended to set aside. There was a mismatch between these students' aspirations and what they experienced in class.

As the year progressed, these students' behaviour in class changed. In the lesson on simple harmonic motion, Edward, who had aspired to be equal dux of the class, asked serious questions which were left unanswered. When I returned to the school in Term 3, he was no longer contributing seriously to the discussion. He clowned around, and seemed to do very little work; the questions he did ask suggested that he was having trouble understanding some basic principles. At the end of the year, although he wrote grandly that

_Would you say your study of Physics this year has been about?_

Physics has been about the laws of the universe and the things that happen because of these laws. (P4, Edward)

his enthusiasm for the subject had dissipated:

_When I am studying Physics I usually..._

sit at the back and not really pay much attention which is pretty stupid really. (P4, Edward)
Other students stopped coming to class - of the students I have quoted, Martin, Tung and Cameron were no longer coming to lessons by the time I came back for the final exercise, and their classmates told me they were studying at home. In their comments at the end of the year, the students who did continue to attend emphasised their own responsibility for arriving at an understanding:

*In our Physics classes this year, we usually...*

- do nothing new, as we usually revise most of our work ourselves (P4, Tom)
- talked about each topic as a class and did questions (P4, Jeffrey)
- talk over various topic and solve them as a class (P4, Mick)
- work together to cover the work and any problems. (P4, Terry)

One of them wrote:

*What would you say your study of Physics this year has been about?*

Our teacher has emphasised the need for study, and independent learning. Especially in physics, a lot of deducting is done, so it is up to each student to do the work themselves. In this subject, if you are not willing to learn, you will not succeed. A feeling of enthusiasm is essential, otherwise it is virtually impossible. This is what I have learnt most, besides the academic side of it. (P4, Mick)

Implicit in this comment is the idea that answers to problems had to be achieved without relying on the teacher.

Ms Brown’s students were different from students in any of the other classes, in that they gave more cursory and less Newtonian answers at the end of the year than at the beginning. In Term I John, who said he wanted to "explain to myself how these formulas arose", gave an extended response to the Box problem, working through the various relationships involved:

**Box 1**

Newton’s third law states that for every action there is an equal and opposite reaction. In the first diagram the box exerts a force on the table, which in turn exerts a force on to the floor. The floor applies a force back into the table, equal to the combined weight of the box and the table. The table exerts part of that force (the part equal to that which the box puts on it) into the box, while the rest of the force (ie the remaining force) is equal to that of the table. All these bits are having a nice time just sitting down, there is an equilibrium. All the actions are caused by gravity of the earth while the reaction is due to the mass of the earth /mass of the table.

*Patrick KA (1998)*

*Teaching and Learning: the construction of an object of study*
The box that is doing the skydiving trick is being acted upon by gravity. The box's reaction to this is absorbing the force and converting it to kinetic energy (a small amount of energy is transferred into other forms). Once the box hits the ground, a force equal to that of the box will be exerted on the ground while the ground will exert an equal and opposite force back to the box. (P4, John)

At the end of the year, his answers were briefer and more schematic:

**Box 2**

In the static situation (box on table) the force due to gravitation exerted by the box on to the table is negated by an equal yet opposite force, the normal reaction. There is no net force.

The box encounters similar reaction and resistance to its movement but the air cannot match the degree of force exerted upon it and a net force, in the direction of weight, causes acceleration of the box downwards.

**Two Boats 2**

In a frictionless system, the two boats should meet at the very centre of the system if the two masses are equal.

If the masses are different, then the tension in the string and the two masses must be known. The position could be found only using these variables. The acceleration of each boat could be ascertained, and from this the positions at time t could be evaluated. This would require an approach using calculus.

(P4, John)

Similarly, Elise in Term 1 gave an answer to the Two Boats problem in which she referred to a number of relevant features of the physical situation, though she did not argue through to a strategy for actually resolving the question.

**Two Boats 1**

The tension of the string and the centre of mass of the system is required to find the position where the boats will meet. Both parties are exerting a force on the string, but one must pull harder than the other for the boats to meet. Length of rope (or distance between them) must be known also.

None of these ideas was followed through in her Term 4 response, which focused exclusively on the elements of a formula which might be used.

**Two Boats 2**

*Patrick KA (1998)*

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You would need to know:
- initial velocity for each
- time taken for each boat to meet
- and the acceleration at which both boats will meet.

Then substituting these values in the formula \( d = ut + \frac{1}{2} at^2 \) (motion in a straight line)

a value for \( d \) will be obtained.

(P4, Elise)

At the end of the year Ms Brown's class included several students like Elise, who had not worked through the relationships between the variables they were using, and who appeared to be focusing primarily on retrieving an appropriate formula.

**Ms Konstantinidis**

Ms Konstantinidis wanted her students to be able to use physics theory to explain natural-world relationships. She did not see this task as problematic, treating the equations they were to use as a straightforward analogue of the relationships they represented. It appeared to me that she did not recognise that there might be discrepancies between her students' intuitive understanding of physical relationships, and the physics they were learning.

The verb most often used by Ms Konstantinidis' students was "do" - all but one student used it. Like Mr Matthews' students, they wrote about doing theory, pracs, work.

_In our Physics classes this year, we usually..._

discuss problems, attempt practicals, do a lot of theory work, and, overall, have a lot of fun especially with Ms Konstantinidis. (P3, Ramona)

Used in this way, the word "do" presents the students' relationship with what was to be done as straightforward and uncomplicated. "Learning" and "doing" were equated. As described by these students, the central feature of their lessons was "doing theory", usually in notes taken from the board, which then had to be followed through in problem-solving and prac work, the other activities of the classroom:

_In our Physics classes this year, we usually..._

write down theory given by the teacher then apply what we have learnt into mathematical problems and experiments. (P3, Louisa)

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do a lot of work and experiments. And learn a lot of new things. (P3, Jane)
do hard work and the principles and theory of the physics work is difficult. (P3, Simone)
do theory off board, learn new concepts and formulas, problems to apply new concepts and formulas, and also pracs. (P3, Helena)

We might conclude that in this classroom the study of physics involved learning propositions and formulas, which could then be directly applied into mathematical problem-solving.

By the end of the year, this picture was enlarged by mention of examination practice:

In our Physics classes this year, we usually...
take notes on the theory of physics, perform too many practicals (which is fun!) and we go over past examination papers most of the time. (P3, Ramona)
do lots of written work on the board, lots and lots of practical work and especially lately have been doing problems associated with physics and exam problems. (P3, Judith)
do theory every lesson. We also continually go over past exam papers to help us revise for the end of year examinations. Once a week we also carry out experiments during the double periods and write them up as reports. (P3, Sarah)

Ms Konstantinidis herself described the lessons in these terms.

In our Physics classes this year, we usually...
took down theory notes, did pracs, did problems. (P3, Ms Konstantinidis)

Only Helena’s description had changed significantly:

In our Physics classes this year, we usually...
learn formulas and how to apply them as well as the theory behind them; learn new concepts and do practical work to explore these concepts; we also learn the relations between the formulas and the concepts and also how to interrelate the different concepts and formulas. (P3, Helena)

Helena’s comments make visible some aspects of Ms Konstantinidis’ lessons which other students did not comment on, but which are evident from the way they

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described what they actually studied. Only one student in Ms Konstantinidis' class maintained a wholly equation-oriented way of characterising Physics.

*What would you say your study of Physics this year has been about?*

This year this course is made up of basically knowing many formulas and applying them to work out lots of different problems. (P3, Judith)

Other students wrote:

*What would you say your study of Physics this year has been about?*

Much of the topics studied are related to energy (nuclear, electrical etc). Luckily for me, we had to opportunity to do an option on electronics which was ACE! Now I believe that if all of the physics students in my class gathered together and worked well with one another, we could solve a real life problem... (P3, Louisa)

My course this year has been learning about forces which act on objects. This was learnt in our kinematics unit which dealt with things such as momentum, impulse, energy, simple harmonic motion, circular motion. We also learned about electricity and magnets. Light and waves were another unit covered. We learnt about how light bends in a prism and the different patterns we see because of it... (P3, Nella)

It has been about practical problems that occur in real life situations for example, what happens when objects move in certain directions with certain velocities etc. It does not end in class, physics can be related to wave properties, nuclear reactions etc. (P3, Sarah)

In Term 1, as we have seen, Ramona and Jane aspired to understand physics theory, while Louisa wanted to understand how theory applied in real life. By the end of the year, all three emphasised the connection between physics theory and everyday experience.

*When I am studying Physics I usually...*

fall asleep (only joking!!), go over my notes, solve some problems and sometimes I try to apply problems involving physics to real-life situations eg why the bird on the tree in front of my window can stand in the tree?!! (P3, Ramona)

find it very interesting. To find out how household electricity is made and also how waves have periods and amplitudes. And all about sound waves. (P3, Jane)

find it boring and too theoretical (bible bashing), yet when I go out into the 'real world' and watch TV or talk to my friends, a lot of what I have studied in class is associated with the events occurring in everyday life, which I already know. (P3, Louisa)

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Helena, who was quoted earlier talking about the connections between different concepts and equations, wrote:

*What would you say your study of Physics this year has been about?*

Physics is a science dealing with real life situations. We have explored many of these in detail during the year. I think my teacher would most like me to understand this about physics, that it can be related to real life. It's not one thing in the classroom and then totally different outside the classroom. Things I learn in physics are happening constantly all around me. (P3, Helena)

In the lessons I saw, Ms Konstantinidis treated physics in a highly quantitative way. In discussing problems, her starting point was typically to list the potentially relevant equations ("what are our equations of motion?") and select the one with variables which fitted the problem. I never saw her discuss with students how they understood the relationships they were observing. She did, however, emphasise that physics equations described observable relationships, even if the process of constructing the correspondence was left implicit.

By the end of the year, most of the students in her class were making comments which represented physics in a very similar way. Even in Term 1, while several of their responses to the problems suggested they did not actually remember which was Newton's Third Law, they were plainly focusing on drawing law and physical situation together. Thus Judith wrote

**Box 1**

For every action, there is an equal and opposite reaction.

Box resting on table

Force of table on ground (Ø) the action

Force of ground on the table (≠) the reaction

Force of box on table (Ø) the action

Force of table on box (≠) the reaction

Box falling towards the ground

Force of box falling (Ø) the action

Force of gravity opposing the falling box (≠) the reaction

In Term 4, their answers were similar, but longer and more complex. They tended to develop a fuller account of the physical situation, rather than a more attenuated one. Judith again:

*Patrick KA (1998).*

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Box 2

Newton’s third law states that for every action, there is an equal reaction acting in the opposite direction.

Eg a person standing on the ground will exert a force on the ground and the ground will react by re-exerting a force on the person. This is why we don’t float in the air or why we don’t sink into the ground.

With the box resting on a table, the box exerts a force on the table, the table exerts a force on the box (this is the reason why the box remains stationary). The table also exerts a force on the ground and the ground exerts a force on the table (equal and opposite reactions).

With the falling box, ‘N’ (in diagram) is the reaction force and ‘mg’ is the force exerted by the box. There is also air resistance opposing the motion of the falling box. This is indicated in the diagram by $F_r = \text{friction}$.

Two Boats 2

To find out where the boats will meet, we firstly need to know the force each person is exerting on the rope and we also need to know the mass of each person and their boat, as this will lead to the calculation of the acceleration ie $\text{force} = \text{mass} \times \text{acceleration} \rightarrow \text{acceleration} = \frac{\text{force}}{\text{mass}}$.

By knowing the velocity of the boat, we can calculate the time using the acceleration found previously. ie $\text{time} = \frac{\text{velocity}}{\text{acceleration}}$.

Then by using the equation $d = ut + \frac{1}{2} at^2$ we can find the distance at which the two boats will meet.

These students did not achieve a consistently Newtonian grasp of the principles they were studying, but their answers were more accurate in Term 4 than in Term 1. More of them were able to cite Newton’s Third Law correctly in the Box problem, and more of them saw that the rope would accelerate the boats in the Two Boats problem.

Nella’s response was the most complete:

\[ d = ut + \frac{1}{2} at^2 \]

We need to know the initial velocity, the acceleration which can be worked out if we know the force applied and the mass of the boats.

\[ F = ma \]

\[ a = \frac{F}{m} \]

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We also need to know how long it took until the two boats met. This can be done by timing them with a stop watch.

Once we know these things we plug everything into the formula.

These students typically responded to the task set by offering formulae and theory in the context of physical situations.

The significance of the object of study

These results could be said to confirm the constructivist account of students' difficulties in learning physics. Most of the students I observed represented force and motion in ways which were inconsistent with Newtonian theory. In their responses to problems, they used physics concepts humpty-dumpty style, imbued with their own interpretation of the situation.

Were these results, as I have suggested, the consequence of the teacher’s construction of physics as an object of study? I have been arguing, in particular, that teachers who did not focus on how their students apprehended physical relationships were unlikely to be able to help them to change their ideas. An alternative interpretation would be that the students’ difficulties with Newtonian physics were the outcome of their teacher’s difficulties; that the teacher’s construction of the subject was less important than his/her knowledge of physics theory.

This is plausible. It certainly seemed to me that Ms Brown and Ms Konstantinidis, who both worked very largely from the textbook, still had difficulty with significant aspects of Newtonian physics. However, my findings indicate that students did not spontaneously change their views of physics phenomena in response to instruction focusing on physics theory, even from highly qualified and knowledgeable teachers. Mr Matthews’ modelling approach, which has gained wide currency in the United States (see Hestenes 1987, Hestenes and Halloun 1995), improved his students’ facility with models, but it did not seem to affect their conceptions of the underlying relationships. Mr Nelson, who systematically interrogated his students’ views of physical phenomena, was the only teacher to produce any students giving consistently Newtonian explanations.

If my interpretation is correct, the conception of physics as the study of the natural world takes on a special significance. It may be argued that the natural-world

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conception is the most vapid of the three I identified, and the least engaged with the physics propositions in the curriculum. I suggest that it constitutes a view of the meaning of physics which opens up the possibility of reading physics theory against felt experience. For this transformative effect, however, it would seem that students' natural-world experiences need to be explicitly brought into relation with theory and formulae, as in Mr Nelson's classes. Teachers who did not share this view of the study of physics did not work in this way. Ms Brown and Mr Matthews both focused their students' attention on what was to be studied, and did not try to explore what their students made of it. Even Ms Konstantinidis, who saw physics as the study of the natural world, assumed a match between their students' experiences and the formulae they were studying, and did not explore her students' understanding, so that they continued to read the formulae in the light of their existing understanding.

This outcome casts some light on the difficulties of the constructivist project, described in Chapter 2, and suggests some issues for further research. To what extent do science courses and teacher education programs help students interrogate the match between their own conceptions of physical phenomena and the physics theory they are dealing with? How do teachers on these courses conceive of what is to be studied? A focus exclusively on "knowledge", "method" or even "pedagogical content knowledge" seems likely to mask issues of dissonance, so that students will continue to interpret what they study in terms of their own experience and expectations. There have been suggestions that many teachers themselves have views of physical phenomena which are discrepant with canonical theory.¹ What are the other pathways by which teachers are enabled to develop insight into the relation between theory and experience?

In conclusion, and more generally, a key issue in this study was that teachers' conceptions of what was to be learnt shaped students' learning. Differences in the classroom construction of physics were visible in the students' descriptions of physics, their approaches to physics problems, and their apprehension of physical relationships. I would argue that students in these classes experienced the study of physics differently.

I turn now to consider the study of history.

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¹ See eg Tobin (1986), Ameh (1986).

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Teaching and Learning: the construction of an object of study
CHAPTER 6
Teaching Australian History

As described in Chapter 3, the "what" and "how" of learning history were distinctly different for the four case study history teachers. The figure below locates these teachers on these two dimensions of knowledge and learning, and summarises (in italics) their descriptions of the activity of learning history.

Figure 6.1 Conceptions of knowledge and conceptions of learning

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncontentious Farmer</td>
<td>Becoming familiar</td>
</tr>
<tr>
<td>Data open to interpretation</td>
<td>Developing an understanding</td>
</tr>
<tr>
<td>Socially constructed</td>
<td></td>
</tr>
</tbody>
</table>

In this chapter, I want to bring into view the different objects of study which these teachers constructed for their students in the lessons I observed. What was being studied? how were students were brought into relationship with it? and, finally, how were students positioned in relation to the activity of the professional historian? At the end of the chapter I return to the general question of the construction of an object of study, in the light of this analysis.

It will be recalled that the Australian History curriculum did not have a common core of topics; rather, eight "common concepts" were prescribed for study in the context of a series of topics from which three were chosen.1 Work on these

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1 The four case study teachers did not in fact teach a common topic. The topics studied in each class were: Land hunger, Wealth beneath the soil, and Melbourne, the growth of a metropolis (Ms Farmer); Australians in wartime, The 1920s, and The Great Depression (Mr West); Aboriginal society before European settlement, European settlement and the effects on

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*Teaching and Learning: the construction of an object of study*
concepts pervaded the teaching of each topic. Hence in this chapter I do not analyse a single lesson, but rather a number of lessons in which the teacher focused on one of these concepts, the concept of empathy.\(^1\) This concept is especially appropriate, because it required the development of a relationship between students and what they were studying. As Mellor put it in her crammer:

To achieve historical thinking you need to both feel and think, to use your cognitive (intellectual) skills and your feelings. A vicarious experience of the past is to experience the past by an involvement with people from the past...

You will need to develop a sense of empathy in order to make intelligent and useful hypotheses about why [people] behaved as they did. To feel empathy you need to be willing to try to ‘put yourself in their shoes’...

You will be trying to identify with their feelings, hopes, doubts, beliefs, values, sufferings, joys or excitement...

You need to reconstruct, as accurately and as empathetically as you can, the society you are studying. It has to be a society you can understand and believe in. It has to be one which real people can inhabit and go about their normal lives. (Mellor, 1986: 14-15, 17-19)

Lessons where teachers worked with their students to develop this sense of understanding seem likely to display the process of constructing history as an object of study.

---

Aboriginal society, and National identity and consciousness 1880-1900 (Ms Parbo); European settlement and the effects on Aboriginal society, Working Men and women and social reform, 1860-1910, and Australians in wartime (Ms Webb).

\(^1\) Because I have used extracts from my observation of several lessons, I do not present a continuous narrative, so I have chosen to write of these lessons in the past tense, rather than the present tense as in Chapter 4.

*Patrick KA (1998)*
*Teaching and Learning: the construction of an object of study*
Ms Farmer: the past as landscape

What has this course been about?

The course has been about the early settlement of Victoria and NSW. It looks at the way of life of the early squatters/selectors, and focuses on the growth of Melbourne from settlement to 1890. It also deals with the impact of the Gold era on both Victoria and Melbourne... (Ms Farmer)

Ms Farmer was one of the teachers whom I registered as having an unproblematic view of history. During one interview, as we were discussing differences of opinion between historians, she commented:

What's happened in the past has happened, so you can't change it. (Interview)

When I interviewed her, her dominant metaphor was a visual one - getting students to "see". As I watched her lessons, it seemed to me that her description of history as fixed was linked to a construction of the past as a landscape. To the mind's eye, this landscape could be manifest and knowable at any particular point in time, while changing across time. Students were positioned as observers of this landscape, and called on to discern and interpret changes in it.

Ms Farmer's class worked steadily through the topics and sub-topics set out in the course description. They spent much of their lesson time going through their textbooks, either reading them aloud around the class or silently taking notes from them under the relevant headings. Reading aloud was always interspersed with discussion and questions - Ms Farmer or one of the students might ask about the meaning of a word, or contribute an additional idea or piece of information. In some lessons Ms Farmer brought in a document collection, a set of pictures, or maps, for the class to look at and discuss. Towards the end of their study of each section, students were asked to write an essay; Ms Farmer would outline what was wanted from it, and later give feedback on how students had tackled the question. Occasionally, when she wanted them to progress more quickly, she wrote notes up on the board for them to copy.

These rather conventional-sounding practices suggest a process of acquiring information, and indeed from time to time that did seem to be Ms Farmer's emphasis. She warned one student, who was entirely failing to concentrate on the task of copying from the board:

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T  We've had this discussion before and I've made it quite clear what I think, you're just writing it down meaninglessly, not absorbing it.

S  I'm not absorbing it!

T  You've got more chance of absorbing it if you're thinking about what you're writing.

(School H4, 4 May 1990)

When I looked to see what Ms Farmer taught, however, describing it as "information" seemed quite inadequate.

Beginning work on the Melbourne topic, Ms Farmer passed out a selection of old photographs and some document extracts from the early days of settlement (including a map of Melbourne in 1838), and showed the first of a series of slides depicting early Melbourne. In looking at the discussion which followed, in this and subsequent lessons, I want to examine how she brought students into relationship with these items, and which features she drew to their attention. She began:

T  All right, listen please, we're going to start looking at Melbourne, the growth of Melbourne, from the beginning to the 1890s depression...

I've got a handout just to let you know what Melbourne might have been like in its early establishment - also - look at these please - really old photos from the sixties through to the eighties. Some of the buildings are still around. Have a look and pass them on.

What you're trying to do is work out just by looking at these things just what Melbourne is really like.

S  You mean what it was like.

T  Yes.

(H4, 2 May 1990 - student's emphasis)

In this introduction, students were positioned as observers ("we're going to start looking"), not only of the photographs, but in relation to the topic generally. "By looking at these things" (the photographs and other documents) they were to "work out what Melbourne is really like". The focus which Ms Farmer prefigured was the visible, physical features of the settlement.

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Most of this lesson was spent in looking at the map of the settlement, and discussing what could be learnt from it; the photographs and documentary extracts were quite briefly reviewed. The subjects of the photographs included the first Princes Bridge, St Paul’s Cathedral, and promenaders in Block Arcade, sites which were familiar to the students. As the photographs passed between them, they remarked on the appearance of the cathedral ("The tower was added later," said Ms Farmer), the old bridge, the crowd (Neville: "The commentary says Not a bare head in sight, but I’ve found one!"). Ms Farmer then took up the discussion, turning to the documents. First, a couple of advertisements for quack remedies, and the prevalent diseases they implied:

T You know leprosy, you all know it’s a disease (they assent), it affects your extremities - it was a problem, you may not have thought this, it was a problem in Melbourne in the early days, also there were very severe plagues of typhoid, scarlet fever, smallpox - these illnesses were a real health problem, the poor parts of Melbourne were disease-ridden, there were problems with sewerage disposal, waste disposal, all those things.

Next, an advertisement for a carriage-builder operating from an address in Bourke Street ("you wouldn’t expect to find a carriage-builder in Bourke Street these days"). Finally, a "gentleman’s agreement" relating to a land sale in Bourke Street (labelled "Sale of Myer Bourke Street frontages, 1838"), which went for "a mare in foal".

T Anyone any idea how much it would cost today?

(no suggestions - general murmur of A lot)

T I don’t know exactly, but off the top of my head, it would cost at least $2000 for a square foot of land in Bourke Street - that’s about this much (shows with her hands). So if you bought a big piece of land like this, and kept it in the family, think of the wealth you would have passed down.

In this part of the lesson, Ms Farmer repeatedly used the present day as a point of reference ("some of the buildings are still around", the carriage-builder in Bourke Street, the Myer frontages).

She then turned their attention to the map, and here it can be seen that the process of visualisation involved more than looking at or even reconstructing a picture.

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T     Anything that catches your eye?

Neville  There was a river running down Elizabeth Street.

T     Very good - yes, Elizabeth Street was really a gully with a stream running down the middle, they had severe problems with drainage for a long time, it got flooded quite frequently, and there were sewerage problems when it flooded - they used to put up walking paths and planks.

What else do you notice?

Neville  There was a carpenter in the city

T     I meant in the overall pattern you can see...

S     Batman’s Hill

T     Yes - race meetings used to be held around Batman’s Hill, as I told you he had his house there, with a vegetable garden in the front where they grew vegetables to eat.

S     The river was called the Yarra Yarra

T     Yes, we’ve dropped a Yarra - what else do you notice?

Neville  It was segmented (Map shows the road grid with no houses marked)

T     What do you mean?

Neville  It’s drawn out in big squares

T     Yes, the Melbourne streets were laid out very early, before many houses were built on them.

(Ibid)

Ms Farmer used the map to generate a series of images of the landscape ("Elizabeth Street was really a gully with a stream running down the middle", "race meetings used to be held around Batman’s Hill"). At the same time, she drew the students’ attention to the pattern of settlement ("the overall pattern you can see"), and pointed out the physical features which had shaped it: the marshes south of the Yarra, and the fresh water upstream of Dight’s Falls. Students were to attend to patterns in what they saw ("the Melbourne streets were laid out very early"), and to be aware of changes in the landscape over time.

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The very early documents describe streets - roads winding around, rather than remove a tree stump you would have to deviate around them, as you drove along the road when you met a tree stump the road would swerve around it. There are some great descriptions of carriages with a horse that had bolted, in the narrow streets like Flinders Lane people would drape their washing out from side to side of the street, and the horses would go charging through all this washing.

There are also some great descriptions of Melbourne in floodtime - Flinders Lane one year was flooded so badly you could sail a boat up it.

What do you notice about the shape of the Yarra - how is it different now?

It's all boarded up - bluestone edges

Right, it's contained, it flows in a channel - at that time it flowed where it wanted to.

What did they do about Elizabeth Street? Did they just build over it?

They put drains in - it took them a long time though. If you look at the prices of land around Elizabeth Street, you can see it really affected the property values, the prices there are much lower.

(Ibid)

This exchange shows Ms Farmer and her students projecting themselves freely into the situation: "when you met a tree stump", "you could sail a boat up it", "the horses would go charging through all this washing". The grammar of this exchange brings the past close to the present ("you would", "you could" - compare Ms Farmer's "what Melbourne is like" in her introduction to the lesson). As in the earlier discussion, Ms Farmer used present-day Melbourne as a frame of reference, both to inform the students' reading of the map, and also to direct their attention to changes over time. Their view of the past was constructed as a series of overlays superimposed on their knowledge of the present.

In a lesson ten days later, Ms Farmer again focused on physical features of the landscape, exploring observable patterns in terms of a sequence of activities. The class was looking at the organisation of space in the city, using the street layout which can be discerned from a modern map.

All right, can you have a look at the layout, page 43, Melbourne - use your powers of imagination - Melways maps are a mess because there's so much on

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them. Look at the layout of Melbourne, then Carlton, and compare Carlton with Fitzroy and Collingwood...

[Student responses]

What's the first thing you notice between Melbourne and Carlton?

S They're at different angles to each other.

T Yes, Melbourne developed first, then the rest of the suburbs were laid out on magnetic north - that's why there's a different alignment.

What else do you notice about the layout of Melbourne and Carlton?

[Several interchanges with students]

Now look at Fitzroy and Collingwood. There's an explanation for it - the city was planned, then the government planned the suburban development of Melbourne, but only some - Carlton, and west of Carlton to North Melbourne - both as Neville's just said have parks and gardens that have been planned and remained as such.

S Collingwood and Fitzroy - lots of one-way streets which would be very narrow, and a lot of deadends.

T Okay, if we know Carlton and Melbourne were planned by the Government - what about Fitzroy and Collingwood?

S Not planned

T So why? To make more money. Who would have lived there? Poor people... Property developers didn't want to waste money. Speculators coming in and buying huge acres of land, divided into tiny little blocks, purely for profit, there are no parks and gardens because they didn't want to waste money.

(H4, 14 May 1990)

In this exchange, Ms Farmer focused on getting her students to identify differences between street grid patterns on the map. She spelt out the meaning of these differences in terms of a sequence of activities. The government planned the wide streets and parks of Carlton, but they did not constrain development in Collingwood; speculators then bought tracts of land in Collingwood and subdivided it into tiny tenement blocks. In a number of later lessons, she emphasised Melbourne's position as a centrally located port, its dependence on its hinterland,

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and the significance of the development of local industry which reduced this dependence - again, focusing on the relationship between physical features of the environment, and changing patterns of activity over time.

In bringing students into relationship with this changing landscape, Ms Farmer positioned them directly as observers of it. When I interviewed her, she said,

I would expect the students to reconstruct and enter into the daily life of a worker or lawyer as it would have been in the different periods of the development of Melbourne. (Interview - emphasis added)

To achieve this, students were to "see" the patterns of daily life: waste disposal, the streetscape, the disposition of mansions for the wealthy on the hills and tenements for the poor on the miasmic plains below, the development of trainlines to serve Melbourne's hinterland. For instance:

T  (reads)... Cesspits - what are cesspits?
S  Dumping ground
S  Pit for poo
T  That's a lovely way of saying it... (continues to read)... Collingwood Farm - that's where they dumped the cesspit waste - that's why vegies grow so well down there. (Reads)...
S  What's a night cart system?
S  Crap in a bucket - then they'd come in the night and take the bucket away.
T  (reads)... Particularly when they were private contractors, they didn't have to make sure they were doing the right thing, these guys emptied pans, everyone has a pan, they emptied it into their cart, they were supposed to dump it in the wasteland, but they used to dump it in Little Flinders Street and the lanes.... So that's the reason why the back lanes were very unhealthy.

(H4 17 May 1990. Extracts from text omitted.)

Ms Farmer commented:

The part of the course students find least interest in is the land legislation, which is very dry - if they ask why they have to know it, I just point to the syllabus. I also try to explain how it

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affected the squatters and selectors. We have to do some politics, but students relate best to domestic-scale detail. (Interview)

This focus on "domestic-scale detail" shaped both the object of study in Ms Farmer’s lessons, and her students’ relationship with it. Ms Farmer focused on the material conditions of life, and dealt with politics (for instance) only marginally - power, consciousness, and ideology were absent from the lessons I observed.1 Secondly, as we have seen, the imaginative effort involved in this direct relationship with "domestic-scale detail" invoked students’ own experience as a frame of reference. In later discussions, this frame of reference continued to be taken for granted as the basis of the interpretations which Ms Farmer constructed.

T The Government had 1095 children in its charge in the 1860s, and it says here (reads - children given sustaining food including wine) Can you imagine children given wine?

(H4, 16 May 1993)

T How did they get rid of bacteria - through boiling?

S Not boiling - they’d used boiling before - that turned the milk brown.

T They didn’t have very good knowledge of how to deal with bacteria.

S (reads aloud)

T They had the miasma theory of disease - they still believed you could pick up bad disease from smells...

(H4, 18 May 1990)

Unfamiliar beliefs or practices were registered as surprising or unsatisfactory ("they didn’t have very good knowledge", "they still believed"). Similarly, Ms Farmer commented that speculators built tenements "purely for profit", working class people did not use trams because they were "mean with their money", "people in those days valued money very highly".

1 Neville, for instance, mentioned in several lessons that he was a descendant of Thomas Bent, Mayor of Brighton, who had considerable influence on the development of Melbourne. Bent’s activities were never discussed.

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The effect of positioning students in this way was to simplify the process of interpretation. The exchange below is taken from the end of a review of the differences between Melbourne in the 1840s and Melbourne in the 1880s:

T  The last thing is attitudes. You’ve really covered it. 40s.
S  Determined - they had a goal in mind.
T  Right. 1880s, what attitude?
S  Make money and enjoy it.
S  More corrupt - make money any way they could.
T  Listen to what we said - who are we missing out?
What about poor people?
Were their attitudes the same?
Neville  Poor people don’t have attitudes!
T  The poor were probably struggling, their attitudes didn’t change.
Daniel  Cynical, bitter, hopeful.
T  You have to give examples, by saying, for example poor class people in Fitzroy and Collingwood with difficulty paying rents.
Neville  They probably didn’t know they were being ripped off.
T  They did know - they would have seen the wealthier homes.
Neville  That didn’t mean they knew about the land speculators and so on.
T  My point is, when you read your essays, make sure you look at the points, watch the dates. That’s very important.

(H4, 23 July 1990)

In this discussion, Ms Farmer used the poor housing and high rents of poor people in Fitzroy and Collingwood to support Daniel’s suggestion that poor people in the 1880s were "cynical, bitter, hopeful". Interpretation was treated as self-evident. The implication is that these attitudes could safely be read off from what students knew about the material situation of workers in the 1880s. Neville’s objection ("they probably didn’t know they were being ripped off") was almost curtly dismissed. Significantly, Ms Farmer’s response was to represent interpretation as

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implicit in perception ("they would have seen the wealthier homes"). Issues to do with perceptions and consciousness, which Neville was raising, were marginalised.

Consistently with this, Ms Farmer treated historical texts as transparent sources of information. She gave most emphasis to the details they provided:

T Okay, if you’re going to write an essay of any sort and want to make a point, like "Diggers were against the use of machinery of any sort in the beginning, and against company mining", you need to back it up with facts - you need some evidence. (Reads) "Many miners were against.... Most miners were against large scale mining." These are quotes. "At Castlemaine... " Here’s an example - at Castlemaine a group of diggers got together and protested at a company going to set up with a large lease, they in fact won - Hotham didn’t give the lease. There’s an example, right.

(H4, 20 September 1990 - emphasis as in lesson)

T [referring to the reading they were doing] I’d take brief notes... pull out a few figures that they use too, please, Gurry gives some good quotes on figures, you can pull those out to use them for essays.

(H4, 18 May 1990)

Students were to look through the text they were using, and apprehend ("enter into") the landscape and activities it depicted.

**Mr West: juggling the data base**

*What has this course been about?*

This has been about finding out what has happened and been thought and done from evidence, as well as about finding out what some historians have said on the basis of the evidence they have read. (Mr West)

Mr West treated the reading of historical texts and artefacts as a complex process of interpretation. He distinguished between this process, and the collection of information, which he saw as primary:

We can look at things in terms of contention as much as we like, but until they have a data base to use as evidence they’re not operating historically, and it takes an awful long time to get that data base... The way I go about it basically is to give enormous amounts

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of time to get that data base, and then every now and again turn it back on them so that they don’t go away thinking it’s all been received wisdom... I find my kids make enormous improvements in the last month or six weeks... it’s not till then that they’re familiar with the data, and they can start tossing it around.

(H2, Interview)

The "data base" image Mr West used in this interview suggests that students were to collect information before they could enter into the process of interpretation, "tossing it around". I have included him in the second category of teachers, those who distinguished between information and the development of interpretations.

Mr West’s lessons involved a great deal of private study. His students spent a considerable proportion of their class time, as well as their study time outside class, working through assignments which he set them: reading texts and other references in order to answer a series of questions on the topics of the course. These assignments were done individually. The class came together from time to time, at the beginning of a topic, and again at intervals for lessons reviewing the main issues on which Mr West wanted students to focus. It was possible for me to observe the whole-class lessons; the process by which Mr West directed students’ learning via the assignment sheets was less visible.

Early in the class’s study of the 1920s, Mr West spent several lessons discussing how the everyday experiences of people living through the World Wars and the 1920s might be reconstructed. He began one lesson with a critique of an "empathy" essay on World War II, by a student whom I shall call Donna.

T  I’ll read you a very good essay - Donna’s - she gave herself a good lot of extra time. [Reads] That’s an adequate introduction - she could have continued the personal tone. “Within weeks the men were away fighting” - is anything wrong with that?

S  They hadn’t gone.

T  No, not for six months. There’s a fine line between imagination and fact! [Reads: wages] No emotion - what about morale, tension? "In response to this threat myself and one of our neighbours went out and built a bomb shelter" - not the slightest bit scared, Donna? It’s good factual stuff, but there’s something missing - the emotions.

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I want to show you a few bits and pieces I've picked up about the traps - just come out the front - you can't write history without sources. [Waves Air Raid Precautions booklet] Say you had picked up this booklet - it's an Air Raid Precautions booklet. The first thing is, the Air Raid signal will be given by — — — three five second signals with a two second break means Raid Impending. A two minute blast means All Clear. There must have been practices. You had to learn these things like a bus timetable. In the back, there's a plan of a shelter. This week Donna built one in an afternoon - not bad, all that joinery!... - there's a reinforced concrete roof - how many rods, how much reinforced concrete? Look at the dimensions when you're going through it - it tells you how to build it, get out your pick tonight.

Plans were to be "gradually unfolded to people" - you can't say you can't have air- raids. Were kids prepared, were they anxious? excited? It's 1941, Donna writes "we had this report so we dug a hole in the ground". The Air Raid Precautions called for volunteers, men between 35 and 40, and women - they called for 20,000 people to enrol as wardens. These were some of the things you had to do: decide on the form of shelter for home or office, consider protection against gas, darkening the house, the things needed for the shelter, check the radio... Dad's away at the war, the kids are howling, someone has a splinter - and you've got to have chloride of lime at the door!

(H2, 14 May 1990)

Mr West began this lesson by emphasising the importance of transforming the formal language of the text into a more immediately personal account.¹ He went on to develop the idea of immediacy, by introducing some actual items from the

¹ He made this explicit in a later lesson, again commenting on one of Donna's essays:

T What's happening here, Donna takes the fairly formal expression from the texts and uses it in an essay that asks you to talk about individual experience. You can personalise this far more. You wouldn't have sat at the table and said, I want to gain more recognition for myself - that's not champing at the bit, saying this - it's hardly a motive, it's something you can reflect later. You want to use terms which are meaningful in terms of her life.

(H2, 23 May 1990)
war. He explained how these items - an ARP booklet and a Peace Certificate -
could be read as evidence of particular experiences, with both practical and
emotional dimensions ("all that joinery!", and "how were the kids prepared, were
they anxious?"). Up to this point the students' role had been to watch and listen; he
went on to pass round the booklet and certificate for them to look at, while he set up
the video which they were to watch next.

In this lesson, we can see that for Mr West constructing an account of the past
involved both the mastery of accumulated details, such as the requirements for con-
structing air-raid shelters, and careful interpretation of their meaning. I want now
to consider this practice of interpretation from two points of view: first, to identify
what Mr West focused on, the kinds of interpretation he made, the stories he told;
and second, to consider how he went about constructing interpretations, and how
he positioned students in relation to the process.

A common feature of Mr West's whole-class lessons was the consideration of a
sequence of items: artefacts from the Wars, as above; speeches and articles from
the 1920s; statistics for strikes and production levels; or accounts of different
women's organisations active during World War I. Usually this material extended
the reading students were supposed to be doing for their assignments - though they
were not familiar with it, if they were up-to-date with their work they would have
some knowledge of its context. The lessons generally followed the same pattern.
First, Mr West made some comments on the topic of the lesson. Then he would
take the class through each item: he would introduce it, if it were a document, he or
a student from the class would read it aloud, and he would comment on what could
be learnt from it. Occasionally he would stop the reading to ask a student the
meaning of a word.

Implicit in this practice is Mr West's conception of interpretation as a higher level
process which involved digging beneath the surface of these details. A good
example is his discussion of a video of the 1920s, which he showed later in the
lesson of 14 May (quoted above). During the video he wrote notes on the board; in
the following lesson, he wrote these notes up again, and took the students through
them. The video in question incorporated original 1920s footage. Mr West began:

The people making videos want action, photographic shots, a mix of other
things, they take a 20-second shot of a machine working, it's pretty boring
basically, they develop a theme around the machine, stress something to do with a
factory, or engineering, or electrification - in this video they had a lot to say about electrification - so as to justify their selection of imagery.

They found plenty of pleasure-seeking footage.

There was a sense of release in the 20s, after the hardships they suffered in the War - men came back to a society which was trying to do something for them, including providing them with land - we'll come back to that in a week or two's time. It was a War to End War, it had been a war far more horrible than anyone had ever known before, people were trying to get their lives together, get the economy productive again, they hoped for the good things, so it's not surprising that the film-makers of the time took a lot of photographs of things getting back to normal, the good things of life, like holidays, Luna Park, the races - pictures of people relaxing, doing things they couldn't have done during the War - you remember racing wasn't allowed in the later years of the War.

(H2, 16 May 1990)

In this lesson Mr West used the video at two levels. He reviewed the events and developments during the 1920s which were portrayed in the video; he also talked about the images of the 1920s which it contained. The roller-coaster image at the start was one Mr West came back to in later classes, inviting the students to evaluate its accuracy as an image of the 1920s. In these comments, he moved from discussing the roller-coaster as an image selected by the video-makers ("they found plenty of pleasure-seeking footage"), to the film of the roller-coaster which they used, as an image of public enjoyment which was originally created to express people's reaction to the World War ("it's not surprising the film-makers of the time took a lot of photographs of things getting back to normal"). Here we can see him uncovering and displaying successive layers of meaning, while his students observed and took notes.

The control Mr West exerted over this process of interpretation positioned his students in relation to an object of study which he defined. In class, they were not asked to construct their own interpretations. Instead, he offered them the meanings he discerned, as an extension of the knowledge they were accumulating. In effect, this practice constructed meaning as intrinsic, contained in the object of study.

An early lesson on the 1920s topic illustrates this positioning of the students. The lesson began with a brief discussion of some propositions from an article about social change in the 1920s, in particular the observation that divorce rates increased.

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This was followed by consideration of a series of short documents, which were read aloud to the class. Mr West commented on each document before turning to the next.

T  We're looking now at things that may have prompted divorces in the twenties, changes in values.

(Reads from text on communal responsibility for child life and motherhood - argument that a Government Department should be set up to value motherhood.)

How does that fit with the picture of the New Woman [in Turner's article]?

S  It's virtually opposite.

T  How? In what ways?

S  This encourages them to stay at home, in the Turner article it says this was a freer time for women, they were off enjoying themselves.

T  Good - so we can see the challenge to this set of values in what people were up to.

Australia Unlimited - what was that about? Don't tell me...

S  Farmers opening up more land

T  So - very optimistic ideas about Australia supporting vast numbers of people - a hundred million, two hundred million, at the most optimistic - vast numbers - they believed all we had to do was populate. So immigration was very important and the birthrate was very important. It was part of the conservative agenda...

The farmers were part of this, there was a push inland a bit, there was a denser rural population. In the middle of all this is a picture of women having babies - so when we talk about women in the twenties we also need to have this traditional maternal view as exemplified by this document.

Men coming back from the War may not have known which way society was turning - confused by the emphasis on motherhood on the one hand and the emphasis on jobs for women on the other hand - a whole range of images which could very well have been confusing.

This MLA from NSW suggests, let's do all we can to promote motherhood to get women to bring healthy children into the world and look after them.

(H2, 21 May 1990)

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Mr West’s questions here positioned students within the story he was developing: one question asked for a summary of the argument put forward in each document, another for a definition of a term he wanted to use. Students were expected to follow the line of thought he was pursuing, and contribute appropriately. The presumed alignment between student and teacher was clear in Mr West’s concluding comments; although he actually constructed this reading, it was offered as a shared interpretation ("we can see"); "when we talk about women...we also need to have this... view").

Moments when students did not provide the expected answer to a question confirm this reading of their expected position in relation to the story Mr West was constructing. In the following sequence of question and answer, a little later in the lesson, Mr West was working through the effects of imposing tariffs on different interest groups - a topic which students had been asked to investigate in their assignment. The relevant moment is sidelined in the extract below:

T What effect did the tariffs have?
S Raise prices.
S Protect local industry.
T What was the Labor Party attitude?
S They support it.
T Okay, so will it help local industry, will it help builders get back on their feet after the war, if you make shovels for £1, as against 10/-, which will you buy?
S The cheap ones.
T What about local manufacturers, what about local labour?
S They’d be pleased.
T What about the farmers?
S They’d be upset.
T What would they have wanted to buy?
S Wheat.
T We don’t import wheat.
S Machinery.

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Yeah - you could import that in quantity, but being protected makes for higher prices.

Why was it costing so much to make things here?

Could it have been that the cost of the basic wage was so high? margins were high? the market was small so the unit cost was high? Lots of possible factors there. Anyway, the farmers were unhappy.

(H2, 21 May 1990)

Similar moments occurred at other times when students were slow to produce the answer the teacher was waiting for:

T  Closer settlement - a detail of Australia Unlimited.
S  So more people could settle?
T  Sort of like that - focus on closer.
S  Not spread out.
T  How could you achieve that?
S  High rise flats
T  In the country??
S  Small subdivisions.
T  Ponder this - we don’t know what they did about the land in 1859 after the goldrushes, but some of you have looked at the opening of the land in the 1860s - the out of work miners wanted more access than they could get in the 40s and 50s. Who had the land then? What do we call people with big holdings?

(silence)
It begins with S
(silence)
With SQ
S  Squatters!

(H2, 21 May 1990)
As I read these exchanges, Mr West's insistence on getting an answer was connected with the development of the story he was telling. In each case, the missing word was to form part of an argument; the answer the student gave helped to constitute the story. In closing the lesson, Mr West tied the threads of this story together, with an extended commentary:

T Squatters had big areas of land - it was hoped the sixties legislation would enable smaller holdings to produce wheat etc - by the 80s many had given up, and those who survived had soaked up other blocks of land, bigger than they were originally given. The settlement process was winding down in the 90s, it started up again in the 1900s, governments got their old policies out - they wanted people out of cities not because of pollution (that didn't exist) but because of social evils [explored earlier in the lesson via the document readings]. The Government looked at the land around, there were big squatting families still, and they had a policy to buy it back - before World War I there were closer settlement policies in most states. [Lesson ends.]

(H2, 21 May 1990)

Students contributed to this story, but they did not participate in shaping it. The process of constructing an historical account was one which the teacher displayed to the students, and into which he drew them very gradually, expecting that they would follow along, and asking them to insert what they knew into the framework he was constructing. Although Mr West might actively deconstruct historical texts, in lessons like the one on the 1920s video, his students were positioned as relatively passive recipients of information and interpretation. As he put it, "realistically, most of them will settle for content rather than contention".

Ms Webb: lots to think about

What has this course been about?

Content.. Skills.. Techniques... Aim - learn to think for selves, consider possibilities, weigh evidence, appreciate variety of interpretation and why people see things differently; enjoy history; encourage students to be precise and methodical; conceptual approach to history; awareness of patterns. (Ms Webb)

Ms Webb spoke about history as a process of investigation - lively, exciting, and involving. When she described her teaching to me she emphasised the importance of getting students to think things out for themselves.

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I want to make history seem accessible - not as a great big body of knowledge to be acquired, but interesting, exciting, offering lots to think about, to do with people and what life’s all about. I want them to be able to think, assess, and weigh up. (Interview)

In class, she positioned herself as an investigator alongside her students. She told stories about her own explorations - searching for the Mahogany Ship at Warmambool, visiting the battlefields in France. However, she consciously held back from expressing her own conclusions, so as to encourage her students to work through to conclusions of their own. During the students’ work on their option, exploring the argument that Portuguese navigators were the first Europeans to find their way to Australia, she said to me:

I have to make out I believe most of it - otherwise they pick up on what I say. Asking sceptical questions is okay, but not passing on my views. (H3, 6 April 1990)

She steered her students towards using the experience and knowledge they already had to develop and investigate propositions about the past. In terms of the categories described in Chapter 3, I assigned her to the third category of teachers, those who represented knowledge as a system of meanings.

In Ms Webb’s class, the process of investigation was public and shared. This work was done in discussion - significantly, Ms Webb did not use the board to write up notes for copying. An early lesson began like this:

T Later in this lesson we’re going to go into another room and watch a video, but first I want to tell you something about the examiners’ meeting I went to on Friday. There was something there that you should all think about.

Australian History at Year 12 is different from all your other subjects - Legal Studies, English Literature, Economics and so on - because there’s no content that everyone in the state does... There is a series of core concepts... What is a concept?

[Various answers]

T I’m going to read you out the list of concepts - no, I’m going to write them on the board.

S I thought we were going to think?

T Well, you can look at them and think.

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(Writes) Evidence - empathy - historical imagination - values - time - change - causation - motivation.

T These are the course concepts, they're common to all students. Let's just whip through them. Evidence. What's evidence?

S Stuff to support your argument.

T Okay, what about empathy?

S It's understanding a situation from another person's point of view?

T Right, standing in another person's shoes.

(H3, 27 March 1990 - emphasises mine)

What was written on the board was not to be copied; it was made visible to the class. In this class, students were challenged to offer their own ideas and responses to the course concepts. Generally, lessons could be seen as a sequence in which students became increasingly familiar with a topic. There was a lot of small-group work, where students investigated and discussed different aspects of a topic, and then reported back to the whole class. Whole-class lessons involved students in reading and then discussing and drawing conclusions from what they had read. Periodically, Ms Webb would spend a lesson getting the class to analyse and discuss an appropriate essay question, usually taken from a past examination paper. Sometimes this involved small-group discussion; at other times, individual students were asked to present their own reading of what answering the examination question would involve ("You have to get rather brave to do this," said Ms Webb. "Criticism isn't a personal affront.").

Although she brought documents and images to some lessons for discussion, Ms Webb did not specifically use them to generate empathy. From the beginning, she focused on getting the students to articulate, structure and develop their ideas and responses, including their sense of what it might have been like to live within a particular situation. As an example, I want to consider one lesson, within the Working Men and Women unit, where the topic was living and working conditions in the later part of the nineteenth century. Early in this topic, each student was asked to investigate a particular rural industry. They were to take notes under a series of headings: the tasks undertaken by workers in that industry; the range of wages, hours, and living conditions; any change over the period; and why the
change occurred. Detailed information was to be sorted into these categories and then reported back to the class.

T  We were about to talk about the mines... Jim.
Remember what we're thinking about - working conditions, change, and why there's change.

Here is Jim, getting into his talk about the mining industry:

Jim  In 1860 the rate of accidents - over 100 miners were killed each year. In 1900 three in a thousand had an accident, and one in a thousand was killed. The death rate from lung disease went from seven in a thousand in 1875 to nineteen in a thousand in 1905.

They lived in houses leased from the Crown, two-thirds of them owned their own homes - a four-room cottage cost £100.

Miners' unions were formed in the 1870s.

Gold mining was dominated by big companies - 200 in 1859-60. In the 1890s gold production rose and there was new investment.

Housing changed but not much. At Creswick in 1861 a third lived in tents, in 1870 a quarter were in temporary accommodation.

The gold towns had instant growth then decline - some gold towns took on a service role.

Changes in technology - dynamite, cyanide process, horsepowered puddling machines, suction dredges, steam power, mechanical power reduced the drain on human energy.

T  Was that good or bad?

Jim  The dynamite was good but the cyanide was bad, it was bad for their health.

...  

T  I can tell you about lung diseases - the fine dust from the new drills - another way change is bad. When you think about changes, think about good or bad - change isn't necessarily a good thing.

(H3, 15 June 1990)

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Ms Webb’s first question was about the effects of specific changes in the industry on the workers concerned. This kind of exchange recurred throughout the lesson - Ms Webb would ask "what changed?" "what effects did that have?" "was it good or bad?". Students were consistently asked to decide whether they thought the changes involved were good or bad - "change isn’t necessarily a good thing". Next, she asked:

T Would you have liked to be a miner?

Jim No

T Why?

Jim The dust - there was something about a man with a jar full of sputum with dust in it.

This can be construed as an "empathy" question - "putting yourself in their shoes" - which called for Jim both to articulate his attitude, and to think about why he reacted as he did.

Ms Webb asked similar questions of every student; their responses were given thoughtfully, and treated seriously. As she saw it, this explicit questioning was part of the process by which students developed their understanding. She said to me when I first interviewed her:

I always assume that the students know something before they start... Students can learn to think if they can talk, express opinions, and say why they think something.

She expected that in the early stages their opinions would be based on very little knowledge. Commenting to me in an interview about this time, Ms Webb said:

At this stage in the year students register general impressions more effectively than details. If I set them a test on what they know you would be horrified at how little it is. They can still find it hard to read a text and pick out the main points which are being made from the mass of detail. At this stage what I want them to do is to build up a picture which they can then recall at the end of the year... The broad brush picture is what they are most likely to remember, and by the end of the year they will be able to fit the details into it. When I first started teaching I was more insistent on getting the facts into them, but I now feel it isn’t actually how students learn.

(Interview, 1 June 1990)

Patrick KA (1998)
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Certainly Jim had just started to find out about miners' living and working conditions, drawing on a few pages of a textbook. Ms Webb nevertheless expected him to have an opinion about what it would be like to be a miner - an impression which he would be able to test if he did further reading, such as was foreshadowed at the end of the lesson.

T Objectives - just to remind ourselves - describe - analyse factors and forces involved in self-improvement and social reform. Empathise - questions like would you like to be a settler, put yourself in their shoes. I also have a large number of articles on particular farms... I will ask some people to do these as tute papers, just to get an idea of what it was really like, was it ever fun.

Opinions, then, were appropriate and legitimate guesses at "what it was really like", which would be better established by further work.

A little later in the lesson, Bonnie was talking about the wheat industry. She identified growth in the area under cultivation, and the introduction of farm machinery, as significant changes in the industry. Again Ms Webb focused on the effect of specific technological change, this time in relation to the structure of the industry:

T So there was a lot more land under cultivation? What was important to get about wheat?

S Technology helped.

T Technology helped - forms of machinery.

S Combine harvester.

T Had they got them by then?

Bonnie Yup.

T Is that enough to remember? Yeah, I think it is. - Anything else that's important - small scale?

Bonnie They started off small, then everyone shifted out.

T Why did the farms get bigger?

Bonnie Because of the railways and the Selection Acts.
Yup - and land in the Mallee. you need bigger farms - and what about machinery, would that tend to make farms bigger or smaller?

Bigger.

Yes, you can chomp into it then - acres and acres.

This exchange again shows Ms Webb pressing for causal connections to be made explicit by the students. She was asking Bonnie to make explicit the connection between the introduction of the combine harvester and growth in the size of farms; to restructure her initial list of points so as to make connections between them.

Ms Webb treated students' learning as a cyclical process. She asked them to reflect on what they already knew and use it to interpret what came next. The process can be clearly seen in an episode following the last of the student presentations. Ms Webb was introducing some figures on the relative decline of the rural population of Australia.

Some general points - the number of people in the mining, agriculture, and pastoral industry went down at the end of the nineteenth century... In 1857 52% were in these occupations... In 1901 it was 29%... There's a significant decline. There are two points. That 29% are still vital to Australia's economy, it's an agricultural economy. Now I'm going to ask you to do some thinking. Where did that 23% go? (My italics)

Ms Webb here gave the students statistics which were new to them - in fact all the ellipses above relate to students asking her to repeat what she was saying so they could write it down. Their work on particular rural industries had not focused on people shifting from the country to the city. The next part of the discussion was presented as speculative ("I'm going to ask you to do some thinking"). Ms Webb did not call on the students to produce evidence or to know the right answer. She did, however, push them to use what they already knew about change in rural industries in the period to read meaning into these new statistics.

Why did they go to the cities?

Jobs in manufacturing.

Gone there because there are jobs. Why? [Discussion of cyclical process of demand and production] Why else might they have gone? [Discussion]

One other important thing.

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S They didn’t like the bush.

T Yes, people like Aaron, settlers who didn’t like the bush. Something else - almost everyone mentioned it. [Student suggests the Depression] No, it was the reverse in the Depression, people left the city because there was no work.

S Technology?

T What did that do to these people?

S Force them out.

T Why?

S Because their labour was not needed.

T Basically farming became less labour intensive - the combine harvester [referred to earlier] made life easier but it also put people out of work... Why not go to the local town and work in the factory there?

S It didn’t have one.

T Why not?

In this discussion, Ms Webb clearly wanted students to produce a particular answer: to connect the growth of the urban population with the introduction of farm machinery, which displaced rural labourers and led to their migration to the cities. She accepted most of their other suggestions, but she persisted until the answer she wanted had been spelt out. An unexplained one-word answer ("Technology?") was not enough. She asked more questions: "what did that do?" "why?" "why not?". These questions pushed the students into contextualising their newly acquired information on the population shift: to reflect on the experiences of the rural workers they had been reading about, and the changes in rural industries they had been recounting, as a way of understanding how people might have come to move from the country to the city.

In the interview I quoted earlier, Ms Webb talked about her students building up a broad brush picture. Her work in this lesson involved her guiding them in this process. Initially she provided them with headings - categories into which they were to sort their information. In the presentations, this resulted in a list of points ordered by topic, but not otherwise connected. In the discussion, she asked each student to connect the various changes they had identified, and in particular to comment on the effect of particular technological changes on working conditions or

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on the structure of the industry. Finally, the students as a group discussed how these changes might explain the movement of population from the country to the city. The figure below shows the structure she developed in the discussions I have quoted.

Figure 6.2  Discursive structure developed by Ms Webb

In these discussions, Ms Webb called on her students both to report details and to develop interpretations and explanations of them. Her role in the lesson was to develop a discursive structure for the information they had collected. She positioned herself in relation to their discourse, rather than positioning them in relation to hers. Her students were participants in a collective process of constructing meanings.

Ms Parbo: looking in through the keyhole

*What has this course been about?*

Aboriginal Australia before 'Whites'; Aboriginal Australia after the 'White' invasion; 'White Australia' and the British heritage, the new nationalism after 100 years of White invasion.

(Ms Parbo - quote marks in original)

When she described her history lessons, Ms Parbo emphasised the importance of getting her students to see different points of view. This metaphor is perhaps so embedded in normal speech that it seems to be a mere synonym for simple

*Patrick KA (1998)*

*Teaching and Learning: the construction of an object of study*
differences of opinion, but that is not how Ms Parbo used it. She spoke of "points of view" to indicate that history was seen differently by different people; that any particular observer necessarily occupied a position from which some features of the historical landscape were visible, while others were out of sight. Speaking to her class, she said:

Let's say the whole room's the past, we're the present, and we look in through the keyhole, what would we see?... If you look at the whole of history, you never see the whole of history.
(H1, 7 August 1990)

As this keyhole image suggests, both what was seen, and how it was understood, would vary with the position of the observer.

Early in my interview with her, Ms Parbo told me about an incident from her early years as a teacher, which had a great effect on her. She was teaching a Year 8 class about revolutions, and arrived at a statement in their text that universal suffrage was introduced in France following the 1848 revolution. A student asked whether this meant that women got the vote.

Of course they didn't, but just the same this book was talking about universal suffrage. That opened my eyes to how women might be left out of history. After that, I went looking for them. (Interview)

She reached the conclusion that everyone necessarily considered history, or society, from their own point of view: participants, historians, herself as researcher or teacher, and her students.

[In my own research] I'm making a profession of filling in the bits of history which have been left out... [When I teach], I try to show my students how the history books are constructed, and how historians come to write as they do... Kids can see that history's not an absolute, it's something that people can have different opinions about, that each one of us is subjective, there's no such thing as objective history... Everyone's got their own perspective, that's all they've got. You must have a point of view, because there's no objective history. (Interview)

In terms of the categories in Chapter 3, I grouped Ms Parbo with the teachers who talked about the construction of interpretations.

Describing what she most wanted her students to learn from studying history, Ms Parbo said she wanted them to recognise, respect and evaluate different points of view. She said,

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I suppose I would like them to understand that people go through changes and that it affects them and their descendants, and I suppose I'd like them to come out being non-racist, non-sexist, tolerant in their outlooks, aware of another way of life other than their own, perhaps thinking a little bit differently about their material needs. I suppose I'd like them to come out of it feeling that this country's big enough for quite a few of us, not just for some of us... I want them to be open-minded enough to see another point of view and perhaps change their mind. Or, hold on to their point of view because they've really thought it through, and haven't been convinced. (Interview)

By studying history, students would begin to apprehend both how historical stories were constructed, and also the different points of view from which their society could be perceived. This project was not merely a matter of turning her students' attention to the "bits of history which have been left out". History could be seen as perceived and rendered differently by historians with different points of view.

What we've been doing in the last twenty years is to get rid of the notion of the Superman History when you learnt when kings were born and died and when governors came and went and when political history ruled the roost and when it was really the men change-makers and their policies that were the objects of study, and we do much more what I would call an Everyman's history and an Everywoman's history of ordinary people - you see the whole question has changed... (Interview)

By bringing up the issue of whose history was worth studying, and how historians framed their object of study, Ms Parbo constructed the study of history as part of a transformation of consciousness. Her objectives were both intellectual and moral. They were associated with the task of educating students as citizens.

It's a lot more than an intellectual exercise for me. I'm very aware of the political ramifications of history teaching and the power of history teaching, I'm very keen to develop democratic processes and democratic confidence. (Interview)

Ms Parbo aimed to get her students both to recognise the existence of different points of view, and to change their own.

Ms Parbo talked about her teaching of Australian History as an extended process in which students would work on these issues at different levels. She described her lessons in terms of student activities which she set up so as to get students to confront issues of perspective and point of view.

Patrick KA (1998)
Teaching and Learning: the construction of an object of study
I have lots and lots of techniques... [With the Women of the Sun video series] I stopped the video at a particular instance, and they'd got their page divided into Aboriginal point of view and European point of view, and they had to talk about that particular instance and how the characters in the video, the black characters viewed that instance, and how the white characters viewed that instance. (Interview)

The interchange of discussion was salient in her description of her teaching. The work she set students to do at home was frequently to prepare for presentation and discussion in lessons, which she described as "talking time":

I run off stuff for them to read, but they have to read it at home, there isn't enough time. (What would you see as the function of the class, at Year 12?) It's talking time. I get a lot of kids, even the year 9s, to do the actual reading and finding out at home, and spend the class time to discuss... Where some kids have done the work and some haven't, I get them into groups, so that they can use the knowledge of other people. (Interview)

She expected her students to do most of their reading outside the classroom, and to use their lesson time for discussion.

Most of the lessons I saw did involve either student presentations, based on reading done outside the classroom, or discussion of materials which Ms Parbo had brought to class. I observed two sequences of lessons where each student presented a report and answered questions on a different aspect of the same topic, and distributed copies of their notes to the other students in the class. Each series of presentations was followed by a general discussion and analysis of what had been said. All the students participated, though some spoke more than others. Ms Parbo used the board to record and analyse what students were saying, but she did not dictate notes. She did, however, ask a great many questions - most of her contributions to class discussion were framed as questions.

What was the object of study which Ms Parbo constructed for her students in these lessons? How did she direct her students' attention, and what did she ask them to do? What did she focus on when she spoke?

In many of the lessons I observed, Ms Parbo asked questions which called on students to explore and evaluate different points of view - their own, historians', and those of participants in historical situations which they were studying. In these discussions, she particularly challenged European stereotypes of Aborigines. An example from an early lesson on Aboriginal Australia illustrates her approach.
The focus of this lesson was the idea of regional differences between Aboriginal tribes. Ms Parbo began by asking,

T What nationalities have we got here in this classroom?

(Students answer: Greek, Japanese, Timorese, Hungarian, Maori)

T What do we have in common?

S We all live here.

S We all live under the same laws - freedom and democracy.

S Most of us are born in Australia.

T How long do I have to live here to be Australian?

S Seven generations!

T We know we have some things in common, but there are a lot of differences.
We've been talking as though all Aborigines were the same - like Victoria - what were the same, what were the differences?

(H1, 19 March 1990)

From differences between students, to differences between Aborigines. The class, in twos and threes, made lists of "similarities and differences", and then pooled their conclusions in a whole-class discussion.

T Okay, what's the same?

S Technology.

T That doesn't say very much.

What sort did they all have?

S Weapons - they were all light.

T (writes on blackboard) Multi-purpose, portable - now they'd be made of fibreglass.

S Varied according to conditions - in coastal regions they'd have a long spear to catch fish, inland they'd have a shorter spear to catch kangaroo, because it was easier to flight.

T (writes) Differed in detail according to local conditions.

Patrick KA (1998)
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Josie They all had totems, but different ones.

T We've got, the same system of totems, differed in individual totems.

(ibtid)

The board filled with general features of Aboriginal society which differed in detail from place to place. Towards the end of the discussion, Ms Parbo asked how students would characterise the common features of Aboriginal society.

T Were aboriginal societies democratic?

Josie Everybody wasn't equal.

T What is democracy?

S Everybody having a say.

S The majority having a say.

S When you choose your own leader.

T Did they choose their leader?

S Different people were in charge of different things - the old men were in charge of sacred sites, the old women were in charge of marriage problems.

(ibtid)

The term "democratic", which Ms Parbo had introduced, implied a comparison with European society; she now made this comparison explicit:

T Was aboriginal society more democratic than European?

Ellen Yes.

T How could you document that?

Maui Each person counted for something - not that all people had anything to say.

T I'm going to pretend that I'm Blainey. The Aborigines killed off babies - they practised infanticide - they killed off babies that were born deformed - they weren't all equal.

Josie Because they were suspicious of diseases - it was for the benefit of the whole tribe.
They were more communist than democratic. Everybody put in, they had a few leaders, they weren't chosen - for the good of all.

A democratic political system, a communistic economic system - everybody taken care of on an economic level.

But also at a social level, everybody was taken care of.

Towards the end of the lesson, Ms Parbo suggested that students use these insights so as to respond effectively to racist remarks about "boongs":

If someone talks about "boongs", what is that person doing?

They’re narrow-minded - generalising - 60 Minutes - going by the newspapers.

You’ve got to talk about changing society - Aborigines were no more the same than we are the same - and change over time - think about 1990, 1790, 1810 - changes in time and differences in location, and yet there are patterns of similarity, but also diversity. If you were having a discussion, sitting opposite the person who called them boongs, what is the next thing you say?

What argument? You're right. Mother saw it when she went to Darwin. - I don't know, I wasn't listening.

You're racist.

Where's your proof?

Where'd you get your information?

I'm not getting at trying to put the person down. - Aborigines are as different as Europeans, the British are different from the Russians, the French from the Germans, and if you tell them they're the same they'll punch you in the mouth - I'll punch you in the mouth.

In this conclusion to the lesson, Ms Parbo argued that the differences between groups of Aborigines which her students had identified could be used to challenge the stereotype implicit in the racist term "boong". The way she framed this argument aligned students with Aborigines, "sitting opposite the person who called..."
them boongs". Grammatically, she rendered students and Aborigines interchangeably ("Aborigines were no more the same than we are the same"). In effect, the students were to speak from the Aborigines' point of view - a position which Ben's resistance (sidelined) makes clearly visible. Ms Parbo often moved students' attention between European and Aboriginal perspectives in this way - opening up consideration of both points of view, but closing the discussion in alignment with the Aborigines.

I take another example of this from an early lesson in the second topic, European settlement and the effects on Aboriginal society. The class had been discussing a series of documents from the early years of European settlement, and in this lesson they were considering a passage from a letter to Sir Joseph Banks from a young Marine with the First Fleet, in which he described his impressions of the aborigines. The students had been asked to read and analyse his remarks for homework, using questions supplied in their text. Ms Parbo's focus at the beginning of this lesson was the European point of view expressed by the Marine. She began by calling on a student to report his conclusions. As Derek spoke, she used what he said to develop questions for the whole class:

T Derek, tell me what this writer thought of the Aborigines.

Derek They were annoying, they went round naked, they only ate fish and roots.

T Why was he cheesed off because they only ate fish and roots?

Ss Not healthy - they didn’t like it.

T Why didn’t they like it, because it was different?

1 Similarly, in a later lesson on Aboriginal religious practices, Ms Parbo drew an explicit parallel between Aborigines' experiences in adapting to modern culture, and her students' cultural dilemmas:

T Any major shopping centre you'll see a mixture of food shops - four or five nationalities - newspapers in four or five languages in every major city. The Aborigines are mixing tradition with today in the same way we try to make sense of our own mixed life - we don't just do what Mum and Dad say - they have some traditions they keep, and some new things.

(H1, 28 March 1990)
It's like the French eating snails - we say Ugh, yuk, what a turn-off.

They ate fish, so did the white people.

So what people eat can put you off - it can be a turn-off as Maui says.

(H1, 22 May 1990)

Ms Parbo began by asking what lay behind the Marine's comments - why should difference be annoying? As Derek went on with his presentation, she continued to push her students to classify the behaviours which the Marine was reacting to, and to register his comments as a perspective on people who behaved in an unfamiliar and unintelligible way:

They lived in rocks, trees, huts; they didn't want to make friends; they wandered round and killed marines, and they attacked unknown whites.

So what sort of things didn't he like?

They were primitive and poor.

And treacherous.

Why?

Because of the way they get back.

You can't trust them.

One minute they're your friend -

Why did they think that?

They couldn't communicate.

They couldn't speak the language, they were some sort of primitive, poor, pathetic things, they eat rubbish, you can't trust them, they turn on you for no reason. What else, Derek, anything else?

They killed stragglers.

Right, that's what's treacherous, he doesn't understand why they're just killing people working on the land.

(ibid)
In this exchange, the students moved initially towards identifying with the Marine. Europeans became "you", Aborigines "they" - "you can't trust them". At this point, Ms Parbo was pushing the class to consider what prompted the Marine to reach his conclusions. The switch back to calling the Marine "he" ("He doesn't understand why") flags a significant change in perspective. At this pivotal point in the discussion, she characterised the Marine’s view as a failure of understanding, and turned the class’s attention to the rationale of the Aborigines’ behaviour, in terms which they had already discussed in their first topic.

T    Why would they do that?

S    It's their land?

T    Yes - perhaps even their sacred sites. They're unacquainted. - Maui obviously hasn't tried snails, they're delicious with garlic butter...

Maui  You can't say anything really until you've tasted it. When I was younger I used to go with my Maori relatives and get sea-snails.

T    You remember that girlfriend I told you I went to New York with, you remember we couldn't get on, well one of the main reasons was she thought it was very funny I liked sour cucumbers... Every time she saw a shop with gherkins in the window she'd say, There's some sour cucumbers, you'd really like those, and laugh, and there are a lot of shops in New York with sour cucumbers in the window.. What we see here is a similar prejudice to today, someone eating something they don't like, and we think they're weird, but if you're not familiar with it, you're the one who's ignorant, not them.

So think about these criticisms - are they valid?

(ibid)

Ms Parbo’s New York story, in which she identified herself as a person "eating something you don’t like", emphasised her turn from the European to the Aboriginal point of view. This time Maui resisted, offering the idea that the Europeans' revulsion at the Aborigines' food might have been involuntary.

Maui  It's strange, it's very rude to say, Ugh yuk, but at the same time I can't stomach lambs fry, and I've got an uncle, when he eats a fish he eats the eyes and the brains, everything

T    Does that make him less of a human being?

Patrick KA (1998)
Teaching and Learning: the construction of an object of study
Ms Parbo did not pursue Maui’s interest in the European perspective. Rather the reverse: by asking Maui whether he thought his uncle was “less of a human being”, she distanced him from the Europeans who rejected the Aborigines as “weird”.

The movement of the discussion in these lessons suggests that Ms Parbo was working to normalise Aboriginal practices, so as to enable her students to see European settlement from a position aligned with the Aboriginal point of view. This strategy can be seen in a later lesson, where the class was watching part of *Women of the Sun* - a video series which uses a story of four generations of Aboriginal women to depict the history of Aboriginal/European relations.

Ms Parbo opened the lesson by saying,

\[ T \quad \text{I want you to divide your page in half, headed Aboriginal point of view and European point of view. It's the video that shows the Aborigines on the mission. As we are watching the video, I'm going to stop it, and we're going to look at the event and how it was perceived by totally different points of view... Now I want you to watch the video. I don't want you to write anything until I stop it. When I do, I want you to jot down what you think the Aborigines' and the European point of view was about the particular event. (They watch an episode: an Aboriginal woman, living with a white sealer, objects to her daughter being sold to another sealer. The setting is the Tasmanian coast in the 1890s. Discussion of exactly what happened.)} \]

\[ T \quad \text{Now I'm going to give you a minute. People on this side [of the classroom] to write down Maydina's point of view, on the other side the European view - how would you view this? (H1, 5 June 1990)} \]

After a pause for students to write down their impressions, there was a general discussion, which Ms Parbo summarised on the board. She called first on the students who had been asked to think about Maydina’s point of view:

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T What does she think will happen?

S She'll be a slave.

T What else?

S Loss of culture.

T Loss of culture, loss of her own identity I'll put...

What else - what was there a good chance of?

S Abused.

T Sexually abused - there was a good chance she'd be sexually abused. The chances were, the mother was just trying to save her child - so she saw this as self-defence, a form of self-defence.

S For her daughter.

S You're getting a bit technical.

(Ibid)

In this exchange, Ms Parbo focused on arguments which could justify Maydina's action, which she glossed as "self-defence". She then turned to the other half of the class.

T All right, let's try and look at this from the sealer's point of view. Nev, the sealer's point of view.

Ned They have a right to, because the Aborigines were like animals.

T How would he see it as a response to being given work, food, shelter?

S Ungrateful. (T writes.)

(Ned NO!!)

Ben They're unpredictable savages, they could turn on you at any time. (T writes this)

(H4, 5 June 1990)

Here, interestingly, Ms Parbo asked what the sealer might think of Maydina's behaviour. She ignored Nev's comment on how he might justify his own behaviour ("They have a right to"). As in the discussion of the Marine's letter, she

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drew attention to different views of the Aborigines, rather than different perspectives on the situation in which Aborigines and Europeans found themselves.

Two other aspects of this lesson are worth some attention. First, Ms Parbo focused on persistent cultural differences between Aborigines and Europeans. She was less interested in change over time, as we can see in this later part of the discussion:

(The Aboriginal woman seen earlier now leads her daughter along the skyline. Choral music. They come to a flowing river. The woman hides behind a tree, approaches a tent, takes food. A European appears. She grabs an axe.)

T What's happened?
S She's stolen food.
S She menaced the settler with an axe.
T Ok that's what's happened - swap sides now.

(The class record their comments. After a pause, T calls for contributions.)

S If I was the European I’ve have a club behind the tree.
T What's the Aborigine's point of view?
S The Europeans are pretty rich, they don't mind. They didn't know how the Europeans had possessions.
T That's right, they didn't know about private property - they share things.
Ben But they would know about it by this time (1890s).
T Yeah - but she didn't steal any luxuries - bare necessities.
S To her maybe it wasn't much, but he could be struggling.
T They didn't know too much about private property - she wants to feed her kid - it's survival.

(ibid)

Ben's point in this discussion related to change in how Aborigines viewed Europeans - the knowledge which Aborigines would have "by this time" of European attitudes to property. Ms Parbo brushed this aside ("they didn't know too much about private property"). She emphasised the Aborigines' traditionally

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communal attitude to property, and, by implication, the persisting cultural difference between Aborigines and Europeans.

Secondly, this lesson provides an opportunity to consider how Ms Parbo treated historical texts. For most of the discussion, as in earlier lessons, Ms Parbo treated Women of the Sun as a transparent window through which Aborigines and Europeans could be observed. Towards the end of the lesson, however, she called the students to think about it as a particular version of the past.

T When was this video made?
Ss Late 80s - Bicentenary
T In the 80s - how can you tell?...
Derek For the Bicentenary
T In 1982 - it was shown on TV in 1982.
How do we know it was not twenty years old?
S It shows both perspectives.
T Twenty years ago it wouldn’t be as critical of the mission and sympathetic of the blacks. What’s the feeling?
Ss Pity - guilty for what the Europeans have done
T Do they want you to feel guilty about being white?
Elaine No
(classroom byplay)
Elaine It just wants us to think about other perspectives - that we don’t have all the answers.
Maui I think we should be (sc. guilty).
Ben I don’t link myself to the Europeans.
T What do they want the audience to go away with?
S It was made when the land rights issue was around.
T The issue is made...
Annie Political. To show how blacks were treated.

Patrick KA (1998)
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Why now?

(H1, 6 June 1990)

In the first part of the lesson the video had been treated as documentary evidence of Aboriginal and European attitudes; here it was treated as an artefact, a text produced in a particular historical context with identifiable purposes. Ms Parbo used the students’ reactions to the video ("what’s the feeling?") to suggest what the purposes of the video-makers might have been, and how they could be seen as markers relating to the historical context in which the video was made.

Part of the notion of point of view, then, as Ms Parbo constructed it, involved discerning and articulating the intention, or meaning, communicated by particular images of the past. This was a task which recurred in many of the lessons I observed. In one lesson, for example, the class worked through a series of cartoons imaging Aborigines; Ms Parbo asked the students to describe how the Aborigines were portrayed, and then to interpret the way faces were drawn and names given to Aboriginal figures in terms of what they suggested about social attitudes to Aborigines. In lessons on the first topic, Aboriginal Australia, the class worked through detailed comparisons of Blainey’s images of Aboriginal society with critiques offered by other historians. Ms Parbo emphasised that the differences were a matter of how the past was read. Discussing the allegations (in Triumph of the Nomads) that Aborigines exposed unwanted children to get rid of them, she said,

T Who else practised infanticide?
S The British - sort of - they had a system where a rich mother didn’t have to nurse her baby, she gave it to a poor mother to feed, and the other baby of the poor mother would usually die - not directly infanticide, but sort of.
T Why does Blainey emphasise infanticide?
S It seemed very brutal.
T Women and babies make a good sob story.
Ben He’s just giving a realistic view of what savages the Aborigines were.
T You’re allowed to have your own opinion - if you believe the Aborigines were savages you can say so.
Ben Because other nations have done it doesn’t mean it’s right.

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Ms Parbo's question introduced the idea that Blainey used images of Aboriginal behaviour to communicate a particular point of view ("Women and babies make a good sob story"). In this lesson, as in others, Ben's resistance highlighted the point at issue. Ben argued that Blainey was giving a "realistic view" of the Aborigines as savages; Ms Parbo that this was an "opinion".

Ms Parbo constructed the historian as someone with an identifiable point of view, communicated through what s/he wrote. Her questions focused students' attention on aspects of the text which might alert them to this point of view. In the *Triumph of the Nomads* lesson just quoted, she made this explicit:

T       Why do we have to do this? Why do we we read this and then two critical reviews of it?

Maui   We don't have to believe what Blainey says.

T       (rising intonation) You don't have to believe what the experts *tell* you?

S       Compare different views

T       What then?

S       You have to come up with your own opinion.

T       Yes, you have to analyse - come up with something of your own.

T       If you're assessing a historian's book as honest, believable, what would you look for? How would you assess my book? (Holds up copy of it)

How would you decide what you can believe from here?

S       Where you got your information from.

S       What's the basis for your opinion?

S       Bias

T       How can you tell bias?

S       The way you write.
Students were positioned as critics of the different images constructed by the texts they were studying, while Ms Parbo presented herself both as a critic and as an historian who might come under their scrutiny.

**Constructing the study of history**

As their interview comments suggested, these four teachers approached the teaching of Australian History very differently, in terms of their views of history, their construction of what students were to learn, and the learning processes which they encouraged. I shall return to their views of history later. At this point, before moving on to consider their effect on their students, I want to reflect on what my classroom observations suggest about the relation between what was to be learnt and the process of learning.

In Chapter 1, I proposed that it would be useful to look at what teachers actually teach; what they construct for their students as an object of study. I surmised that the teacher’s practice would be intelligible in the light of his/her conception of what students needed to learn, so that what was taught, and how it was to be learnt, would be intimately related. The classes I have described suggest that these conceptions interact.

From one point of view, Mr West and Ms Webb gave quite similar accounts of what their students needed to learn. They both emphasised the importance of their students acquiring knowledge; they both wanted their students to learn to develop historical interpretations. However, they described the relation between these outcomes differently, and they adopted very different approaches to the process of learning involved. Mr West established a two-stage process, whereby students started by amassing information to be interpreted later. Ms Webb emphasised the need for her students to develop their command of the interpretative process from the outset. As we have seen, the effect was that Mr West positioned students as recipients of information and analyses, while Ms Webb focused on getting her students to connect one piece of information with another and to build up a pattern of personal meanings and interpretations.

Ms Farmer and Ms Parbo took different views of the nature of history. Ms Farmer communicated a sense that history and the learning of history was unproblematic, while Ms Parbo insisted that both history and learning history were intensely interpretative. They too positioned their students quite differently. Students in Ms
Farmer's class took down notes and discussed interpretations which were represented as obvious and unmistakable; there was no need for them to develop independent analyses. Both the object of study, and the process of learning, were unproblematic. Ms Parbo's students, by contrast, were constantly challenged to speculate: to try and identify the perspectives of historical actors or historians themselves. While Ms Parbo argued fiercely for her own interpretations, she encouraged her students to critique them and to develop and support alternative views (see for instance her attitude to Ben and Maui). She argued explicitly that historical accounts, including her own and her students', were necessarily constructed from particular perspectives.

It seems likely that students in these classes would experience the study of history rather differently, and this would be visible in how they tackled tasks of historical interpretation. By implication, they would have different views of the status of historical knowledge. The next chapter investigates these issues.
CHAPTER 7
Studying Australian History

Australia is such a boring country... European history had wars, bloody battles - in
Australian history you've got people earning money, plain ordinary everyday things that
don't stick in your mind, nothing separate from yourself, there's no reason to think over
and beyond what you know already - maybe it's too close to home, too familiar.
(Ben, H4, 2 August 1990)

[When I study Australian History, I] am interested and annoyed at the high levels of
racism, sexism and brutality that occurred and I wonder why it took 13 years of
schooling before I was exposed to such incidents and attitudes.
(Maui, H1, Term 4 1990)

Chapter 6 described the objects of study which the case study Australian History
teachers constructed for their students, and how they positioned their students in
relation to it. This chapter explores the impact these teachers had on their students' understanding, by looking at what the students had to say about the study of history, and at what they did when they were confronted with a task of historical analysis.

As in Chapter 4, I start by considering how students responded at the beginning of
the year, and work through to their responses at the end. My data consist of student questionnaire responses from the beginning and end of the year; informal interviews with some students during the year; and students' answers to a history exercise, also completed at the beginning and end of the year. How did these students start the year? When they wrote about what they were to study, how did they describe

---

1 I asked students to read a passage from an historical text and respond to open-ended questions on it, and to complete a set of unfinished sentences on their study of Australian History. In three schools, students did this exercise about a month into Term 1, and again early in Term 4, before the private study period for examinations began. Ms Farmer was, however, on leave during Term 1, so her students did their first exercise early in Term 2, soon after her return. The instruments I used for the exercise are discussed in Chapter 2, and attached as Appendix 3.

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it? What did they expect of their studies? Did students in different classes differ in their responses to these questions?

Secondly, I consider how students perceived their lessons. How did they describe what happened in their classrooms? Did their descriptions change over time? Were there any differences between students in different classes, and do they line up with the analyses presented in Chapter 6? To answer these questions, I draw on student responses to both sentence completion exercises, and on comments from some individual students in the course of the year.

Next, I analyse how students described the study of history at the end of the year. Were there any changes, compared with the beginning of the year? Did any systematic differences between classes emerge?

Finally, I consider how students tackled the task of reading an historical passage. Saljö and Wyndhamn (unpublished paper) argue that how students respond to a task can be read as constituting their understanding of what the task requires - what they think is expected of them. Following this line of argument, the focus and frame of reference of a student’s responses on this task would indicate what the student made of the study of history s/he had experienced. What did students focus on in reading an historical passage? What frame of reference did they use in responding? Were there differences between students in different classes at the beginning of the year? at the end of the year? Did the final responses of students in different classes show any signs of being affected by the differences between their teachers?

The comparisons in this chapter are qualitative rather than statistical. Almost all the students in the four case-study Australian History classes agreed to participate in my research, but the classes themselves were quite small, with sixteen or fewer students in each. On the first occasion, twenty-six students answered questions on the Garrioch passage, and twenty-eight on the Hinton passage (approximately half

1 Of the total of sixty-one students, fifty-nine agreed to take part, including two who joined Ms Webb’s class later in the year.

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the students in each class). By the end of the year, some of these students were no longer studying Australian History, and some were attending class erratically. Forty-four students were in class for the Term 4 exercise. Although they were all asked to do both exercises, some only responded to the sentence completion sheet and some tackled only one exercise: in all, thirty-three students tackled the Garrich passage at the end of the year, and thirty-six the Hinton passage. In each class, therefore, the number of students who might be expected to fall into each category was frequently less than five. Statistical comparisons at the classroom level were inappropriate. Although I have counted up answers of various kinds, my main aim in the analysis which follows is to understand the answers students gave in terms of the classroom practices I observed.

What students expected of Australian History

Asked about their study of this subject, almost all the students mentioned increased knowledge or understanding. However, as with the teachers, they gave different accounts of what was to be learnt. I discerned four conceptions in their responses: the topics or material in the course; knowledge of Australian history; understanding of Australian history – either explanation or a feeling for "how things used to be". In this last category, I have differentiated between acquiring an understanding and developing a better understanding.

Table 7.1 illustrates these conceptions, and shows how many students predominantly expressed each of them in Term 1 and Term 4. It will be seen that there was a small shift in the direction of the higher-level conceptions in the course of the year; this will be discussed later.

1 As described in Chapter 2, this was deliberate. I expected that it would provide some control on the effect of familiarity. For each student, it also enabled me to compare responses to the same exercise at different times, and different exercises at the same time.

2 In addition, most students – nearly two-thirds – mentioned wanting a satisfactory pass at the end of the year. A few mentioned only their results, and one student mentioned acquiring a relevant skill (to "learn how to write an excellent standard of history essay" (H2, S8)). None talked about understanding the process of studying history.

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<table>
<thead>
<tr>
<th>Focus</th>
<th>Term 1</th>
<th>Term 4</th>
</tr>
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<tbody>
<tr>
<td>Learn about the topics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>In studying Australian History this year, what I want most is to be able to remember the information so I can pass my exam. Remembering dates and examples is important to this. I also don't want to be bored.</em> (H3, Alex)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>In our Australian History classes this year we usually take notes, discuss topics and complete set work in class if necessary. We watch videos and make notes in class to help us with our topics.</em> (H4, Jim)</td>
<td></td>
<td></td>
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<tr>
<td>Know more about Australian history</td>
<td></td>
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<tr>
<td><em>In studying Australian History this year, what I want most is to gain knowledge of the history of Australia.</em> (H2, Marty)</td>
<td></td>
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<tr>
<td>to have a concrete knowledge of general Australian history before I walk out of this school forever. (H4, Sandra)</td>
<td></td>
<td></td>
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<tr>
<td>Understand Australia and Australian history</td>
<td></td>
<td></td>
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<tr>
<td>to gain a very good pass, and understand what life during the wars, twenties and depression was like for the Australians that lived through it. (H2, Mirelle)</td>
<td></td>
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</tr>
<tr>
<td>to have a basic outline of the history of Australia, and have general knowledge of events that have occurred, and how it may have been to be living in the same country but a different time (H2, Lara)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop a better understanding of aspects of Australian history</td>
<td></td>
<td></td>
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<tr>
<td>to understand more about Australia’s history dealing with the First Australians as it is something I have not been familiar with. (H1, Scott)</td>
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<tr>
<td>to discover more about Aborigines and their life styles, are they in the situation in 1990 because of the white man or self-destruction (H1, Maui)</td>
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A few students went no further than becoming familiar with the topics to be studied. This way of representing what was to be learnt suggests an unproblematic subject, contained in texts or curriculum. It is reminiscent of descriptions used by some teachers in the first category of those I interviewed (see Chapter 3). Learning this kind of material involved developing familiarity with it ("learn about the subject").

Many students described the subject as offering them knowledge of Australia’s history, in very general terms. Both this knowledge and the process of acquiring it were represented as uncontentious. A number of these students said that this knowledge of the past would give them insight into Australia in the present. These students also tended to represent their learning as straightforward ("to learn about", "to gain", "to give me").

Some students talked about reaching an "understanding" rather than gaining knowledge. These students’ comments suggest they construed learning as a process of active engagement, though the object of study was still unproblematic. This was particularly communicated by comments from students - almost all in Mr West’s class - who said they wanted to know "what it was like":

*In studying Australian History this year, what I want most is ...*

to have a basic outline of the history of Australia, and have general knowledge of events that have occurred, and how it may have been to be living in the same country but a different time (H2, Lara)

Lara’s comment here throws up an interesting contrast. Her references to "general knowledge" and "a basic outline" suggest she saw the past as unambiguous, but "how it may have been" suggests that she saw reconstructing individual experience as conjectural. This way of putting it comes close to Mr West’s image of data and interpretation.

These statements seem qualitatively different from comments by students who focused on some specific aspect of the past which they wanted to understand.

*In studying Australian History this year, what I want most is ...*

to discover more about Aborigines and their life styles, are they in the situation in 1990 because of the white man or self-destruction (H1, Maui)

Maui’s comment, in particular, suggests that he wanted to develop a view rather than to acquire one. These students implied that the process of developing and

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sustaining an opinion involved reflection and not merely the acquisition of knowledge.

In summary, the dominant theme among these students was that they wanted to attain some insight into Australia’s history. In general, both the history and the process of coming to understand it were represented as unproblematic, a matter of familiarity rather than effort. The study of history, as represented in these comments, involved the acquisition of knowledge about the past. There were no big differences in expectations or aspirations between the four classes. However, there were already some differences between the classes in how they represented their relationship with the past as an object of study. Some students from Mr West’s class talked about wanting to know "what it was like", which suggests a process of interpreting fact; three students from Ms Parbo’s class talked about developing their own opinions and insights. There was no indication that any of the students expected to be studying the process of historical investigation, as laid out in the course description.¹

How students saw their classes

As in my initial interviews with the teachers, I asked students to describe what usually happened in their history lessons. I expected that students’ descriptions of classroom practice would change in the course of the year to reflect more closely what their current teacher did. I found, in fact, that there were already plain differences between comments from students in different classes early in the year, which mirrored the differences I observed between their teachers. The main changes to be observed later in the year related to students’ attitudes, rather than their perceptions of what went on in their classrooms.

In each of the four classes I observed there were some students whose aspirations and ideas about the study of history were in tension with their teacher. These students’ comments during the year provide insights into the way their teacher constructed the study of the subject, and the interactive nature of the process - how the object of study was defined at its boundaries, where the teacher and his/her students were at odds.

¹ See Chapter 3.

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In three of the classrooms, I was able to interview students during lessons which were devoted to private option work. This gave me a chance to ask about how they went about studying history in the option, where there was more opportunity for them to design the research themselves, and to compare this work with what they did in class. In Ms Parbo’s class, though I did not get this chance to conduct individual interviews, it was possible to identify students who resisted the line that Ms Parbo was following.¹

*Ms Farmer’s students: “the facts are the facts”*

In their initial comments, Ms Farmer’s students were the most likely to focused on study activities; what was studied was summarised as "topics we are studying". Typical answers included:

*In our Australian History classes this year we usually*

- take notes, discuss topics and complete set work in class if necessary. We watch videos and make notes in class to help us with our topics. (H4, Jim, T1)
- discuss topics we are studying or do writing exercises on certain topics. (H4, Sandra, T1)
- take notes from the board and read our textbooks. (H4, Linda, T1)

Ben’s description suggests that he already felt somewhat dissatisfied with this approach:

*In our Australian History classes this year we usually*

- sit and talk. Try to do some work. Tell Donny and Neville and Sarah to shut up.
- Read a bit. Complain how hot it is. Complain how cold it is. Answer some questions and try to listen. (H4, Ben, T1)

Ben’s mention of "work" here identifies a significant reading of the activities in Ms Farmer’s class. By Term 4, most of her students represented the study of history as "work":

¹ Year 12 is a stressful period for Victorian students, because the VCE results determine their access to tertiary education. I tried to intrude as little as possible into the students’ time. Although I was present at seven of the option lessons in Ms Parbo’s class, they all involved groupwork and whole-class discussion, rather than private work.

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In our Australian History classes this year we usually
complete a lot of essays, a lot of Research Assignments, a big option, and two big exams - and lots of classwork. Other than that, it's quite simple. (H4, Damian, T4)
managed to get all our work done to a reasonable standard, while having fun in class as well. (H4, Kerry, T4)
took notes from the board and read the textbook. (H4, Linda, T4)
talk a lot amongst ourselves. Read extracts of our textbook. Take notes. Have
discussions on the core work. (H4, Sandra, T4)

Their focus on the matter-of-fact activities of studying suggests that these students' relationship with the subject-matter was straightforward and unproblematic.

Two of Ms Farmer's students took a somewhat different view. Jane expressed a sense of exploring history:

In our Australian History classes this year we usually
explore aspects of Australian history in detail by means of written notes, discussion, videos, book etc. (H4, Jane, T4)

Ben was the only student to mention the content of the discussion:

In our Australian History classes this year we usually
discuss more of the social aspects of the time period we are discussing, apart from wads of dates. Perhaps that's why I'm so terrible with dates but can, I think, capture the mood of the times, and how people felt then. (H4, Ben, T4)

Both Ben and Jane talked to me in interviews during the year about their experience of studying Nazi Germany in Year 11, which they described with great enthusiasm. It seemed to me that their approach to Australian History was considerably affected by this experience.

These students told me that their work in history at Year 11 and Year 12 had been very different. At the end of the year, Kath wrote:

In our Australian History classes this year we usually
look at aspects of the course in notes/discussion form. We do not get involved in role-play etc. It is a very theoretical subject. (H4, Kath)

Kath's mention of role play here was a reference back to the approach to studying history which she had experienced the year before, in her Year 11 modern history
class. When I talked to her in Term 2, she recalled this class very enthusiastically, particularly a role play exercise set in the marketplace of a small German town, in which she had played the part of a young Jewish woman. The topic arose spontaneously as we were discussing an essay question she had been set.

It's a typical Ms Farmer history question... it's a contentious question but it really could have only one answer or a couple of answers - in history the facts are the facts, it's not your opinion, you really have to base your opinion on the facts... In HDS and Biology I can work the facts into an essay, it's more clearcut. Less your opinion? You have to use your opinions in HDS... The trouble is history doesn't offer enough opinion for me to get my teeth around so I can really enjoy it... If I found out my idea didn't correspond with the book I'd change it, but if it's basically right - in History I tend to conform to what's in the books because I'm not interested enough to form an opinion, in literature I'll have an opinion and I'll argue for it, but in history, I just think, Well, I have to write an essay, I'd better think of something - history's just history, it happened.

I used to be good at history... Last year I thought the Russian section of History was very boring, I didn't get along with the teacher, but Hitler got me really interested, it was fascinating why he did it, why was he so warped, and yet he was so guiltless, why did the people of Germany love him so much - I worked that out in the end. The History teacher last year made us ask questions, like Why did they vote him in? why was he so guiltless? - a lot of questions - we had to ask a lot of questions and discuss them - we did role play - we had Mein Kampf on sale in a market place, I was a Jewess, I was bashed up and finally raped and murdered, Tony raped and murdered me. (To Tony) You remember that role play we did last year, do you remember how you raped and murdered me? (Tony grins, says he was a Storm Trooper) See, he remembers it really well too. Andrew was a mental deficient, he got killed off, then he was a storm trooper. It was something you could really get into. It was really different, a different approach to teaching.

Australian history's very very boring, European history was more interesting. (H4, Kath, 30 July 1990)

Kath's conclusion that Australian History was a "very theoretical subject" suggests that she identified the subject with the way in which her study of it was organised. She described her experience the previous year very differently: "Hitler got me really interested, it was fascinating why he did it", "we had to ask a lot of questions". By contrast, in Australian history, "history's just history: it
happened"; "Australian history's very very boring". Kath's comments indicate that she accepted this alternative way of working as intrinsic in the subject itself.

A second student in this class, Ben, had also been greatly impressed by his work on European history in Year 11. Ben's comments illustrate the effect of the teacher in communicating a vision of the discipline and its possibilities. Like Kath, he expressed his perception of the different approach adopted in Australian History by saying that Australian History was intrinsically boring.

Australia is such a boring country... European history had wars, bloody battles - in Australian history you've got people earning money, plain ordinary everyday things that don't stick in your mind, nothing separate from yourself, there's no reason to think over and beyond what you know already - maybe it's too close to home, too familiar. (H4, Ben, 2 August 1990)

This last comment - "nothing separate from yourself" - sounds very much like Ben's way of describing Ms Farmer's unproblematic identification with the people the class were studying. Unlike Kath, however, Ben continued to pursue questions of his own, in a way which he identified with his experience in Year 11. For his research option, he had chosen to look at the development of a local theatre group and its changing role in the community, and he had been telling me how he thought the meaning of involvement in the group had changed.

*But when you were describing how people used the theatre at the beginning of this century you were saying very clearly how their perspective was different from yours?*

It was different in some respects - people wanted to get together and have a community spirit - they felt they belonged once and they wanted to belong again, they might have done everything to do that. We feel today we do belong, it's not a foreign country any more, it's more familiar.

The role play last year made you feel - you can't replace the fear, the feeling of pride, your country is getting it together - or that someone will knock on your door - but it's easier to imagine yourself back then because there were a lot of similarities, people were concerned with the price of rates... someone was pedalling a bike down a road and came off and hit his head and they had a big benefit for him - there were so few people, there was so much concern - there are a lot of similarities and a lot of differences, it's better to tie it together - if you can see a vein of similarities, the differences are easier to see, you can relate to them.

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Ben was clearly interested in identifying similarities and differences between past and present, and thus thinking himself into a different point of view; but he represented this approach as being outside the scope of the Australian History course.

So are you using the kind of ideas you had last year when you think about history this year?

In my mind - I’m not getting up and doing role play - but it’s easier to imagine what it would have been like - we go into more ordinary everyday things, what they liked to cook, how they kept the house clean, sanitation, that makes it easier to imagine - it makes you aware - I won’t remember it for tests and things, I’ve got a lot of knowledge, but maybe not in the way the people who designed the course intended...

[My emphasis]

He specifically connected the kind of work he was doing for his option with his teacher’s approach in the Year 11 history class:

Last year because I went into the living conditions of the German people at the time, in a study of why people were sucked into the Nazi vortex, I learned to see things from their point of view, that complicates things, you don’t just see things and say that’s the way they are, it’s a more interesting way to look at things.

I don’t know whether I would have started doing it from this year’s course... At the time we did European it was more the teacher illustrating what we had to do. I do it myself this year. We do have class discussions, but mainly last year it was class discussions, we had the factual stuff for homework, this year we have more factual stuff in class, there’s not as much discussion and application of the stuff... It’s more traditional in class this year.

But you still look at it the same way as you did last year?

Yes - if you didn’t do last year’s course, maybe you wouldn’t think like that, start thinking like that, I don’t know if this year actually encourages you to question things and look at things from the other person’s point of view. (H4, Ben, 2 August 1990)

At the end of the year, Ben was still frustrated by the course.

What would you say your study of Australian History this year has been about?

A lot of it is going into ‘what makes us what we are today’ - and the motivations behind the establishment of white settlement. However, there is no rounding off, no tying into a modern context, and therefore, I think, we lose some of the significance of

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what we are trying to learn. Yes, it is interesting, and yes I feel I have gained something - but ... oh, I don’t know, SOMETHING is missing. Perhaps it’s the fact that the more you go into Australian history, the more you realise how shallow it is.

(H4, Ben)

Ben separated his own activities in studying Australian history from his perception of the subject itself, which he defined in terms of how it was constituted in his classroom.

Derrick was one of the students in Ms Farmer’s class who had not experienced the Year 11 European History subject. His description of Australian History was quite like Ben’s, but without Ben’s sense of there being another possibility.

*What sort of problems do you expect to have [with your option work]?*

A few problems getting the exact details - who did what and when - it’s really illustrating what I know already. That’s what history is, one event then the reaction to the event which causes another event - something happens which then causes something else, the thing about history is it’s a factual thing, something’s happened, there may be arguments over exactly what happened, but even the theories within history are facts - the main point is the series of events.

*So when you study history, what do you do?*

I see what’s written in the book, form an opinion, usually the opinion I get from the book, agreement with what the book’s saying. Events in Europe are more interesting, Australian History can get very dry and tedious

Kath, Ben and Derrick agreed in defining the history they were studying as "a factual thing", "a series of events". As Kath put it, "It doesn’t offer enough opinion for you to get your teeth around".

*Mr West’s students: “You have to go into it to find out what happens”*

In Term 1, Mr West’s students talked about listening to lectures from their teacher and then answering questions on assignment sheets in periods of individual study. They said things like:

*In our Australian History classes this year we usually*

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answer questions in class which our teacher wants done. We also listen to our teacher and he gives us useful information regarding the topic we are doing, for instance WW1. (H2, Graeme, T1)

listen to the teacher discussing relevant information on topics we are studying and reading extracts and we answer a lot of questions referring to different references in our books. We get a lot of sheets. (H2, Kirstin, T1)

hear Mr West give a lecture and then write our own notes about the topic. (H2, Jan, T1)

In this class several students mentioned "the teacher discussing".

In Term 4, as compared with Term 1, these students gave more cursory replies, and were somewhat less enthusiastic. Some students mentioned class discussions.

*In our Australian History classes this year we usually*

talk about important areas in the core. (H2, Jenette)
write notes and discuss. (H2, Daniel)
gather evidence and notes on various events and aspects of the course, write essays, and listen to the teacher and write notes on what he discusses. (H2, Kirstin)
work on our own assignment work or take notes according to the lectures the teacher gives. Class discussions are encouraged but not too many people really get involved in them. (H2, Andrea)

Most students, however, focused on lectures and notes for assignments.

*In our Australian History classes this year we usually*

work at our own pace, with the teacher giving us general lectures on each area of the topic. (H2, Jan)
work by ourselves or listen to Mr Webb preaching to us. (H2, John)
get assignment sheets which by using our texts and other sources get information about the topics we learn. And are sometimes lectured in which case we take notes. And essay writing. (H2, Lara)
take notes from teacher's lectures. (H2, Donna)

The emphasis in these comments was on individual work in relation to the set topics. "Work", as in Ms Farmer's class, signalled relatively unproblematic activity - "get information", "take notes".

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A number of Mr West's students had studied European History in Year 11, and mentioned that the subject matter had been more interesting in Year 11; but they did not emphasise the differences between their Year 11 and Year 12 studies. They focused more on the contrast between their option research and their normal essay and assignment work, emphasising the investigative character of the option. They talked about the task of assignment work in terms of collecting information, foregrounding the highly structured questions they were set to answer. Seeing patterns and thinking about interpretation was seen as difficult.

Mirelle, for instance, saw assignment work as a routine business of collecting facts:

The core work's usually just facts and things you can copy straight out of books. [For the option] you have to find your own information - whereas [usually you're given] page references and you copy it out and learn it. This is your own work, you go out and find your own information, things like that, whereas it's usually just given... He lectures and we write down notes, or we work on assignments. Usually he talks about it and then you go and do the questions. I do mine in great lumps - nothing for two weeks and then get a lot done. Most of the time you're doing the bit just before it [the focus of Mr West's talk] and that helps with the questions you're doing next. (H2, Mirelle 15 August 1990)

Donna's description of collecting facts for assignments was similar. The topic came up as she was describing her approach to doing research for her option, on Women in the Depression. I asked,

*Will it be the same as doing an essay, or different?*

Usually I do an essay from the book - I write down the relevant things on a piece of paper and sort them out in order. What I do for our option - it will be the same as last year, but there's more expected - you've got to go into it more. Last year what I did was very concise, I started with the end, and fitted it into the topic. This is very general, that's why I'm playing around.

I'll find the books, then just copy out relevant information under headings, sort out the information, then write it. I can't work from hundreds of books. I'll find the books, then find the relevant bits in the books. I would write down anything about women in the depression - last year I wrote down everything. Once I've got all the bits down, I'll look and see where I've got most information. *So you accumulate the information, and see what shape it takes?* Yeah. *Like what's in the core?* No - he

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gives us the references, and we look them up and write down what each of them says, which is usually the same thing.

(H2, Donna, 8 August 1990)

Donna, however, was frustrated by the difficulty of seeing any pattern in what they found. She said:

I don’t know - I finished with a B last year, I’m getting Bs now, I got As in the option work and things, I just got a D. It seems - I don’t really care. When I did the exam, I hadn’t finished the notes, I just summarised the 20s book and learnt the book. I don’t find I need notes, it only helps if you use the books. Issues [textbook] is too complicated... The questions [on the assignment sheets] are too confusing. He puts everything under a subheading, everything’s a different question - if it’s laid out in a book it flows, you can understand it, he separates everything and it’s too hard to put it back together.

(H2, Donna, 8 August 1990)

This comment suggests that Donna found the separation of fact and interpretation was hard to manage ("it’s too hard to put it back together").

Some of Mr West’s students were excited by moments when they arrived at an insight into the experiences of people in the periods they were studying.1 Here I found Demetrios’ experience particularly suggestive, because there seemed to be a mismatch between his enthusiasm and interest and Mr West’s expectations. Demetrios was excited by the unifying ideas he had picked up from Mr West’s introductory discussion of the 1920s; Mr West’s comments on his essay suggest

1 Kris, for instance, explicitly compared her own view of flying as commonplace with the hero’s welcome given to pilots in the 1920s. After agreeing that she did not usually talk in class discussion ("no-one in that class really shares their ideas"), she said:

"On the Amazing Facts day, I contributed to that. What? Aviation in Australia. Why was that amazing? It was - how exciting it was for them, the way pilots were given a hero’s status, really fantastic - it was so new to them and exciting. It was so different. We just accept planes flying every day, when they saw it it was totally new to them... I really liked this essay [on experiences in wartime] - all about rationing and things like that - closing down sporting activities and things like that."
that this was not an appropriate starting point. Demetrios found this hard to understand.

The kind of question he asks, I realise it's not just glossing over the topic - you have to go into it to find out what happens. Like, at the beginning I knew about the Charleston, it was a glamorised idea of the 1920s, then I found out there was a lot more to it than fun and games... I wrote a paragraph, a rough for the essay, it opened with the way everyone glances on the 20s, the reminders of the Jazz Age, the roaring 20s, but once that face is lifted you can see what the 20s were shaped like... Then he dictated an answer to the essay, and a couple of days before I'd written a paragraph very similar to that - he must have read mine!

When he first asked us what we saw in the 20s, everyone was saying dancing, cars - then he told us it wasn't really like that, he told us about what really happened - there was entertainment, but the Catholics didn't like the way the girls danced...

(H2, Demetrios, 8 August 1990)

He was disappointed that he received low marks for his rendering of these ideas.

I failed that essay, he goes, Waffle... Every time I think I go well I go bad. I thought I went bad in the exam and I went well. I didn't think I'd get an F. I don't want to be mean but what encouragement do I have. Sometimes I think he picks things up that shouldn't be picked up - one comment he wrote, "Not a verb in this sentence" - that's irrelevant in marking a history essay. I was really shocked. (H2, Demetrios, 8 August 1990)

What was going on here? Mr West's comment "Waffle" suggests that he rejected Demetrios' attempts to imitate his characterisations of the period without presenting appropriate supporting evidence. Demetrios found this criticism hard to understand. At the same time, he felt that he had understood the question being asked (taken from an old exam paper) differently from Mr West, and in a way which was consistent with the examiners' treatment of it.

When he structures the essay on the board, I can see what he's getting at. I wrote down the major differences in Australian society in the 1920s, and how it was affected by the war, I wrote a list of the developments at home, I wrote W on those affected by war - they used a list in the examiners' report. I didn't base my answer on them but it helped me out - I checked them against it. Differences and conflict Is that the same, or different? Conflict say would be political party against political party. Differences were differences between Australian society in the 20s and society in the World War. I

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didn’t take the differences - differences can be conflicts - I read the examiners’ report - I thought the 20s compared with the World War related to differences. Mr West says to make a list, I did.

You’re not sure what to do to do better?

Now I look at this [model answer] I do. It’s simple now because he’s put it into three parts, hasn’t he. The differences and conflicts are sort of the same... I think I’ve separated them more than he has, he’s connected them together... You understood “differences” differently from him? Yeah - because I read that [examiners’ report]... I found it very helpful at first, it gave me a structure to base the essay on. Then I got it back and went Oops, now I know what he wants... (H2, Demetrios, 8 August 1990)

The feedback Demetrios got in relation to the individual process of essay-writing did not help him to be successful.

It’s confusing... [Discusses topic of next essay] If I took it another way, he might be thinking another way, and the same thing would happen as with the last essay. (H2, Demetrios, 8 August 1990)

Demetrios spoke enthusiastically about the insights Mr West generated for him in whole-class lessons, and the discoveries he made in his option work on women in the legal profession - he told me how difficult it had been for women, first to gain access to law courses and then to join practices within the legal profession. His frustrations seemed to be related to a lack of opportunity to discuss the process of interpretation.

Ms Webb’s students: "You can examine all the evidence and decide what you think"

In Ms Webb’s class, early in the year, students described participating in discussions aimed at increasing their understanding.

In our Australian History classes this year we usually discuss and take notes of the topic we are doing in depth, then using all the information compiled, we piece it all together by means of essay writing. (H3, Gerry, T1)

do some discussion, explore and investigate the topic, answer some questions, and analyse what we’ve learnt. (H3, Chanelle, T1)

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either read through new material as a class, go over work previously completed or discuss why actions occurred and elements of humanity in order to understand the topic. (H3, Alex, T1)

These students were the only ones to mention analysing as an activity. They emphasised their active involvement in putting together an understanding ("we piece it all together", "discuss... in order to understand the topic").

Between Term 1 and Term 4, the main change in students' comments in Ms Webb's class was an increased emphasis on the study of history as a collective enterprise:

*In our Australian History classes this year we usually*

listen to our teacher and take notes. We also complete essays and questions on specific topics we are covering. (H3, Melanie, T4)

had class discussions, where everyone was asked questions by Ms Webb and made to contribute. (H3, Linda, T4)

discussed certain topics, wrote timed essays, took notes, answered short questions, did small tests, read notes and shared ideas in class discussion. Mainly worked. (H3, Tod, T4)

receive information from the teacher, discuss it so we all have a good understanding of it. (H3, Miranda, T4)

held discussions or took notes while Ms Webb explained the work. Asked questions when needed. We also did essays and writing exercises in class a lot. (H3, Esther, T4)

These comments depict students busily engaged in activities directed towards making sense of "topics" and "information", working cooperatively so that everyone could achieve this understanding ("everyone was asked"; "shared ideas", "we all have a good understanding"). Here, the topics to be understood are out of view. Rather, in Term 4, as in Term 1, the focus was on the effort involved in understanding. For these students, understanding was problematic.

There appeared to be relatively little dissonance between Ms Webb and her students. About a week after they started work on the option, I asked Ms Webb's students what they were working on, and the reasons for the way they were tackling it. I spoke to eight of them (the others were in the library, or in another room watching a video). All the students I interviewed spoke confidently of what they were doing. Jerry, for instance, had started by organising his folder, writing a set of questions

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about the status of each piece of evidence at the foot of each page - not an approach Ms Webb had specifically suggested. I asked,

    What made you do it this way? I don’t know, I just thought it would be a good idea. You have to answer these questions. [They were set out in the brief for the assignment.] So I thought I’d answer them on the way through and get an idea of where I’m going.

(Jerry, H3, 6 April 1990)

This orderly approach was part of an overall intention:

    Why did you choose this topic? I thought it would be a good one to get my teeth into, you can really examine all this evidence and decide what you think.

(Jerry, H3, 6 April 1990)

Other students were less highly organised, but their comments suggest a similar sense that they were working through a systematic analysis step by step.

    I’m starting with the Dauphin map, working through the evidence. At the moment I’m writing down the main points in favour. Have you come across any against? Not yet, I’m reading Macintyre though. I expect I’ll find the arguments against later.

(Julie, H3, 6 April 1990)

    I’m going through this list of events and taking them separately and collecting information on what happened, when and why. There are a lot of events here, are you going to collect information on all of them? I can’t find information on all of them yet, I’m just writing about the ones I can find in these references, I’m making sure I get different types.

(Miranda, H3, 6 April 1990)

    I looked at the maps first, but it was all too detailed and it didn’t clearly say why they’re important or when they date from, so I thought I’d look them up in something which said something more useful about them. Doesn’t this book [Macintyre] say anything useful about them? It’s too complicated, it’s not clear enough, I thought I’d start on something easier.

(Chanelle, H3, 6 April 1990)

The verbs these students used carry a sense of confident control and direction: see for instance Chanelle’s reaction to the complexity of Macintyre’s discussion of the

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Portuguese maps, and comments like "I'm starting", "I'm making sure", "I'm working out". Work for the option was represented as a process in which students themselves took responsibility for collecting, analysing and evaluating evidence and arguments - a process which they appeared to find both manageable and interesting.

Ms Parbo's students: "It is about clearing our consciousness"

Ms Parbo's class described their lessons differently from the beginning. Almost all of them talked about what they were studying - "the plight of the Aborigines", "the facts of aboriginals" - rather than writing of topics or "the past". Comments included:

In our Australian History classes this year we usually
make assumptions on aboriginal arrivals. And try to establish evidence to prove how
we back our assumptions. (H1, Milo, T1)

discuss and debate how the Aborigines lived in Australia before the European Invasion.
(H1, Jarrod, T1)

discuss and argue about theories about the Aboriginal way of life. (H1, Tim, T1)
talk a lot about theories (H1, Derek, T1)

These students described their classes as involving talk, debate, and argument. Even the few who wrote more conventionally about study activities described them in terms which suggested interaction:

In our Australian History classes this year we usually
review homework, make notes, watch videos (H1, Petros, T1)
discuss the topic then write essays and present talks (H1, Steven, T1)
study the topics with the teacher and sometimes referring to books (H1, Scott, T1)

One said

In our Australian History classes this year we usually
complain. (H1, Jerry, T1)

In Term 4, again, most of Ms Parbo's students saw their lessons as dominated by talk about issues.

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In our Australian History classes this year we usually
discuss things on the Aborigines, national identity, and the History. (H1, Petros, T4)
talk about aboriginal life, the conflict between Europeans and Aborigines and National
Identity. (H1, Jarrod, T4)
debated on issues. (H1, Steven, T4)

Several students expressed personal reactions to this process. Ben, typically, was
sour about it:

In our Australian History classes this year we usually
discuss the obvious. (H1, Ben, T4)

Maui frankly enjoyed it:

In our Australian History classes this year we usually
argued, laughed, discussed, debated, enjoyed and wrote about controversial issues.
Relevant not only to the 19th century but also relevant to conditions in the 20th
century. (H1, Maui, T4)

Elaine and Jenny found it challenging:

In our Australian History classes this year we usually
attempted to probe ourselves for the answers, that the course gave us questions for.
(H1, Elaine, T4)
took an interest in what was going on and tried to make our own opinions as well as
accepting the teachers and the historians that we learned about. (H1, Jenny, T4)

Where students in other classes focused primarily on their activities in studying
history, many of Ms Parbo’s students mentioned what they were studying. They
represented both the process of study, and the object of study itself, as problematic.

This is apparent in the moments of disagreement in Ms Parbo’s class. Several of
Ms Parbo’s students openly disagreed with her approach, and others struggled to
come to grips with it. Unlike students in the other classes, they were quite likely to
voice their comments in the classroom. What did they focus on?

At several points during the year, Maui resisted Ms Parbo’s pressure for value
judgements. Comparing Aboriginal religious practices with the modern Australian
situation, for instance:
Is it better to have no choice, or a smorgasbord?

Maui: What does it matter if it's better?

(H1, 29 March 1990)

Criticising Blainey:

T: Often he doesn't say, I think, but it is.
S: What's wrong with feeling strongly about your own opinion?
Maui: Can't you say you think all other opinions are wrong?
T: Perhaps not.

(H1, 5 April 1990)

In his comment on the course at the end of the year, however, Maui wrote:

When I study history, I
am interested and annoyed at the high levels of racism, sexism and brutality that
occurred and I wonder why it took 13 years of schooling before I was exposed to such
incidents and attitudes... (Maui, H1, T4)

This comment suggests that we can read Maui's contestations as a process of
engagement with the ideas Ms Parbo was proposing to her class, rather than as an
outright rejection of them.

Another student in Ms Parbo's class, Brian, was more explicitly resistant - at one
point, in fact, Ms Parbo said to him:

T: What do you think, Brian? You're often very critical.

(H1, 7 June 1990)

Brian was the student who thought Blainey was "just giving a realistic view of what
savages the aborigines were", and who took the side of the railway passenger
critical of "boongs" - see Chapter 6. In the discussion just quoted, he picked up
Maui's line of argument - which Maui had meanwhile abandoned.

Ella: It's just a theory of mine - that historians, because all they counted was male action, had
preconceptions of what history should be, male achievement, that's

Brian: But there was far less female achievement.

Maui: Women weren't given a chance.
Brian  Relative to male achievement.

(H1, 7 August 1990)

At the end of the year Brian, unlike Maui, did not relish from his opposition to Ms Parbo’s position. He wrote:

In studying Australian History this year, what I most want is
An objective view from Ms Parbo.

What is your Australian History course about?
It is about clearing our consciousness in relation to Aboriginals by saying the British were almost totally wrong all the time. However it is mainly about learning about Australia’s heritage.

(Brian, H1, T4)

In their moments of dispute, however, both Brian and Maui focused on what Ms Parbo saw as major issues in the course.

In summary, it can be seen that students were generally quick to identify how their teacher handled classroom processes. From early in the year, they described distinctly different classroom activities. Implicit in their descriptions of these activities was variation in the object of study constructed in the different classrooms.

Student aspirations at the end of the year

By the end of the year, these students’ experiences were visible in their descriptions of what they were studying.

In Term 4, with the exams looming close, the examination result was salient to more students, but most students still mentioned wanting more knowledge or understanding. By Term 4, however, there were some striking differences between classes in the way students articulated what they wanted to know or learn about.

Ms Farmer’s students talked in terms of learning and acquiring knowledge, expressed in very general terms ("Australia’s history" "to learn about my country"). Only one mentioned "understanding"; six talked about learning and knowledge. For instance:

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In studying Australian History this year, what I want most is ...

to pass well. What I initially wanted I have received: to learn about my country and what has happened in it. (H4, Damian)
a knowledge of Australia’s history. (H4, Lena)
to get a basic knowledge of Aust. History in the period we have covered. (H4, Sandra)
to pass but the accumulation of knowledge is a factor if a smaller one. (H4, Derrick)

These comments suggest a notion of knowledge as unproblematic, a matter of familiarity ("a basic knowledge", "my country and what has happened in it").

Among Mr West’s students, seven mentioned only their result, and five mentioned wanting to achieve knowledge or understanding. Four of them talked about knowledge of the topics being studied:

In studying Australian History this year, what I want most is ...

to pass my end of year exam and to learn aspects of the history of Australia (H2, Kirstin)
to pass, knowing the different experiences of people during the three topics we have learnt, topic 12, 13, 14. (H2, Jan)
a good understanding of our history topics and to enjoy learning about it. (H2, Lara)
a good mark and have a good idea of what happened during and after the war, the 1920s and the depression. (H2, Graeme)

The verbs these students used ("know", "have", "learn") indicate that these students were also settling for familiarity with what was to be learnt. One student indicated an interest in "what life was like":

In studying Australian History this year, what I want most is ...

to pass my final examination and grasp at least a vague idea of what life was like for Australians previously. (H2, Andrea)

These changes seem to me to line up with a change in these students’ attitude to the subject. The sense of interested exploration and interpretation present in students’ comments earlier in the year has disappeared.

Ms Webb’s class was larger than it had been at the beginning of the year - two students had joined it - but two students were absent at the time of the second exercise. Of the fourteen who responded, five focused exclusively on their result. Only two focused on developing an understanding:

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In studying Australian History this year, what I want most is ...

to understand what people went through which helped to develop the society I live in today. (H3, Virginia)

to appreciate the attitudes and ideas of people who lived during the time periods we are studying. (H3, Lana)

By contrast, seven students - half the class - wrote about mastering the topics, and being able to present their ideas clearly and effectively. Two of these students specifically mentioned acquiring understanding or knowledge in the process.

In studying Australian History this year, what I want most is ...

to grasp the utmost out of the topics and write relevant and precise essays that give me a good end of year mark. (H3, Melanie)

to gain a clearer understanding of all of the topics, so that I can write easily about them as though they are topics for discussion, not just things I have memorised. (H3, Anne)

The number of students responding in Ms Parbo's class was smaller than in Term 1: four of the initial group of students were no longer studying the subject,¹ and two were absent on the day of the second exercise. As in Term 1, students in this class were the least focused on their results. Only three limited themselves to mentioning their result. Six of the ten students responding talked about understanding and awareness of the past in a present context. For instance:

In studying Australian History this year, what I want most is ...

an understanding of the Australian way of life (H1, Milo)

to get a good result and enlighten friends and family on the plight of aborigines and the oppression they have had to endure for over 200 years (H1, Maui)

to gain a general knowledge on how Aborigines live, Europeans attitudes and how Europeans lived (H1, Derek).

Elaine commented:

In our Australian History classes this year, we ...

attempted to probe ourselves for the answers, that the course gave us questions for.

¹ One of these students had moved interstate during the year, and one had left school.

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As in Term 1, these students' answers suggested a commitment to the content of the course.

Typically, then, Ms Farmer's students talked about knowing more; Mr West's students talked about knowing their topics or grasping "what life was like"; Ms Webb's students talked about mastering or grasping the topics they were studying; and Ms Parbo's students talked about being enlightened about "the plight of the Aborigines" and "the reasons for the way we are now".

**Student readings of historical texts**

By the end of the year, these differences between classes were visible in the way that students actually tackled an exercise in reading an historical text.

As with the Physics students (reported in Chapter 5), I gave the History students a pair of exercises to tackle. The exercises required them to read a brief passage from an historical text, and then to answer a set of open-ended questions. Because the four classes in the case study had no common topic in Australian History, the extracts were deliberately set elsewhere. One, an extract from Hinton's *Fanshen*, focused on the changes in women's role in Chinese society following the Communist Revolution, as exemplified by a conflict between a woman and her husband where the woman successfully insisted on her right to attend public meetings. The other was an extract from Garrioch's *Neighbourhood and Community in Paris, 1714-1790*, in which Garrioch discussed the function of public quarrels, illustrated by an animated reconstruction of a dispute between the wife of a public writer and a pawnbroker.

I asked students to do these exercises primarily to discover what they attended to when they read an unfamiliar historical text. In both cases the questions I asked were designed to give the students an opportunity to reflect on the argument propounded in the text; to identify the structure of this argument; to speculate on the outcome of the story and the purposes of the writer; and to locate the extract within a more general frame of reference. In analysing the students' responses, I looked first to see what they focused on in reading the text, and the frame of reference they used. In the different readings which emerged from this analysis, the historian was
positioned quite differently in relation to the events and arguments propounded in
the text.¹

In the analysis which follows, I first categorise students’ responses to the exercises
at the start of the year, and reflect on the positioning of the historian in each
category. In the discussion which follows, I consider how students in each of the
classes answered at the end of the year, and relate their positioning of the historian
to the approach which their teacher adopted. Following Säljö’s argument, I
expected that by the end of the year, students in Ms Webb’s and Ms Parbo’s classes
would tackle the two tasks in ways which tended to distinguish them from students
in the other classes.

At the beginning of the year, I found that responses to the Hinton extract varied
most obviously around the students’ construction of the purposes of the historian.
Most students read this extract as an account of individual experience, in the context
of a particular place and time; a few, mostly from Ms Parbo’s class, read it in terms
of universal ethical issues, transcending time and place. Responses to the extract
from Garrioch differed more in terms of the relation between the historian and his
account of the past. In every class, most students read the extract as a transparent
window on to the events it described; while a few (none in Ms Parbo’s class)
rendered it as a developing argument providing a particular interpretation of those
events.

Reading the story: women and the Chinese revolution

Students found Hinton fairly accessible: his prose was easy to read, with few
foreign words and obviously unfamiliar terms, and he dealt with a familiar theme,
the liberation of women from generations of oppression. In their answers to my
questions, however, they focused on distinctly different aspects of the story Hinton
told, and recounted it within different frames of reference. They read the passage
variously as providing an account of women struggling for equality (conception A);

¹ I chose not to use Biggs’ SOLO taxonomy, which could perhaps have been seen to fit the
material quite neatly (see Biggs and Collis, 1982). Biggs focuses on students’ handling of
the structure of an argument, whereas my interest was in what the students took to be its
subject-matter.

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describing the experience of individual women (conception B); and analysing the interplay between individual experience and social relations (conception C).

These responses are tabulated, with examples, in Table 7.2.

Table 7.2 Readings of Hinton

<table>
<thead>
<tr>
<th>Conception</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Women struggling for equality</td>
<td>The extract involves the liberation of Chinese women within a certain village. After gaining enough courage to speak up for themselves, they found that they too deserved all the respect the men received. They had organised women's meetings, and when a member was beaten by her husband for attending, the women demanded an explanation for his actions. When he accused them of a means of seduction they beat him until he promised not to beat his wife again... This is symbolic of today. (H1, Ella, T1)</td>
</tr>
<tr>
<td>Individual experience in the framework of a universal fight for equal opportunity</td>
<td>The extract is about the Chinese women of the village, Long Bow, in 1945, and how they form a Women's Association, designed to take a stand against the oppression of their husbands. The outcome of this is illustrated in the example of Ch'eng Ai-lien... The women were regarded as &quot;private property, expected to work hard, bear children, serve their fathers, husbands and mothers-in-law, and speak only when spoken to&quot;. The women faced the oppression of their husbands and also domestic seclusion. William Hinton lived in Long Bow in 1947, where women were becoming liberated. He may have heard the story of Ch'eng Ai-lien through the women of the village, being the first successful event of liberation, and observed their stand against the men... (Bronwen, H3, T1)</td>
</tr>
</tbody>
</table>
C Change in gender relations

Socially located in Long Bow village, as a cultural or historical site

The extract is about how the women of China, during 1945, voiced their ideas on being sold to husbands and being owned by families. The women did not want to be their husbands' slaves. They wanted to have their own opinions and be able to voice them...Hinton tells the story...to inform us of what a hard, protected life Chinese women lived before the revolution to make us understand how hard it was for them to voice opinions...Hinton is on the women's side, this is because he only shows their side of the story. The men of the town would only have acted the way they do because they knew no better or would not be willing to say they thought it was unfair. These men were mostly peasants and would not know any better. It was the way they were brought up. (H2, Mirelle, T1)

Answers which I categorised as conception A dealt with the extract as a description of individual experience in the framework of a universal fight for equal opportunity. In these responses, the elements of the situation were characterised as moral certainties. Thus Steven, also from Ms Parbo's class, wrote:

This extract is about the continued oppression of women, not only in Eastern cultures but throughout the whole world. The extract applies to all nations, racial groups, socio-economic areas. I believe that it is a woman's role to be vigilant, and let nobody including her husband interfere with her rights or beliefs. The women were ruled by an iron fist so to speak and were restricted by both social and cultural beliefs. The husbands expected the women to cater to their every need, they soon found out that the women weren't prepared to take the treatment any more.

Because of the nature of this revolution, I'm sure that the story would have been passed around, maybe Hinton was told by a woman. This incident probably went down in history.

[Story is told] to pass on a message, a very important lesson is to be learnt from this extract. Women deserve the same rights as men and do not have to endure the struggle that is needed for people to take notice. (H1, Steven, T1)

Students responding in this way did not emphasise the historical time-and-place particulars which Hinton provided. They represented the historian as a moralist with a universal message to deliver.

Answers evincing conception B focused on the experience of the individual women, in the framework of the particular local historical situation. Bronwen, quoted in the

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example, emphasised insights into the individual's experience ("it encouraged the women", "William Hinton lived in Long Bow in 1947"). The processes of change were located in time and place, and ascribed to intentional behaviour on the part of individuals. Responses of this kind positioned the historian as an neutral observer.

Finally, I categorised as conception C the responses which focused on change in gender relations in the context of Long Bow village. Some of these responses identified Long Bow as an historical site, others described it as a cultural site. In both cases, the student represented gender relations as socially located rather than universal. In the example quoted, Mirelle depicted Hinton constructing his account out of what he was told, and thus offering an interpretation rather than an "objective" description of the facts. In her final remarks we can see her doing the same thing ("it was the way they were brought up"). Malcolm, from Ms Parbo's class, gave a similar analysis:

This extract tells the story about a woman who lives in China. She is living in a society where the men have the power and the control within each family. However, the story starts when the lady gets beaten up by her husband as a result of attending a Womens Association meeting. The whole purpose of the meeting was to increase women's power within the society. The fact that the husband does not see the purpose or the satisfaction of this meeting. He gets upset and beat his wife up. The wife therefore complains to the Association and as a result they succeed by beating her husband up, and eventually he sees that he is overpowered by women.

[The story is told as] an example which displays the success of the Women's Association fight for equality between male and females within a society.

I believe that things will change for other women in the village because they may be influenced by the incident between Ch'eng Alien and Man-ts'ang. They are encouraged to believe within themselves that they have the right to be treated equally.

Does Hinton take sides? Yes. His views are not balanced - too much on women. Does not explain why men have the upper hand. (H1, Malcolm, T1)

These students discussed the interplay between individual experience and social practices and expectations. They represented the historian as analysing the process and developing a point of view on it. Students reading the passage as social analysis, unlike those in the two previous categories, were likely to represent the historian's conclusions as problematic.

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Reading the historian: public quarrels in eighteenth century Paris

Turning now to the Garrioch extract. Students found this extract far more difficult to read. There were comments about the difficulty of the language (particularly the French words, though these were all provided with an explanatory gloss). Many students found it hard to re-tell the story and predict what might have happened next, which suggested to me that they had difficulty understanding both the narrative and the argument in which it was set. In a sense, this did not affect the analysis, since it was still possible to work out which features of the text the students attended to.

As summarised in Table 7.3, I discerned four different ways of reading Garrioch: as a description of exotic events, in an unfamiliar setting (conception A); as a description of individual experience in the framework of personal motivation (conception B); as a description of social practices in a particular society (conception C); and as an analysis of the dynamics of the society (conception D).

<table>
<thead>
<tr>
<th>Conception</th>
<th>Example</th>
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<tbody>
<tr>
<td>A Exotic and</td>
<td>An extract about the eccentricities of the French (18th c) need for an</td>
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<tr>
<td>unfamiliar</td>
<td>audience when a dispute is being fought over in public. It would show</td>
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<tr>
<td>behaviours</td>
<td>that the French seem to need to perform in order to have full effect.</td>
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<tr>
<td>Narrative detail</td>
<td>Their arguments are theatrical because it is apparently unusual for</td>
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<td></td>
<td>public arguments to be such a main source of entertainment for the</td>
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<td></td>
<td>public. It is like a theatre act, a public argument. [Paris at the</td>
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<tr>
<td></td>
<td>time would be] very dramatic, tough and criminal. (H1, Tim, T1)</td>
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<tr>
<td>B Experiences of</td>
<td>It's about a neighbourhood quarrel set in Paris between a woman and a</td>
</tr>
<tr>
<td>individuals</td>
<td>man she had pawned some jewellery to. Although it's an argument</td>
</tr>
<tr>
<td>Particular local</td>
<td>between the two of them, the whole community seems to be involved.</td>
</tr>
<tr>
<td>historical</td>
<td>[The story] was used as an example - to tell the story of what it was</td>
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<tr>
<td>situation</td>
<td>like to live in eighteenth century Paris. People were rude, didn't have a</td>
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<tr>
<td></td>
<td>great deal of patience, they were proud, liked to involve the whole</td>
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<tr>
<td></td>
<td>neighbour[hood] in their quarrels that seemed to be a ritual to the</td>
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<tr>
<td></td>
<td>community. (H4, Jane, T1)</td>
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C Social practices  
Located in eighteenth century Paris, as a cultural or historical site

The extract is about the way French society in the 18th century carried out ways of settling their disputes by one person trying to belittle the other and winning the argument. This draws the public to the person’s grievances. Garrioich uses this story as it highlights the system the French used and the way the argument was carried out. (H1, Jarrod, T1)

D Functions of public quarrels in Parisian society  
Located in eighteenth century Paris, as a cultural or historical site

The extract is about people’s quest for recognition in a community. It tells of a quarrel between two people, a pawnbroker and a wife of a writer, over goods swapped for money a few years back. It starts off slow and quiet but things progressed to shouting and a crowd gathered around watching this ‘show’. Finally the man slaps the woman and a soldier intervenes, breaking it up. If the soldier had not broken it up, I think someone else would have. The quarrels were usually held in public where onlookers could enjoy the performance but could also control minimising the damage to individuals... Life in Paris in the 18th century was one of public position and power. One had to show his strength in public in order to be recognised as having a strong position in society. (H3, Gerry, T1)

Students whose answers I categorised as conception A represented Garrioich as giving a description of exotic and unfamiliar behaviours. Tim, quoted as an example, positioned the historian as an observer, reporting what was to be seen. Similarly John, from Mr West’s class:

A special process occurs during a street quarrel in which the quarrellers play off each other just as they would theatrically. It is just like a play, which is performed in front of a crowd and always acted out.

This story is a typical example of what street quarrels contained and who participated in them. Life in Paris must have been full of life, as there was plenty of action in the streets. It could have been a fairly hard time financially because people had to pawn things to survive and also had to resort to prostitution.

Were these questions difficult? Yes, the extract, especially start and finish, was difficult to comprehend. The questions are based mainly on your interpretation rather than on facts in the extract. (H2, John, T1)

Students giving this kind of response focused on the detail of the narrative. They found it hard to make sense of the question about the historian’s bias, and represented what the historian recorded as "facts".

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A second group of students, whose answers I categorised as showing conception B, focused on the experiences of the individuals in the extract. Whereas Tim and John viewed the story as a spectacle, Jane talked about "what it was like to live in eighteenth century Paris". Similarly, Tony wrote:

I would say that the extract is about a dispute, a public dispute between an anonymous pawnbroker and an equally anonymous hooker who are vying for a bit of recognition of those around them. It would seem that the quarrels were a form of entertainment, as there was not TV or radio in the 1700s it appears as if this was a form of passive or mostly passive amusement designed to break the monotony of simply existing. The people needed to be set apart from each other but at the same time they wanted to be together so other people could see they were different. It showed that there are parallels between life back then and now, especially about people wanting to be different and other people seeing them being different. [Garrioch tells story] to give us an illustration that we can identify with in 1990. There are pawnbrokers and hookers now as there was then. We could probably quite easily imagine the same thing happening today except the row wouldn't be public. (H4, Tony, T1)

These students represented the historian's task as the re-creation of the experiences of the past.

A third group of students, categorised as showing conception C, wrote about the social practices which Garrioch described. These students focused on the way in which arguments were conducted, rather than the feelings of the individuals participating in them or the oddity of their behaviour. The public nature of the quarrels was represented as a social practice:

The extract is about individuals in a community, who try and use the public as a means of punishment, or penalty on someone who they despise or are having problems with. This is done by publicly starting a dispute in public so it gains people's attention and then making it seem like the other person is wrong to the eyes of the onlookers. This is effective because it can humiliate them without actually using force, but rather the public's opinion. I would tell the friend that it's a story using a man and woman engaging in a dispute to emphasise the point that people need or take into consideration other people's view when trying to illustrate someone's bad points... [Garrioch tells the story] to emphasise the point using a common example occurring in many communities... (H1, Scout, T1)
The present tense used by both Jarrod and Scott again represents the historian as describing, rather than constructing, this practice.

Finally, in conception D, there were some students who focused on the functions of public quarrels in Parisian society. Gerry, for instance, identified gains for individuals (recognition, enjoyment) and society (minimising the damage to individuals). Although Kris drew different conclusions, she also focused on the function of public arguments:

The extract is about a public dispute between a pawnbroker and the wife of a public writer. It takes place in the street, near a market. After greeting one another, they end up insulting each other. The woman turns and walks down the street with the man close behind her. The pawnbroker strikes out at the woman and a soldier breaks up the dispute. The writer uses this example of a dispute to prove his point that street disputes bring the community together by providing a theatrical scene which they (the public and onlookers) can enter into when violence becomes apparent... The community seems very insecure as it thrives on public disputes and street quarrels to bring it together and provide security. It seems that the people need to see others insecurities and humiliations to make them feel better about themselves. (H2, Kris, T1)

Both these students positioned the historian as constructing an account, and Kris wrote that he "uses this example... to prove his point". This was, however, unusual.1

Differences between schools

By the end of the year, the responses from students in the case study classes in the study showed signs of the conceptions expressed by the four teachers in the case study.

MS FARMER As described in Chapters 3 and 5, Ms Farmer emphasised narrative, fact, and the individual experience unproblematically visible in physical detail. Consistent with this, Damian’s answers to the Garrioch questions (categorised as conception C) suggest a view of history as spectacle and the historian as narrator:

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1 Most of the students who were asked to respond to the passage from Garrioch registered his argument as factual, and found it difficult to answer the question about “bias”.

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This extract is about a French community and the way they behave. They enjoy participating in or watching disputes and they have made them, almost, an art form. The street quarrels are seemingly rehearsed by observation and practice. The expressions used are common and they all follow a 'checklist' of behaviour... This is an example. It shows the motions of the procedure and the reactions... Is Garrioch taking sides? No, he seems rather neutral... [Parisian life in the eighteenth century] seems to have been very lively, animated and colourful. The people seem to have needed something to be happy with, and like a good TV show or cricket match, they enjoyed it. (H4, Damian, T4)

Kerry wrote in a similar vein:

This is a descriptive piece which Garrioch uses to bring attention to the way people can react in public places.

Is Garrioch taking sides? Not so much taking sides but rather feel the reader feel sorry for the woman as she is the one who is continually insulted. What did you learn from this story about Parisian life in the eighteenth century? That people of this time staged their disputes for entertainment, showing a lack of many other forms of entertainment. Life was very open, as people use publicity to achieve awareness, showing a lack of privacy. (H4, Kerry, T4)

In both these responses, the historian is almost invisible ("rather neutral"). This is a position which one might expect from Ms Farmer's students. Typically, they construed "taking sides" as a defect.

A similar judgement is visible in Ben's responses, which are particularly interesting because of the conflict Ben expressed when comparing his Year 11 and Year 12 experience of history, as discussed earlier in this chapter. Ben was critical of Hinton because his visible preferences were "unprofessional", he was not "reporting the facts". However, his own analysis went much further than an account of facts. In his first response he wrote:

Of course Hinton is taking sides. His mere use of the women exposing the cowardice of the men, or man, by triumphant violence, shows an unprofessional subjectivity. He is not reporting the facts. He perhaps is right, and effective, but he doesn't show both sides. (H4, Ben, T1)

In Term 4, he put it like this:
The extract is very much from a woman's point of view, but not only a woman's point of view - from the point of view of a woman who firmly believed in communism as a way of bettering their lives... He tells this story in order to act as some type of document for all the 'history books' to refer to ie who did what and when - this is down to earth. He wants to give insight into "what life was like" during that time... Hinton is taking sides because he lets the story take sides. He could have portrayed the women as violent conspirators, desperate for revenge and power. He could also have given a balanced (taking into account Man-ts'ang's point of view) account of the scene. Obviously he has only used one piece of material and formed his own opinions from there. It, I suppose, has little historical significance because it is so biased (for a secondhand account; if it was first hand, bias would be acceptable).

(H4, Ben, T4)

These responses, like his comments on the Australian History course, display a contradiction between Ben's own practice and his description of history as found in "history books". Ben used Hinton's account to develop a subtle account of different meanings and social relationships, including Hinton's own position in relation to the story he was telling. At the same time, he asserted that a "down to earth" history book would not offer this kind of problematic account. Professional history books, he implied, were those which gave a neutral account of "who did what and when", excluding passion, triumph, and even the process of constructing the story - the very features of the Hinton extract which Ben himself found interesting.

MR WEST In considering Mr West's approach, we saw that he emphasised the collection of facts, while himself modelling an interpretative approach in which he did not require his students to participate, and which some students, like Demetrios, found it hard to imitate. Answers from his students were more cursory at the end of the year than at the beginning, and less likely to position the historian as actively constructing an account. John, whose first response to the Garrioch piece was quoted earlier, was the only student in this class to expound Garrioch's argument (conception D). Several other students focused almost exclusively on the behaviours described in the two extracts, and positioned the events being described directly in the context of their own experience. Mick, for instance, wrote of the Garrioch piece:

[Street quarrels are described as theatrical] because people argue in homes, courtyards etc but not on the streets.

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He concluded that life in Paris would have been:

Very boring and people would not be able to do what they pleased. Would have been a lot of arguing and pawning because people were very and selling everything off.
The questions aren't difficult to answer but I believe they are stupid and non-interesting. (H2, Mick, T4)

Donna wrote:

It is about the dramatising and theatrics of disputes in the street for attention...
It was a bad life - prisoners and pawnbrokers, fights in the streets, men hitting women.
People were attention-seeking.
*Did you find the questions difficult to answer?* No, just boring. (H2, Donna, T4)

Graeme summarised the Hinton extract:

It talks about women and how mistreated they are by men. It talks about remarks from women and complaints about their husbands to treat them bad. Quite stupid.
(H2, Graeme, T4)

The impatience and resistance suggested by these replies (and others I have not quoted) connect, I think, with Demetrios's response. Earlier in this chapter I described Demetrios' efforts to take on Mr West's image of the 1920s, and his interest in the otherness of history - his excitement at discovering how difficult it had been for women to gain access first to law courses and then to practice within the legal profession. Answering the Garrioch questions, Demetrios wrote:

[The extract is about] How people argue in public and how they act it out to gain attention...
*Is Garrioch taking sides?* Same as the other sheet I did. No, because he was merely stating the facts.
*What can you find out from this extract about life in eighteenth century Paris?* Not much because the piece is really concentrated on an argument not on life in Paris in the 18 century. There are no real personal experiences we can () to see how life was.
(H2, Demetrios, T4)

Demetrios here seems to express a vision of history as potentially enabling insight into the experiences of individuals, which is defeated by an historian who is rendered as "merely stating the facts".

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Ms Webb and Ms Parbo both completed one of the Term 4 exercises themselves, so we can read their responses as an indication of what they might expect of their students.

MS WEBB wrote,

[The extract is about] community life in Paris 1740-1790, emphasis on patterns of behaviour which enabled disputes to be dealt with by the community. [Garrioch tells the story of the pawnbroker and the wife of the public writer] to illustrate the point that public violence of disputes helped preserve the community by channelling discontent and frustration into forms which public could control with minimum damage to individuals and group; to personalise the point to enable reader to empathise, experience a perhaps unfamiliar situation; [to give a] step by step demonstration of theatrical nature of disputes.

Does Garrioch take sides? With whom? Writer appears to appreciate (and enjoy) techniques employed but aim to describe/interpret behaviour may be bias - his interpretation of what is taking place - I'm unable to judge of basis available info.

Ms Webb's description here of Garrioch's possible purposes for recounting the particular incident in this extract recalls her own many-sided strategies in the classroom: he tells the story at once "to illustrate the point", "to personalise the point", and to give a "step by step demonstration". In this response I see Ms Webb aligning herself with Garrioch's point of view. She registered Garrioch's account as interpretative rather than descriptive ("his interpretation of what is taking place"), but she expounded it rather than offering an independent critique of it.

Ms Webb's patient coaching of her students into a confident and analytical reading of their texts was evident in her students' responses. All of them wrote more fully and more confidently at the end of the year than at the beginning. Responding to the Garrioch extract, in particular, almost all of them focused on the function of public arguments (eleven out of fourteen, compared with three out of seven at the start of the year). Linda's response (conception D) was typical:

The extract is about the dispute settling activities in eighteenth century Paris. It is about the acting and entertainment aspect of having a dispute. The example, a dispute between the wife of a public writer and a pawnbroker, they get into an argument and it is immediately carried into the streets of the local community, where insult after insult is thrown at each other. Everybody stops and observes the dispute, that is why they

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make it so theatrical. This was done because this way the dispute could be kept under control, by the public.

Because the parties in the disputes are yelling at each other, in order for the passers by to hear, they are putting on a performance. Despite the fact that the dispute is genuine, their handling of it in the street is a performance.

They wouldn't have bashed each other as the object of the dispute is to embarrass or humiliate the other person.

To show the way things were handled in eighteenth century Paris, that disputes were entertainment and that it was probably a good way to handle it, as there was little or no violence.

(H3, Linda, T4)

In this response Linda provided an acute summary of Garrioich's argument. She positioned herself alongside Garrioich in the activity of describing and analysing an historically situated episode: "Despite the fact that the dispute is genuine, their handling of it in the street is a performance". In line with this, her last comment ("it was probably a good way to handle it") suggests that she recognised that Garrioich was evaluating as well as describing the process of public debate.

Dealing with the Hinton extract, Ms Webb's students located the story firmly in time and place. Most of them represented it as dealing with changes in gender relations in Chinese society (conception C):

*Why does Hinton tell the story of Ch'eng Ai-lien and Man-ts'ang?* Hinton tells this story because it is a very good example of how the revolution changed their lives, and maybe the lives of others. Also Ch'eng Ai-lien was directly involved with the Women's Association which made her a candidate for a point of action in her life.

(H3, Melanie, T4)

The story of Ch'eng Ai-lien and Man-ts'ang is very important in portraying the beginning of the liberation of women - Ch'eng Ai-lien's actions were unprecedented within the village of Long Bow... It is very likely Ch'eng Ai-lien's actions and success gave the other women of Long Bow the confidence and courage to take a stand against the men. (H3, Bronwen, T4)

It was an example of how the women of the village grouped together and held Ch'eng Ai-lien, who was being beaten by her husband Man-ts'ang. It also reflected how the times were and how they changed after the uprisal. (H3, Gerry, T4)
To allow the reader to empathise with the situation and relate it to their own experience and life. It allows the reader to absorb the information on a personal level. (H3, Alex, T4)

Hinton tells the story to make people aware that women are not property to be acquired, they are human beings, with a right to live. It is not a story just about the couple, it is a story of courage and the fight for freedom and human rights. He tells the story to give people an understanding of the women's fight. (H3, Linda, T4)

In these responses, the experiences of individuals are rendered as illustrative, with the historian accorded the role of interpreter.

MS PARBO Principal features of Ms Parbo's teaching were her emphasis on universal moral issues, and her emphasis on point of view as culturally determined. Tackling the Garriochn extract, Ms Parbo herself discerned in it a cultural pattern of oppression in which women were particularly oppressed. She emphasised the suppression of activism, rather than the maintenance of social order:

[The passage] is a theory about why disputes take place and their role in keeping society entertained and focussed on the sideshow rather than more serious frustrations which may turn people into activists and overthrow social orders.

[Garrioich describes street quarrels as theatrical] because he thinks they follow a pattern which arouse interest in both the onlookers and which make them predictable. Like a drama, it has a build up and climax that entertains an audience.

What can you learn about eighteenth century Paris? People lived and conversed openly in the streets. Sexism and namecalling were common. When a man hit a woman, the woman was arrested. Guards had the power to arrest and to decide culpability, not just arrest all those involved and find out what really happened. (H1, Ms Parbo, T4)

In this response, Ms Parbo represented the historian as identifying and articulating these themes (the passage "is a theory", "he thinks they follow a pattern").

Ms Parbo's students responded in recognisably similar terms, identifying in both extracts universal moral themes and cultural conflicts of perspective.

They responded only briefly to the Garrioich passage, which several students said they did not understand. They were likely to emphasise the gender of the two people in conflict, and to see their dispute as emblematic of gender relations:

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It is about wife and husband relations. It is concerned with disputes and how they occur and end... [Life in Paris] was male dominant and filled with disputes. (H1, Malcolm, T4)

[The extract is about] a public dispute between a man and a woman. The aggressive nature between the 2 parties. The man more physically aggressive, while the woman emotionally. (H1, Steven, T4)

In Australia, Melbourne 1990, the story is often the same. (H1, Elaine, T4)

Amplifying these conflicts, some students saw them as expressing different points of view. Brian, for instance, registered

the diversity of values and attitudes [in eighteenth century Paris]. And especially diversity of how one believes the law will prevail in certain circumstances. (H1, Brian, T4)

This statement, in the context of a very scrappy answer, seems to indicate what Brian thought would be wanted. Similarly, perhaps, Petros’s response:

[Why does Garroch tell the story of the pawnbroker and the wife of the public writer?]
It creates a message. A message which puts our minds at bay. It makes us more aware of the things that occur in our society...

[Life in Paris] was hard. The people were rough. Life was terrible. Paris in the 18th century would have been a nightmare. (H1, Petros, T4 - my emphasis)

Comments from this class on the Hinton extract followed a similar pattern, but they were far more extensive. The students frequently wrote in the present tense, and expressed a sense of an ongoing struggle to which they were personally committed. Even at the beginning of the year, they were particularly likely to read the Hinton extract in terms of a universal fight for equal opportunity. Jerry was one of four students who rendered the extract in purely contemporary terms (conception A), writing that

[The story is told] to show that women want to be productive in the community, and have a say in public affairs (H1, Jerry, T1).

In Term 4, several students took this line.

Essentially it portrays women in their universal struggle to be recognised as equal... Women in this story and reality still lack equal social standing... This situation still exists in many families and societies. An uproar would occur if this story was made

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public in African tribes, or India. We are just beginning the revolution - it has not
become a reality until everyone actually begins to see that there is no substantial
reason for any divisions in the sexes. (H1, Elaine, T4)

[It's] about the relationship between those oppressed and those who rule and the
arrogance and prejudice the oppressed encounter as they struggle for their rights... It is
a universal example that all people who have been oppressed can associate with. The
rise, the bashing, the rise when fallen and then the joining together to gain objectives.

- An example of 'people power'!... Perhaps he is taking sides with the women. Really
he's just giving an account of the rise and union of the oppressed. (H1, Maui, T4)

Others will feel inspired to adopt the same actions and be more strong. (H1, Scott,
T4)

Hinton tells the story of Ch’eng Ai’lien to put a message across. A message to speak
out without fear. Have a say in the world. (H1, Petros, T4)

This extract is about... woman coming out from the oppression of the men. (H1,
Jarrod, T4)

Other students described the women’s struggle against oppression in terms of
cultural tradition and change. Jenny wrote:

It illustrates the stark difference in cultures that are steeped in tradition, compared to
cultures that we are aware of, it explores a change that occurs that alters a culture and a
community; the story of Ch’eng Ai-lien can be considered as universal and it is a
sample of what can be achieved (even though I don’t agree with the violent aspect of
the change).

(H1, Jenny, T4)

Finally, the position of the historian. Almost all the students in this class said that
Hinton sided with the women. Whereas students in other classes based this
conclusion on the language Hinton used to describe the women’s predicament, Ms
Parbo’s students tended to refer to the perspective from which the story was told:

He portrays the women as people seeking equality, without expressing the men’s
opinions or justification for their behaviour. Yet it is generally recognised that the
men’s opinions were bred out of fear. (H1, Elaine, T4)

Yes, he is taking the side of the women. Did not take the perspective of the husband’s
actions fully when he bashed his wife. (H1, Brian, T4)
Very strong on the negative side of men. Men are seen as barbarians. Too emotional for women. Women are seen as suppressed and helpless individuals. No freedom but a lot of depression. (H1, Steven, T4)

Every example Hinton introduces seems to be in sympathy of the women and not really give reasons for the men’s actions and why they were afraid to let their wives and sisters become enlightened. (H1, Jenny, T4)

A number of students in other classes remarked that Hinton was a foreigner, and therefore had to rely on local sources for his story; Brian was the only one to suggest that he might also bring "an American perspective" to his account, though he did not detail where it might be visible.

It is an American perspective on women’s lives role and interactions with males (husbands) in their fight for liberation situated in Long Bow (China)... (H1, Brian, T4)

Taken together, these responses indicate that Ms Parbo’s students generally represented the study of history as bearing directly on social struggles in their own lives; as Elaine put it,

[Hinton tells the story of Ch’eng Ai’lien and Man-ts’ang] to portray a story in fable fashion which relates directly to our own values - without being too threatening to our lifestyle, or proposing imminent change. (H1, Elaine, T4)

These students expected that historical writing would provide an account of cultural diversity and different points of view, so that even when these did not come clearly into view, as in the Garroch passage, they looked for and reported them. Though they took up his account with excitement, they read Hinton critically and identified with some care the indications of where his sympathies lay. In these respects, they were distinctively different from students in other classes.

**Overview**

The evidence of this chapter is that students responded to the teacher’s construction of the subject, not least when they resisted or disputed it. Their reading of historical discourse and their sense of the currency of historical debate was visibly influenced by their teachers. The differences I have reported go deep, and touch both the content and the project of studying history. In Ms Farmer’s class, Australian history was familiar, local, domestic; in Ms Parbo’s class it was challenging,

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divisive, and powerfully related to contemporary debates. In Mr West’s class, the teacher was the expert historian; in Ms Webb’s class, students undertook the study of history and from the beginning tried to decode and interpret the texts they were studying. These teachers constructed meanings for history which located their students in relation to political and social entities.

Considering how the study of history was constructed in these classes enables us to appreciate the significance of the teacher’s role. Teachers’ practices are not neutral. They are not merely different ways of manipulating ”pedagogical content knowledge”, in Shulman’s term. They involve adopting or refusing a position of political critique. Either choice is, in effect, political.

To say this is not to criticise any of the teachers whose work I have described. Rather, I would concur with Walkerdine, writing of the way in which schooling constructs the Plowden child, but writing also generally about the production of ”individuals” by social processes:

Power is implicated in the very form of theories and practices which constitute and fix the natural-normal and its exclusions... We need to rethink the whole field of debate. It is not just a question of shifting the emphasis from the individual to the social. What we need to understand is how that condition which we call individuality is formed within apparatuses of social regulation, including education. For my part, I think we can no longer afford to avoid questioning each and every one of the commonsense assumptions which have provided the building blocks for our current political calculations.

(Walkerdine 1983: 87)

It is plain from the students’ responses that we need to take a nuanced and discriminating view of the teacher’s impact. Students, like teachers, bring to the classroom their expectations and conceptions of what is to be studied, and these views interact with the object of study which the teacher constructs. As Walkerdine implies, their conceptions of history are not simply formed by educational encounters with a single teacher. If education functions as an ”apparatus of social regulation”, its effects are neither uniform nor simple. At the same time, the concept of the object of study which I have advanced does help us to appreciate how different readings of history can be generated within the school system. These different readings are potentially of profound social significance – as can be seen from the accounts of Australian history which have become so powerfully evocative in Australia in the 1990s.

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CHAPTER 8
Discussion and conclusions

It is, of course, possible to simplify the medium in which a scientist works by simplifying its main actors. The history of science, after all, does not just consist of facts and conclusions drawn from facts. It also contains ideas, interpretations of facts, problems created by conflicting interpretations, mistakes, and so on. On closer analysis we even find that science knows no ‘bare facts’ at all but that the ‘facts’ that enter our knowledge are already viewed in a certain way and are, therefore, essentially ideational.... A little brainwashing will go a long way in making the history of science duller, simpler, more uniform, more ‘objective’ and more easily accessible to treatment by strict and unchangeable rules. Scientific education as we know it today has precisely this aim.


This study has focused on the proposition that the object of study which the teacher constructs in the tasks, activities and discourse of the classroom shapes both what and how students learn. The case study chapters have explored in depth the relation between what was taught in particular classrooms, and what students made of it. In this chapter, I compare the findings of the history and physics case studies, and consider their more general implications for curriculum.

I argue that the case study teachers were pivotal in the construction of curriculum, in that they significantly influenced how and what their students learnt. This means that teachers can be seen as critical in the production and reproduction of disciplines and disciplinary knowledge; and that their role deserves significant research attention in relation to the production of cultural capital. I conclude that teachers' views of curriculum are critical in implementing curriculum and developing new approaches to teaching and learning. Responding to drafts of this study, the case study teachers commented on these issues. Their responses underline the importance of a collaborative approach.

Constructing curriculum

The concept of the object of study has enabled us to consider what teachers make of the curriculum in the classroom. We can see that what is taught cannot be taken for granted or characterised merely in terms of how much or little the teacher knows. Initially, I proposed that it would express the teacher's conception

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of the discipline and of knowledge in the discipline. In this section, I review the conceptions of the subject expressed by the teachers, and go on to consider their implications in relation to how and what students learnt.

The analysis developed from the teacher interviews proposes a parallel sequence of conceptions in physics and history. What is to be studied is seen in a widening context: the narrow focus on facts or algorithms, the wider view of a body of knowledge or theory, and the relational view where the physicist or the historian is seen to construct theoretical interpretations or readings of relevant detail. This is recapitulated in Table 8.1.

### Figure 8.1 Teachers’ conceptions of the study of physics and history

<table>
<thead>
<tr>
<th>What is to be studied</th>
<th>How students relate to it</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physics</strong></td>
<td><strong>History</strong></td>
</tr>
<tr>
<td>Management of algorithms</td>
<td>Material remnants of the past</td>
</tr>
<tr>
<td><em>Ms Brown</em></td>
<td><em>Ms Farmer</em></td>
</tr>
<tr>
<td>Body of theory</td>
<td>Body of knowledge</td>
</tr>
<tr>
<td><em>Mr Matthews</em></td>
<td><em>Mr West</em></td>
</tr>
<tr>
<td>Natural world</td>
<td>Development of interpretations</td>
</tr>
<tr>
<td><em>Ms Konstantinidis, Mr Nelson</em></td>
<td><em>Ms Webb, Ms Parbo</em></td>
</tr>
<tr>
<td></td>
<td>Cover, use, do, work out</td>
</tr>
<tr>
<td></td>
<td>Cover, become familiar, look, do</td>
</tr>
<tr>
<td></td>
<td>Recognise, apply, sort out, simplify</td>
</tr>
<tr>
<td></td>
<td>Master, accumulate, recognise, come to see, interpret</td>
</tr>
<tr>
<td></td>
<td>Feel, see, rethink, re-interpret</td>
</tr>
<tr>
<td></td>
<td>Feel, change, connect, imagine, construct</td>
</tr>
</tbody>
</table>

There is an interesting structural similarity in these series of conceptions. The equations and mathematical equations of physics can be seen as analogous to the details and "facts" of history, and both physics and history teachers described students’ learning in terms of covering or doing the content of the subject or working through the text. There is a similar parallel between a focus on the structure of physics theory and iteration between detail and interpretative argument in history, and again teachers in both disciplines described their...

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students’ learning in terms of recognising relationships, with a focus on the body of knowledge which students were to master. Finally, teachers who focused on the natural world in describing the study of physics, like history teachers who saw the study of history in terms of connecting the past with present experience, focused on the relation between their students and what was to be studied, and saw the students’ construction of knowledge as itself problematic. ¹

These differences were apparent in what the case study teachers called upon their students to do. In both physics and history, teachers who focused on the collection of information or algorithms actively deterred students from articulating and exploring wider questions of meaning: for instance Ms Brown’s treatment of the "at rest" position in relation to the weight on the spring (Chapter 4); and Ms Farmer’s unresponsiveness to Neville’s interest in political consciousness (Chapter 6). Where the teacher described the subject as offering a view of the world, s/he asked students to call on and reinterpret their own experience in their work with the subject: for instance Ms Webb’s probing questions as her students began to think through the impact of technology on late nineteenth century rural life, and Ms Parbo’s careful drawing out of her students’ interpretations of Tench’s diary (Chapter 6); Mr Nelson’s interrogation of his students’ observations and ideas about the weight bouncing on the spring (Chapter 4).² Differences in

¹ I note that these conceptions parallel other analyses of practice-related conceptions. Sandberg, for instance, analyses conceptions of the task of engine optimisation as an instance of thinking about competency. He discerns three conceptions: accurately optimising separate qualities of the engine; accurately optimising interacting qualities of the engine in the right order; and optimising interacting qualities of the engine through a practical sense of the engine (Sandberg 1994). Similarly, Dall’Alba, analysing material from beginning medical students, identified three conceptions of the medical interview. Dall’Alba and Sandberg describe these different conceptions as meaning structures, which they distinguish from the cognitive structures of phenomenographic research (Dall’Alba and Sandberg, 1996). In each of these analyses, the highest level conception brings into view the practitioner, as an active agent in relation to the practice of the discipline. Details and the relations between them are seen in the context of the practitioner engaged in what Säljö calls the “life-world” (Säljö 1997).

² I am reminded also of the hubbub from the back of Mr Nelson’s class as students gathered round Kellie-Ann, who was using crocodile clips to incorporate a pencil in the electric circuit
these teachers' conceptions of what was to be learnt were intimately related to the kind of learning which they encouraged.

At the same time, the classroom observations help us to develop a more complex and nuanced understanding of this broad picture. In each class, there were some discrepant moments when students' relation to the subject was constructed in a way I found surprising: where what was to be known was rendered as fixed, by Mr Nelson; or problematised, by Ms Farmer, Mr Matthews, or Ms Brown. Some examples.

From Chapter 4, we can recall Mr Nelson attempting to negotiate his students into making their own observations, but at the same time accepting his position as guardian of the correct view ("I'll tell you you're right, and you tell me what you mean"). In this situation, Mr Nelson's privileged knowledge seemed to me to press students towards second-guessing the answers he had in mind, rather than engaging in the exploratory process which he was overtly encouraging.

Ms Farmer, a geographer by training, brought to the history classroom her insights and enthusiasm for the relation between place and social practice; when this intersected with the history curriculum, she constructed a more complex and problematic activity than when she was working through historical narrative. This is visible in the lesson quoted in Chapter 6, where she worked to get her students to read the political and economic meanings embedded in the map of inner Melbourne, in a way which does not fit neatly with the image of history as given and transparent. Incidentally, this episode illustrates the value of focusing on what the teacher actually constructs as an object of study, rather than on the teacher's conception of teaching. It suggests that Ms Farmer's construction of the study of geography would be rather different from her construction of history.

The change of pace in Mr Matthews' class was more accidental. Mr Matthews, as I have indicated in Chapter 4, described his task as inducting students into the practice of science. His focus on this particular occasion was on identifying sources of error. Serendipitously, he constructed an experience which led students
to puzzle over the way they had modelled the situation: an experiment in projectile motion, where the students were to roll a ball down an incline so that it would fall to the floor; as he rather gleefully pointed out at the end of the lesson, all their predictions for its landing point were substantially different from their observed results, because none of them had taken into account the rotational motion of the ball.

Similarly unintended, I think, was a telling moment in Ms Brown’s class: she was drawing on the blackboard as she described the forces on an arrow as it flew through the air ("there's the force of the bow", she said, and then as she began to draw in the forces "Oh! No! - You see, you should always draw in the forces so you know what's going on!"). Ms Brown’s comments about the forces on the arrow in flight were consistent with her use of algorithms to solve problems, but in this case the dissonance between her own understanding and the algorithm opened up a space for students to interrogate their own understanding.

Moments like these demonstrate that the teachers' practice was dynamic. While the conceptions I discerned in the interviews were broadly visible in their practice, they were all actively engaged with their students and with what they were teaching; they were open to change in a way which is not visible in a static analysis of conceptions.1 I return to this point below.

**How students learn: the production of students’ approaches to learning**

From the student’s perspective the object of study which the teacher constructs in the classroom constitutes an encounter with the discipline and with disciplinary knowledge. Seen from this perspective, it could be said that the teachers produced both how their students went about learning, and what their students actually learnt. I turn now to the first of these points.

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1 This is not inconsistent with phenomenographic theory: as Marton puts it, a set of conceptions is a “second-order analysis” constructed by the researcher on the basis of discourse and/or practice. Conceptions are therefore not characteristic of individuals, and indeed the same individual may express more than one conception of a particular phenomenon. See Marton and Booth (1997) for a recent exposition of this argument.
The case study teachers actively elicited different approaches to learning. What they presented for students' attention, and how they constructed their students' relation with it, clearly influenced how the students apprehended what was to be learnt and the task of learning; though this influence was not simple or uniform.

In the classes taught by Ms Farmer and Ms Brown, students commonly reported that studying history or physics required the acquisition of unproblematic information, which corresponds neatly with the "surface" approach to learning discussed in Chapter 2. By contrast, Mr Nelson, Ms Webb and Ms Parbo got most of their students to explore and analyse what they were studying and to describe their work in the subject in a way which was consistent with a "deep" approach. Mr West and Mr Matthews, who positioned themselves as interpreters, evoked more variable responses from their students: some of their students identified with the task of interpretation, while others focused on the material to be learnt, and read the teacher's interpretations as a given.

In this context, the overall consistency between teachers' views of the subject and their construction of learning strikes me as important. At the outset of this study, I noted several science teaching studies reporting that teachers with a positivist view of science taught along conventionally positivist lines, in spite of their declared commitment to exploratory or constructivist approaches (see, for instance, Johnston, 1988; Baird et al, 1991). I surmised that teachers wishing to accommodate to a constructivist philosophy would find it difficult to implement in the classroom if they maintained a positivist reading of what was to be learnt. Ms Konstantinidis' experience illustrates this point.

As will be recalled from Chapter 4, Ms Konstantinidis took a view of physics which was at odds with her aspirations. From the outset, she emphasised the value of physics as a means of explaining the physical world, but she rendered what was to be studied primarily in terms of formulas and algorithms, which she treated as transparently explanatory. She used the rhetoric of understanding, but the learning tasks of her classroom essentially involved the recall of detail. In response, not surprisingly, her students picked up her emphasis on the natural world, and infused the equations they were studying with their own taken-for-granted apprehension of familiar situations. Their aspirations suggested a deep approach; their practice, memorisation and recall. I connect this outcome with the responses of students who respond positively to items on Biggs' Deep scale, but whose attainment indicates that they have not achieved a deep level of
understanding (Ramsden et al., 1988). Hence, perhaps, the inconsistent and rather weak association between deep approach and attainment reported by Trigwell and Prosser (1991).

Overall, these results suggest that there is an intelligible connection between the teacher's conception of the object of study and the student's approach to learning. The construction of the subject in the different case study classrooms brought into view different aspects or dimensions of the discipline for students to encounter and explore. In this sense, the teacher's view of the discipline framed the discourse and expectations of the classroom.

This fairly simple correspondence does not, of course, do justice to the thick and variable interactions of teachers and students. One complexity, discussed in Chapter 5 and Chapter 7, is that none of the classes in the case study were homogeneous. In all of them, students contributed perspectives and points of view which were at odds with their teacher. Some students maintained their initial reading of the subject through to the end of the year - among them, I suspect, the students in Ms Brown's and Ms Farmer's class who stopped attending. Others, like Ben in Ms Farmer's class, modified their reading of the subject while not entirely abandoning their initial aspirations. While the case study teachers influenced their students' learning, they did not wholly determine it.

Episodes like those noted above must also have influenced students' learning. These moments, like eddies in the flow of the lesson, point up the importance to students' learning of the teacher's construction of knowledge. At these points, as Marton and Booth put it, variation in meaning was brought into or excluded from students' awareness (Marton and Booth, 1997). Where a single interpretation is privileged, students seem more likely to aim at producing the correct answer, rather than continuing to work on their own interpretations. Where "factual" statements are problematised, their theoretical and experiential burden is brought into view, and learning is constructed as a more active process. At these moments, students are called on to relate different elements of their knowledge, to use clues, to connect one observation with another - processes which look very like "deep learning".

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I suggest, then, that students' approaches to learning are liable to be shaped by the teacher's conception of what is to be learnt. Where the teacher conceives what is to be learnt as unproblematic, students' exploration is necessarily constrained, since it is simply not relevant for the teacher to provide occasions for them to re-evaluate their thinking. Conversely, where the teacher conceives what is to be learnt as constructed and the process of learning as problematic, it makes sense for the teacher to seek students' active engagement in interpretation and rethinking. Hence staff development focused on enlarging teachers' conceptions of learning needs also, I would suggest, to engage with their conceptions of what is to be learnt.

**What students learn: the production of disciplinary understanding**

The variation apparent in this study has further and profound consequences for the disciplinary knowledge which is made available to students. It helps us to appreciate why students' conceptions of physical phenomena have been apparently so resistant to change, and helps us to see how a fact-oriented definition of what is to be learnt works to restrict students' learning.

Conventionally, phenomenographic categories of conception are expected to be related, so that higher order conceptions embrace lower order outcomes (Marton and Booth 1997). I would argue that the conceptions which I have identified display an inner relation which has important implications for students' learning. Recurring to Sandberg's higher order conception of competency, the competent physicist or historian can be seen as one who interprets and integrates detailed information and theory within a holistic sense of real-world relationships. Within

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1 This conclusion is consistent with the recent paper by Trigwell and Prosser (1997), which argues for a relation between the teacher's apprehension of the kind of learning afforded by a particular context, his/her prior experience of an information transfer or conceptual change/student-centred learning approach, and the approach s/he adopts in the perceived context. The Trigwell/Prosser model leaves implicit the relation between the teacher's approach and his/her conception of what is to be learnt, which I have highlighted.

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such a relational view, detail and theory are actually conceived differently (cf Sandberg 1994: 143-144).¹

Some of the students and teachers who aspired to integrate theory and practice with experience did not maintain this integration in practice, in that they did not explore the relationship between their own experience and the principles they were studying. The impact of this on their learning is plain from the results of Ms Konstantinidis' class. As we have seen, these students emphasised the value of physics in enabling them to understand the natural world, they referred to real-world physical relationships in responding to problems, and they deployed formulae to express these relationships. Their initial responses suggested that they interpreted the formulae as an unproblematic match with their own experience of physical relationships. At the end of the year, they drew on a wider range of formulae, so that they were able to give a more complex account of the problem situations; but they continued to use the formulae as if they provided a mathematical description for familiar physical relationships. This approach enabled them to maintain familiar views of what they were studying. Their understanding of what was going on did not come into view. Hence they were unaware of the dissonance between their own views and the theory underpinning the formulae they were using.² By contrast, where teachers constructed the subject so as to encourage students to re-interpret their own experience in the light of the principles and the detail they were learning, the students' understanding was more likely to change.³

¹ cf also Hammer (1995), who argues that securing change in students' conceptions requires the teacher to attend to their epistemologies; and Roth (1995), who argues that what is to be taught in science is not merely canonical theory but the relation of the practice of science and scientific engagement with regions of discourse and experience.

² In terms of Holyoak and Thagard's analysis of analogical mapping, these students did not recognise the structural differences between the two elements of the analogy. See Holyoak and Thagard (1995).

³ This does not imply that these teachers or their students took a uniform view of the subject matter (cf the differences between Ms Webb's and Ms Parbo's students, Chapter 7).
This conclusion has implications for curriculum. It suggests that it is important for teachers to adopt a relational view not only of learning processes, but of what is to be learnt. Emphasis on the prime importance of students’ acquiring information and mastering facts is likely to constitute an object of study which deters students from extending and developing their understanding; ultimately, this is likely to constrain the further learning available to them.¹

Current pressures on teachers in Victorian schools do not encourage them to adopt a more relational view of learning. The present government has criticised students’ performance and the level of accountability in schools, and is in the process of introducing system-wide testing and standardised reporting across the years of compulsory schooling. The recently issued Curriculum and Standards Framework (C & SF) sets learning objectives which refer more often to mastering detail than to exploring, interpreting, analysing or relating.

This can be seen in Table 8.1, which lists the verbs used in the outcome statements for Time, Continuity and Change (including history), and The Physical World (including physics). The outcome statements relate to work across the years of compulsory schooling, from the Preparatory class to Year 10.

This table displays a relation between the student and what is to be learnt which implies that the teacher should enable students to acquire a prescribed body of knowledge. The verbs which are used suggest that the knowledge to be acquired is seen as unproblematic, like the "facts" of science education as Feyerabend depicts it in the epigraph to this chapter. The results of this study indicate that presenting knowledge in this way will generate difficulties for students who are unfamiliar with the conceptual freight which "facts" necessarily carry.

¹ cf Jones (1986) on the impact of a limited view of the curriculum in constraining students' options.
Table 8.1 Verbs used in C&SF outcome statements for Time, Continuity & Change and The Physical World

<table>
<thead>
<tr>
<th>Verbs</th>
<th>Count</th>
<th>Verbs</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>describe, identify or portray</td>
<td>7</td>
<td>describe, identify, recognise,</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>report, demonstrate</td>
<td></td>
</tr>
<tr>
<td>categorise, classify, compare</td>
<td>3</td>
<td>use, compare, classify,</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>interpret</td>
<td></td>
</tr>
<tr>
<td>analyse, explain, construct</td>
<td>5</td>
<td>explain, construct</td>
<td>7</td>
</tr>
<tr>
<td>investigate, interpret, explore</td>
<td>5</td>
<td>design, relate, investigate</td>
<td>6</td>
</tr>
<tr>
<td>discuss</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Such a curriculum may well restrict rather than enlarge students’ learning.

I turn now to the wider issues raised by these findings, in relation to the production of disciplinary knowledge and its relation to cultural capital.

Producing the discipline and disciplinary knowledge

The variation evident in the case study classes shows that teachers play a pivotal role in the production and reproduction of their discipline.

Post-Kuhnian studies of the evolution of scientific discourse have focused mainly on the processes by which disciplinary knowledge is defined and theories achieve acceptance. Thus Mulkay, Latour, Shapin and others have argued that the acceptance of new findings and propositions within a discipline is fundamentally a social process (see eg Mulkay 1979, 1991; Latour 1987; Shapin 1988; Bazerman 1988). This argument connects with Bourdieu’s depiction of disciplinary knowledge as a contested field, which various agents and social institutions struggle to control. (Bourdieu 1977/1972, 1983). More recently, researchers have

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begun to investigate the processes whereby disciplinary knowledges and discourses are developed and maintained by their practitioners (see eg Messer-Davidow *et al.*, 1993). This work has identified the work of the discipline primarily in its research and public discourse; the processes whereby students are introduced to study in the field have not yet been explored.

It may sound obvious to say that any particular discipline is constituted by a diversity of approaches and theorisations.¹ Post-modernist analyses typically deconstruct the changes of fashion which disciplines encounter: the new theories and theorists, the new concerns (cf Sosnoski, in Messer-Davidow *et al.*, 1993, for an illustration of the incommensurability of learning within any given field of study). The particular interest of this study, in relation to the constitution and continuance of disciplinarity and disciplinary knowledge, is that it brings into view different readings of the discipline as they are constructed by different teachers and taken on by students. I want now to suggest that this play of discourse can be read, in Bourdieu’s terms, as a struggle over the constitution of the discipline.

I have shown that even working within the same subject and the same curriculum, different teachers constructed different versions of their discipline in the classroom, which powerfully affected their students’ conceptions of the central activities of the discipline and their understanding of key ideas within it. These differences have a significance which goes beyond the immediate impact on students’ learning. They suggest that disciplinary knowledge is fractured rather than unitary; that teachers impart to their students diverse views of the discipline. This diversity is not merely a function of individual difference. As reported in Chapter 3, the views of the case study teachers were shared by other teachers. Further, their views clearly relate to other accounts of physics and history: most obviously with accounts of the study of history and physics, but implicitly also with historical versions of the discourse and practice of the discipline. From this

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¹ Becher (1989a, 1991), reports two particularly relevant studies of the commonalities and diversities in descriptions of physics and history given by a sample of academics. These were part of a wider investigation of the relationship between knowledge forms and knowledge communities (Becher, 1989b). While Becher sought commonalities, it is plain from comments by his respondents that they also perceived diversity within their field.

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point of view they are unlike the differences between teachers discerned by Evans, which appeared to be grounded in style, personality and individual politics (see e.g. Evans, 1990).

In relation to the study of history, the conceptions I have identified link with a recent analysis by an academic historian. Macintyre (1997), reviewing the study of history in Australia, distinguishes three approaches to "knowing history": "mastering precise and absolute knowledge", "knowing history as a process", and recognising the "radical changes of perspective" which alternative histories require. Macintyre figures these as historically successive. I would argue that they are all visible, not only in the classrooms I observed, but in contemporary rhetoric. From the perspective of the history professor, the post-modern play of self-conscious and self-referential discourse, in works like Denig's *Mr Bligh's Bad Language*, may have succeeded theoretically grounded studies like Thompson's *Making of the English Working Class*; but there is a persistent narrative focus in the stories which are told in individual biographies and local histories, family genealogies, local museums, historical theme parks, even journalists' enquiries into students' level of knowledge of dates and events.

The study of physics is also and more obviously a field where the various conceptions I have described co-exist. de Laet (1989), cited in Chapter 3, remarks the dominance of the equation-oriented teaching of physics, and distinguishes it from the hands-on practice-based approach prominent in the Nuffield schemes; constructivist science educators have emphasised the importance of focusing on the student's experience of natural phenomena. In Victoria, this has been a particularly strong interest among the network of teachers and academics interested in promoting the involvement of girls in science, as well as among science educators concerned at the misunderstandings of physical concepts displayed by university entrants and even by science teachers. Constructivism, however, attracts criticism in physics journals and even in journals devoted to physics teaching. New school curricula developed on conservative principles, such as the Curriculum and Standards Frameworks

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1 Though Kutnick (1990) and Woolnough (1988, 1989) argue that physics teachers were resistant to the changes embodied in Nuffield.
already mentioned, are expressed in terms of propositions which students need to know, rather than relationships they are to understand.

Seen from a post-modern perspective, these competing versions of traditional disciplinary knowledge seem likely to support the privileging of particular forms of knowledge (cf Chakrabarty in Ruthven, 1991). Their continuing presence suggests that it will be some time before they are undermined by post-modern critiques. Ruthven's view of the relation between "new humanities" and established disciplines intimates, indeed, that they are likely to coexist:

The new humanities are powered by the transformative energies of people responsive to changes in the material conditions of intellectual life both here and overseas. Far from demonising critical theory as the destroyer of the old humanities, those who are making the running in the new humanities treat it instead as a heuristic device for identifying certain types of knowledge which are occluded by traditional modes of representation. Because such representational modes constitute the dominant cultural forms and practices of societies past and present, it is imperative to understand the ways in which, consciously or unconsciously, they continue to be complicit in the making of universalist claims founded on the suppression of differences and heterogeneities... These are unnerving times for older members of the Academy [sc. of the Humanities] like me, who established our reputations in an earlier paradigm of knowledge, and are now made to feel from time to time that what we know isn't worth knowing any more, because a different set of questions is now on the agenda. (Ruthven 1991: viii).

The Year 12 teachers whom I observed can be seen as participant in these contests. Insofar as their perspectives shaped their students' views of the discipline, they contributed to the formation of physics and history as cultural practices.

More generally, it could be argued that teachers necessarily perform this role at whatever level they are teaching. In Chapter 1, I referred to Doyle's discussion of the conceptual differences in the meaning of reading, as a task, in different primary classrooms. At tertiary level, Ramsden and his colleagues have used the concept of an object of study to investigate the teaching of a range of disciplines (among them history, accountancy, physics and creative writing) and found that at this level, too, there is variation between teachers in terms of what is taught and how it is to be learnt (see eg Martin, 1992; Balla et al, 1992).
Teachers as cultural agents

The findings I have outlined have implications for the status of teaching as a cultural practice. How does the teacher's role in the production of knowledge connect with Bourdieu's concept of cultural capital - the differentiation of social groupings via their access to privileged or "sacred" knowledge?

This question draws us towards the consideration of intersecting and competing theories of class, of culture, of knowledge, of curriculum, and the relation between them, a field which is too large and diverse to be summarised here. Nevertheless, I want at least to indicate the relation between the classroom processes I have reported and their cultural context.

In general, the social location of conceptions has not received much attention in phenomenographic studies; it has been assumed that conceptions have a generality which is independent of social setting. Following this model, my analyses have distinguished the classes I observed in terms of the teachers' and students' conceptions, rather than situating them socially and culturally within the school and the community. Säljö, however, has argued that the analysis of conceptions is in effect a strategy for analysing discourse preferences, and that these are socially constructed (see eg Säljö 1997). This implies a significant relation between contexts and discourses which could be linked with theories of cultural capital and social reproduction. Certainly the classroom processes I observed seemed to produce cultural differences between groups of students. The study of physics offered to students in the case study schools was so different that it could be argued these students were not competing in their Year 12 examinations on equal terms, while the history case study suggests that students in the different classes were at the least inducted into different conceptions of historical knowledge.

The concept of cultural capital was propounded by Bourdieu in relation to the privileged knowledges of French society (Bourdieu 1977/1972). He writes of the *habitus* which is inculcated into different social groupings: the tastes, preferences and behaviours which are regarded as social markers. The relation between social

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1 There has, however, been a growing interest in the possibility of cultural differences in students' approaches to learning; see for instance Samuelowicz (1987), Bosley (1993), Furnham (1993), Kember and Gow (1990), Kember (1996), Watkins and Biggs (1996)

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status and curriculum content was widely canvassed in the 1970s and early 1980s. Academic work theorising and researching this relation connected, in Victoria as elsewhere, with a school-level interest in localised and student-oriented curriculum, based on the argument that conventional curricula were alien to students from lower status and/or migrant families in both content and language (see Whitty 1985 for a wide-ranging and penetrating review of the field). In a series of studies of the relation between privilege and schooling in Australia, Connell and his associates have argued that schooling enables the reproduction of hegemony, via the relation between schools, teachers, and the social context (see eg Connell et al. 1981, Connell 1985). The gendering of knowledge has more recently become a research focus, and a trail-blazing study by Walkerdine argued that primary classrooms actively construct the gendered child who is inserted into socially determined knowledge practices (Walkerdine 1988).

Locally, the privileging of certain kinds of school knowledge has been explored by Teese in a series of studies of Year 12 outcomes. He argues that socio-economic privilege, marked by area of residence and sector of schooling, is displayed in subject choice and in examination results. Students from elite private schools, like those where Mr Nelson and Mr Matthews taught, continue to perform significantly better in public examinations than students from working class schools like those where Ms Brown and Ms Konstantinidis taught (see eg Teese 1989). Ozolins (in Barnes and Johnson, 1981) and Farrell (1996) have analysed examiners’ reports on Year 12 subjects, and concluded that examiners privilege a discourse style which is associated with social positioning.

There has been a dual interest in much of this work, focusing on the one hand on explicating the processes whereby access to privilege is maintained in modern capitalist societies (cf Anderson and Vervoorn 1983), and on the other hand on identifying the opportunities which education might offer for social transformation. Specifically, some researchers have seen atomised and fragmented curricula as characteristic of teaching in working class schools and argued that this approach to knowledge perpetuates disadvantage (see eg Anyon 1981, Jones 1986). In this light, the current use of atomised competencies as

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1 Anyon (1981), for instance, reports a study of five primary schools where the curriculum was constituted and children positioned in relation to it in ways which she argues connected them into their future economic and social position in society. The curriculum at the working class
educational objectives certainly dramatises the potential of schooling to produce low-level workers (cf Sandberg, 1994).

This study offers material which is relevant to these concerns, although it was not designed to address them. In focusing on the teacher’s construction of learning, I deliberately set aside the social context in which the teachers worked and the individual histories on which they drew. The explorations I have reported were concentrated in a few schools and would not support generalisations about social positioning and learning outcomes. I asked the case study teachers to participate primarily on the basis of the differences between them which emerged in the interviews; while I selected classes in schools of diverse types, the schools were not chosen to be representative of their type. Nevertheless, the social context of the differences I have described are suggestive and deserve further investigation.

The physics case study schools were differentiated across two dimensions: gender and status. Mr West and Ms Konstantinidis taught in girls’ schools (an elite private school and a government school serving a disadvantaged district, respectively); Mr Matthews and Ms Brown taught boys’ classes (also in an elite private school and a government school serving a disadvantaged district, respectively). The differences in learning experiences which I have reported thus

schools was limited and degraded; the teachers had a low opinion of what the children would be able to learn, and the children had a low opinion of the school. In effect, these children were being prepared for mechanical and routine work. Executives’ children at the high-status school, by contrast, were pushed into high-level cognition and were achievement-oriented and anxious, an apt preparation for the control of production rather than the creation of new knowledge. The children of professionals were allowed and encouraged to explore ideas and were imaginative and discursive, acquiring symbolic capital suitable to the professional middle classes. She argues that in each of these practices were implicit contradictions and oppositions, which offered an opportunity for “transformative pedagogies” to support the development of critical consciousness.

1 The two government schools both served areas classified as disadvantaged: on the Ross Index of disadvantage, both scored below the state mean of 149, and Ms Konstantinidis’ school scored only 142. Ms Konstantinidis’ school was a single-sex girls’ school. Ms Brown’s had been a single-sex boys’ school; there were few girls at Year 12 level and only one in the physics class I observed.
split on status lines, with the government school teachers focusing primarily on familiarity with equations, and the teachers at the elite schools inducting students into the practice of science (at the boys' school) and working to help them reinterpret their experience on Newtonian lines (at the girls' school). As Anyon observed, it was the students from the more disadvantaged areas who were offered the more atomised and mathematised curriculum. Interestingly, there were also differences along gender lines: it was the girls' teachers, and not the boys', who emphasised the importance of physics as a means of understanding the natural world.¹

This tidy pattern is not apparent in the history case study schools. There were some status differences between these schools: Ms Webb's school served a relatively homogeneous neighbourhood in the outer suburbs, Ms Parbo's school straddled immigrant and established neighbourhoods, while Mr West and Ms Farmer both taught in schools set in prosperous middle suburbia.² These differences, however, did not match the learning the students displayed. Contrary to expectation, it was students from the schools in relatively less advantaged areas who provided more developed and reflective responses to the historical texts of the exercise I gave them.

These patterns tend to confirm the significance of the teacher's construction of the curriculum. They suggest that there is likely to be a complex and variable relationship between teachers' construction of their subject, the culture of their school, and their perceptions of their students' needs. In the physics case study, both the private schools had large science staffs in which the case study teachers held senior positions. Both the government schools had small science staffs, and the case study teachers were both young and professionally somewhat isolated - Ms Konstantinidis told me that when she was appointed as a first year out teacher she was the only teacher in the school with a "physics mark", hence the only

¹ Of the comment of a physics teacher I interviewed, who said that in his view the extended answer questions in the physics examination had been introduced specifically to allow girls to pick up marks, by answering in words rather than using numbers.

² The Ross Index scores of these schools were 162 and 159 (Mr West and Ms Farmer), and 155 (Ms Parbo and Ms Webb).

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teacher qualified to teach Year 12 physics. In the history case study, all four teachers were experienced and held posts of responsibility within their school, though their comments indicated that the schools were not equally collegial.

My observations would suggest that while teachers were likely to relate to the culture(s) of their school, they did not necessarily endorse or express a shared approach or shared values. In some schools teachers mentioned active discussion of curriculum issues and a strongly collaborative approach; in other schools, I encountered teachers who had virtually no discussion with colleagues teaching precisely the same curriculum. In several schools, both government and private, I interviewed two teachers in the same school who described their teaching of the same subject quite differently. Even where there was common planning, it did not necessarily connote shared reflection or deep level discussion (cf Hargreaves 1994). It might even be suggested that teachers are involved in a cultural struggle within their school, in the sense that the object of study they construct is likely to be contested by their students and may not be supported by their colleagues.

In the context of cultural reproduction, several significant questions emerge which deserve further research.

First, what produces variation in teachers’ conceptions of their subject? I did not track the education and experience of the case study teachers – the historical and cultural trajectory which brought them to the classroom – nor did I trace the influences on their conceptions of their subject. Ramsden and his colleagues have undertaken work on the construction of an object of study at tertiary level, which suggests that university education is also differentially constructed. It would be interesting to explore the development of these conceptions over time, and in different contexts.

Secondly, how do teachers come to change their views of their subject? In general terms, this is the issue addressed by Knapp (1997), cited above, and in a different

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1 It is important to recall that these schools were not selected to be representative. The government school teachers whom I interviewed included several highly qualified and experienced physics teachers, among them a senior Year 12 physics examiner, a physics curriculum consultant, and a teacher who combined the role of head of physics with lecturing in Physics Methods in a university Diploma of Education.

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form by Ball in his work on policy implementation (see eg Ball 1990, 1993). The particular form of the question I propose, however, suggests a focus on the processes whereby educational institutions foster sustained reflection on and discussion about fundamental curriculum issues.

Lastly, what is the relation between teachers' conceptions of their subject and the conception which is privileged by the assessment process? In the present study, I was unable to gain access to a comprehensive set of examination results, but in any case the question is wider than the results of a particular cohort of students. If different teachers enact different readings of the curriculum, and students taught by them are assessed externally, some students are likely to be disadvantaged. From a research perspective, it must be interesting to establish the links and connections between the views of teachers and the assessment criteria which are actually applied. From the perspective of students and teachers, equity would suggest a systematic approach to the development of a common understanding by teachers.

**Implications for disciplinary knowledge and curriculum objectives**

The web of connections between the *what* and *how* of learning help to explain why teaching is not simply reformed by getting teachers to adopt different teaching practices. As described in Chapter 1, the project of constructivism has been to modify the teaching of science by getting teachers to bring into view and to challenge what students make of the concepts being taught - a project which appears unintelligible if what is to be learnt is seen as straightforward fact. The constructivist project, like other theories of teaching, incorporates a view of knowledge as well as a view of learning. It follows that dialogue about teaching and learning strategies is likely to founder if it does not also support teachers in revisiting and re-evaluating their views of what students need to learn.

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1 This required individual permissions from the students concerned. Several students were absent from class at the relevant time in some of the schools, and some other students did not wish to disclose their results.

2 Recently evidenced in an extensive interchange about constructivism on the PhysLner e-mail list, for university physics teachers interested in research on science education.

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Curriculum history has conventionally focused on the struggle towards innovation and the implementation of new perspectives. From the standpoint of the innovator, the persistence of established points of view figures as resistive or contrary, if it is not seen as hegemonic (cf Chakrabarty in Ruthven 1991). Teachers are construed in terms of their relation to change. Thus in a recent review of systemic change in science and mathematics curricula, Knapp (1997) cites a range of teacher attributes which are seen as relevant to the impact of policy on the classroom:

- teachers' conceptions of mathematical or science knowledge
- teachers' beliefs about learning and learners' capabilities
- teachers' mastery of content... [their] pedagogical content knowledge, and their beliefs about pedagogical practice
- teachers' repertoires of subject-related practices and strategies for coping with classroom contingencies
- teachers' decisions about what content to teach, how to engage learners in the learning process, and how to assess what learners have learned
- the actual structure and demands of the academic tasks in which learners engage

(Knapp 1997: 233)

This list is offered as a set of distinct dimensions of the teacher's work.

My results suggest that these dimensions are intimately related in the object of study which teachers construct for their students, and that there is an intrinsic consistency between what is to be learnt and how it is to be learnt. Hence, as I have already indicated, asking teachers to change the kind of learning they encourage, or the kind of learning objectives they are to achieve, is to demand significant rethinking and possibly quite fundamental change. Knapp (1997) remarks that systemic change, to be effective, has been found to require consistency between the elements of the system that bear on the classroom. I would propose that it also requires opportunities for teachers to review, question, analyse and discuss the proposed change, and time and collegial support for them to consider and work through its implications. Variation in ideas about what is to

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be taught could usefully be brought into view in teacher training and professional development, and would be an appropriate focus for reflection and discussion between teachers involved in curriculum change projects.

The powerful differences between the teachers in this study remind us also that these debates and discussions will not necessarily achieve consensus. It is plain that education is in the deepest sense a political activity, which positions students with a diversity of perspectives and approaches in relation to the disciplines and societies which they are entering.

**Teachers' perspectives**

Finally, I return to the case study teachers' views of these proposals. Their comments indicate some of the issues and difficulties in the interpretations I have proposed.

There is a paradox in the account I have given of these teachers' practice. I have tried to keep very close to what actually happened, to provide substantial detail of particular lessons and students' responses. At the same time, however, the interpretations I have offered are abstract - in phenomenographic jargon, a second-order analysis - in that I have tried to draw out of this material the implicit conceptions of what is to be studied and how. This analysis was developed by me as researcher, rather than by or with the teachers. This was partly because I was wary of intruding on or influencing them, and partly also because discussing my interpretations seemed likely to press them to justify or theorise what they did and lead them away from describing their practice. Nevertheless, returning the interpretations to teachers could be seen as a necessary step in curriculum or staff development, if it is to engage with teachers' views of what their students need to learn.

As I was completing this chapter, I came upon a recent paper by a group of researchers at Deakin University, entitled "Do you see what I see? Reading a different classroom scene" (Reid *et al.*, 1996). This paper reports two classroom scenes as they were observed and recorded by different members of the team. Their notes and recollections of the same lesson only occasionally coincided: they were watching for and attended to quite different aspects of it. Their moral:
We can no longer make any claim for the innocence of our representations of classroom practice, and... we cannot use them unproblematically as a knowledge base upon which other claims can be founded.

(Reid et al., 1996: 102)

This conclusion points to the partiality of the individual perspective (cf Tobin and Espinet 1987, Tobin 1991).

I was therefore particularly interested to find out whether the case study teachers recognised my interpretation of what they taught, and whether they saw value in the concept of the object of study. Before concluding this chapter, I sent my draft to the case study teachers to check whether at least they found it recognisable, and to discuss with them the account I had given of the object of study they constructed.\(^1\) I found that the concept of the object of study was more salient and interesting to some than to others; their responses suggest that a key issue here is the teacher's consciousness of the possibility and value of variation.

Mr Nelson and Ms Parbo were the most interested in the concept of an object of study. Ms Parbo was particularly interested in the issue of variation; by implication, she rejected the hierarchical presentation of the conceptions:

It's interesting. I didn't see myself, in the comparison, as being better or worse so much as having different views of history - I'm glad we got that keyhole metaphor.

(Ms Parbo, December 1997)

She linked the value of variation among teachers with the issue of computer-based learning and the reporting of students' attainments via the Department of Education program Kidmap:

There's now such an attempt through technology to manipulate teaching - with computers, there's such a determination to pre-arrange questions. A lot of people think computers free you up, but it means any questions not asked are presupposed not to exist. So many questions don't exist. When you move to this, it takes away the personal factor, they can employ fewer people, it's a profit and loss thing. There's an incredible press for computerisation. You know

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\(^1\) I sent copies of my draft to the eight case study teachers, and invited them to contact me with their comments; I followed this up with telephone calls. All but Mr West responded with comments.

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Kidmap? Yes It's not a bad idea, but it hasn't been thought through. It might work for a primary school teacher with twenty-five students who they teach all year, but it's hopeless for a secondary teacher with 150 students they see for 2 periods a week for six months. But because it's computerised, it's seen to be egalitarian, treats everyone the same way.

(ibid.)

Interestingly, Mr Nelson also raised the issue of computer-based learning, which he also felt limited what was available to students to learn:

My school has got into computers in a big way. A lot of staff felt the computer was devaluing the role of the teacher... Your work is the key to that one. The curriculum statement can look the same but the delivery is different... The teacher can give a deeper understanding of what the curriculum is on about and what's needed in interaction with students... I don't see how the computer could deliver what you've been studying. You could argue that it depends on who writes what into the software, but my practice has a high level of interaction with students and a high level of observation - a high level of interaction with the whole group - it's very multifaceted... It's much more difficult to achieve learning where concepts are deeply grasped with computer aided instruction.

(Mr Nelson, January 1998)

Both these teachers, from different points of view, were concerned about the possibility that computer-based instruction could result in information being fragmented and atomised, and that students would be less likely to achieve insight and understanding as a result.

Two of the teachers focused mainly on the issue of students' learning. Mr Matthews was not convinced by my argument about students' learning:

I came across as a bit intolerant or uninterested in students' pre-existing ideas. Probably fair comment, but when students misunderstand things in physics they do it so comprehensively that they sound as if they're talking a foreign language. I'm still not totally convinced by your conclusion that 'wrong' ideas need to be challenged or explored. (Mr Matthews - e-mail December 1997)

Ms Webb described how her own thinking had changed; her main interest in looking back over her lessons was in identifying strategies which she had already developed and which she was now strongly committed to.

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Groups of us have moved to look at the whole notion of seven intelligences, and how the way you learnt impacts on how you teach. You need to make sure everybody's learning. It's made quite an impact.¹

(Ms Webb)

I asked Ms Webb how useful she thought the object of study concept might be to teachers. Her reply suggests that it could be viewed as relevant, but threatening:

Discussing that could be useful but I think it would be highly threatening to some teachers. In the initial stages we talked a lot about what we were teaching. We had some trouble in our group of teachers because they felt challenged by being asked what they thought their students got out of their teaching.

(Ms Webb, December 1997)

Certainly some of the teachers felt it was important to explain how they had come to teach as they did. Both Mr Matthews and Ms Brown commented on the models and pressures which were acting on them as teachers. Mr Matthews saw what was taught as a relatively pragmatic response to the situation in which the teacher finds him/herself:

You made an interesting comment (Ch 1) about certain types of tasks being suitable for classrooms, and so they tend to represent the curriculum. I totally agree, and I think this may be a much bigger factor than you realise. If lesson plans don't work (ie the class is rowdy) they don't get used twice, but that worksheet that has the whole class working silently for 40 minutes gets wheeled out every year!... As far as the school administration and the parents are concerned, a good teacher has the students working happily and quietly, sets lots of homework, and marks it promptly. Good exam results are a bonus. Newtonian thinking isn't high on their priorities... Let's face it - most teachers want to teach in the same style as the teacher they most admired when they were at school.

(Mr Matthews - e-mail December 1997)

¹ She had been centrally involved in a project at the school to work through the implications of research on students' learning styles; she commented to me that of a whole Year 12 class, only one student learnt in the same way that she did, and she had altered and extended the ways in which she represented the material to be studied so as to make it accessible to other students in the class. (Interview, December 1997)
Ms Brown felt her teaching had been partly the result of being "thrown into it", partly an outcome of the approach she had experienced at university:

I teach chemistry now - I did a physics sub-major and I was thrown into it [teaching physics], I was really a chemistry major. [As I taught it] I grew to understand the concepts more... Physics at uni is mainly equations. They're like a life-jacket. When in doubt, cling on to an equation, it will get you through.

(Ms Brown, December 1997)

Ms Konstantinidis expressed a similar view:

What I wanted was for them to get a deep and meaningful understanding of the universe - but the lesson was so structured and so formal! It's like, "Oh my god, did I really do that"... You do your uni study but it's all abstract. When it comes back to presenting stuff your own lack of consolidation of those ideas becomes apparent. It probably took me about six years to get a good grasp of the content... (Ms Konstantinidis, December 1997)

Ms Parbo was interested in how the other teachers might have arrived at their approach, and suggested a new project which would track the changing conceptions of teachers and students over an extended period of time. This project did not explore the origins of teachers' conceptions - to do so would have extended the research to an unmanageable degree. Nevertheless, the issue is clearly important to teachers and it seems likely that it would need to be addressed in discussions of what is taught.

All these teachers were satisfied with my account of their teaching. Ms Farmer, however, felt that I had over-emphasised the significance of a particular comment she had made, and given a distorted account of her work as a result:

You've taken a flippant comment that I made and based your work around it. It was seven years ago. To be able to go back over seven years is very difficult, but one of the things you've put I wouldn't have said. I did tend to give quite a visual aspect, but not that you don't need to look at arguments over different points of view. That might not have been the key issue in that topic. That sounds as though I didn't take into account how people view history, social issues, women; I am aware of different historical viewpoints - that's not the case - I do look at the different angles. I tell the students they have to be aware of what's written in the documents and that historians' accounts are all secondhand material - they have to be aware of the biases that those people are putting down. In Melbourne, I was drawing a picture, but there's an assumption that I don't do that in what I taught. It's related to the topic? Yes. (Ms Farmer)
My description of the study of history in Ms Farmer's classroom is, I think, consistent with my observations and with her students' responses, and even with her language here ("the biases that those people are putting down"). However, it is clear that the interpretation I have proposed does not emerge as directly as I intended from her own description of what she was doing. I hoped that my interpretations would be recognisable; in this case, what I have put appears to Ms Farmer to distort her position. Her response underlines the difference between a collaboratively developed interpretation, and the outsider's view. The process of clarifying what precisely is being taught is difficult and sensitive. It requires not only sustained involvement by the researcher (see Ms Farmer's comment about the influence of the topic on her teaching), but also, ideally, a continued interaction between observer and teacher in the attempt to develop a shared understanding.¹

These findings suggest that variation in the construction of the object of study is significant to students' learning and critical in the implementation of curriculum. They suggest also that it would be valuable for teachers to be directly engaged in discussing in some depth not only how students are to learn, but what they are to learn; a lesson for staff developers and curriculum developers alike. Future research could usefully be conducted in collaboration with teachers, and focus on the practicality and effectiveness of such discussions.

¹ cf Peter Elbow's program of collegial observations, reported in Elbow (1986): Chapter 9, and the work of the Monash University science education group in developing collaborative action learning research projects, reported in Baird et al. (1991).

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Appendix 1: Note on methodology

This Appendix provides a brief background discussion on the relation between the various analyses which I conducted, the processes of analysis which I adopted, and the validity and reliability of the results.

This study began from a recognition that there are differences in how the same curriculum is rendered in different classrooms. My focus was on characterising these differences and how they affected what students learnt. Hence the study can be seen an exploration of the production of discourse, which I undertook in three stages: first, identifying differences between teachers' discourses in relation to their subject; second, tracking teachers as they engaged their students in discourse in the classroom; finally, analysing the discourse of their students in relation to what and how they were studying.

Underlying the different stages of this work is my expectation that a teacher's practice is likely to be intelligibly connected with the account s/he gives of it - that the language in which the teacher describes the discipline, and the verbs s/he uses to characterise students' relation to it, are likely to be recognisably connected with the discourse and tasks which s/he establishes in the classroom. Phenomenographic analysis enables us to capture the different conceptions which teachers and students express; tracking the dynamic discourse of the classroom enables us to see how the teacher actively positions his/her students in relation to a particular conception of what is to be studied. The apparently static phenomenographic analysis of abstract "categories of conception" can thus be connected into a dynamic process whereby students are positioned in classroom discourse, brought to focus on particular questions, asked to respond to particular tasks; in short, to engage with the object of study which the teacher constructs for them.

Each of the stages of this work involved methodological decisions and iterations through analytical processes. The table below lists the analyses I undertook in relation to this material, and the broad approach adopted to each analysis.

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## Table A1: Analyses and analytical approach

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<thead>
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<th>Group</th>
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<th>Approach</th>
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<td></td>
<td>positioning of students in relation to discipline</td>
<td>Discourse analysis</td>
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<td></td>
<td>construction of what is to be attended to - focus of questions and responses</td>
<td>Discourse analysis</td>
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<td></td>
<td>tasks set for students</td>
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<td>Physics students</td>
<td>study of physics</td>
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<tr>
<td></td>
<td>perceptions of lessons</td>
<td>Discourse analysis</td>
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<tr>
<td></td>
<td>approaches to each of four physics problems</td>
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<td></td>
<td>force and motion (Two Boats context)</td>
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<td>character of an historical account (Garrioch)</td>
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Appendix 1: Note on methodology

relation of historian to historical account (Hinton)  Phenomenographic
relation of historian to historical account (Garrioch)  Phenomenographic

My protocol for the phenomenographic analyses followed a consistent pattern, iterating repeatedly through a sequence of six steps:1

(1) formulating the phenomenon of interest.
This was less obvious than it sounds, and I returned to it after each round of sorting the responses. Defining the relevant phenomenon was particularly critical in relation to the history passages and the Newton's Third Law problems, where I was seeking to identify a phenomenon which would be intelligibly related to the variation in students' responses. I tested and rejected a number of possibilities.

(2) deciding on the unit of analysis.
Frequently phenomenographic analyses are based on segments of interviews rather than complete interviews. I considered this approach, but decided to treat each response as a gestalt. In the case of the interviews, I took the whole of each interview; in the case of students' responses to my sentence completion prompts, I took the responses as a cluster; in the case of responses to the History passages, I dealt with each passage separately, but considered the responses to it as a cluster; in the case of responses to the Physics problems, I took the response to a particular problem separately from the student's responses to other problems.

(3) sorting responses in terms of the focus and frame of reference they evinced in relation to this phenomenon.
This derived from suggestions made by Ference Marton in meetings of the University of Melbourne Physics project group. I found that identifying the focus of each response was a powerful strategy for grouping responses, and

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1 This approach was broadly modelled on the work of Bowden et al. in the University of Melbourne Physics project group, researching student conceptions of physics phenomena; I attended a number of meetings of this group early in my research. cf Bowdenet al.(1992).

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identifying the frame of reference helped in describing the grouping. Again the sorting was an iterative process.

(4) developing a description of these groupings
That is to say, trying to find a way of describing the grouping which identified what the responses had in common: their focus and frame of reference.

(5) assessing the fit between individual responses and my description of the grouping.
Where responses did not fit, I either sought to reclassify them into another grouping, or reconsidered my description of the grouping as a whole.

(6) considering the relation between groupings
At this point, I looked at the category descriptions to see whether, and how, they might be structurally related to each other, and if so whether a hierarchy of categories had emerged. Generally it seemed possible to order the categories from the less complex to the more complete; in relation to teachers' conceptions of physics and history, however, it seemed prejudicial to assume that the ordering was hierarchical in advance of exploring students' experiences. My eventual assessment (in Chapter 8) draws on a range of material to argue that there was a hierarchy in these conceptions, and is not based merely in the category descriptions.

It will be observed that I did not recruit others to re-categorise the material; the task was large, and I concluded that Sandberg's arguments to the contrary were persuasive (Sandberg 1997). However, the steps I followed broadly conform with Sandberg's interpretative guidelines, and I have followed his guidance also in presenting my final analyses in some detail and with extended examples, so that they can be assessed in terms of their persuasiveness and the insights they offer.

Whereas phenomenography seeks to simplify discourse by discerning commonalities and similarities in the way in which representations of phenomena are patterned, discourse analysis attends to the detail of verbal interactions in which the attention of the participants is focused, modified and shaped. In developing my own approach to discourse analysis, I drew particularly on Lakoff's work on the way in which embedded bodily metaphors express fundamental relationships (Lakoff 1987); Schön's analysis of the movement of argument and question in coaching sessions by "master practitioners" (Schön 1983); and Walkerdine's analysis of interactions in which the teacher's language, questions and
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encouragement work together to produce the rational child (Walkerdine 1988). In analysing how each teacher constructed the discourse of his/her classroom, my principal steps were:

(1) identifying the teacher’s "framing metaphor", drawn from the verbs s/he used in describing his/her practice
I revisited these verbs from time to time as I developed my account of each teacher’s practice.

(2) observing a considerable number of lessons
Because I was conscious that brief episodes of observation might be seriously unrepresentative, I observed and recorded around twenty-five lessons taught by each teacher. These lessons included at least one series on the same topic, and a range of lessons with different activities. For physics, this was likely to include experiments, option work, whole-class instruction, and work on problems; for history, it would include group-work, student presentations, whole-class instruction, option work, and feedback on assessment tasks.

(3) reviewing my records of these classroom observations
In these reviews, I listed the tasks which the teacher set, highlighted the questions s/he asked, highlighted questions and contributions from students, and characterised the teacher’s responses. I particularly sought to find moments when teacher and student were at odds, so as to discern the boundaries which the teacher was drawing and the grounds of the student’s contestation.

(4) characterising the teacher’s focus across lessons
This was a quasi-phenomenographic element in the analysis. Working through my records, I sought to describe the focus of attention in each lesson - what was given attention, what was excluded or ignored - and compared it with the teacher’s focus in other lessons.

(5) selecting comparable episodes for detailed analysis
The episodes which are analysed in Chapters 4 and 6 were chosen primarily because they related to the same element of the curriculum. In the case of Physics, I made a point of attending the first lesson each teacher taught on Simple Harmonic Motion: it incorporated fundamental mechanics principles (hence provided a link to the problems I was using as an exercise); and

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unlike other mechanics topics, all the classes were encountering it for the first time in Year 12. In History, the choice was less straightforward, as there was no common topic, only common concepts; as explained in Chapter 7, I decided to select lessons where the teacher addressed the concept of empathy, which again was thematically connected with the exercise I had given.

(6) articulating the movement of discourse within the selected episodes
These analyses are presented in detail in Chapters 5 and 7. I sought to connect each of these analyses with the teacher's framing metaphor and conception of the discipline, and to check my interpretations by visiting and revisiting of other transcripts. I also drew on students' comments in interviews and in response to my questionnaire prompts.

(7) sharing my interpretations with the case study teachers
I sent all the teachers copies of early draft accounts, which I discussed with them informally; this was the point at which I asked them to nominate pseudonyms. When the work was nearly finished, I sent them copies of the relevant chapters in close to final form, and contacted them for feedback. Their comments at this point are discussed in Chapter 8.

Apart from feedback from the teachers themselves, I did not seek outside confirmation of the interpretations I offered. As with the phenomenographic analyses, my accounts of classroom discourse are primarily offered as interpretations which must be judged on the insights they generate.

Finally, a methodological problem which I found peculiarly difficult. The argument I have pursued is essentially qualitative, rather than quantitative: I wanted to explore how teachers construct an object of study for their students, and to see whether the character of this object of study influences the students' learning. How to evaluate this relationship? A quantitative approach, classifying and counting students' responses, has practical problems: the number of students in each class was quite small, and there was a diversity of initial expectations and experience. Further, and perhaps more importantly, this approach could be seen as a objectivistic project, inconsistent with the broadly phenomenological approach I have adopted (cf Sandberg 1997). In practice, I did not resolve this issue, offering both head-counts and extensive quotation from students describing their experience and offering responses to problems.

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Overall, the methodology I have adopted has been qualitative and interpretative, focusing on making sense of what teachers and students said and wrote. I have tried to be careful, thoughtful and open in my interpretations. My approach is a reasonable match with Sandberg's criteria for maintaining interpretative awareness:

- an orientation towards the phenomenon and how it appears throughout the research process
- seeking to describe the experience under investigation, rather than trying to explain it
- horizontalizing the material being analysed - treating everything which is said as being of equal importance
- seeking structural features in the experience under investigation
- using intentionality as a correlational rule (looking at what is focused on and how it is represented).

(Based on Sandberg 1997: 210)

Given the project I have addressed, it is less important that my findings are seen as valid and reliable, than that they are generative of new insights into the relation between teaching and learning. This is a judgement which can only be made by others.
Appendix 2: Interview protocol

Interviews with the Physics and Australian History teachers were guided by the following protocol.

1. What would you say your subject is about? what would you most want your students to carry away at the end of Year 12?

2. How would you go about introducing a particular topic - can you tell me about one which comes to mind?

3. What problems do you find your students have? How do they show up?

4. What strategies do you use to help students having difficulties??

5. (Physics) What do you see as the role of experiments/laboratory work/equations?
   
   (History) Which units are you taking? what influences that?

6. Why do your students choose to take this subject?

7. Could you tell me about your option and how you handle that?

8. What kinds of change in the course do you expect with the new VCE?
The following pages provide the introductory instructions, texts and questions used in the History exercise.

In first semester, half the students were asked to respond to the Hinton extract, and half to respond to the Garrioch extract. In second semester, all students were asked to respond to both extracts.
APPENDIX 3A: History exercises

(University letterhead)

The following exercise is part of some research I am doing at the University of Melbourne. I need you to write your name, so I can ask some of you to talk to me later, but I shan’t be using anyone’s name when I write up the research.

First I am asking you to read an historical extract, then answer some questions about it. There are no right or wrong answers to the questions - you just need to think about what was in the text and decide what you think.

When you have answered all the questions, please turn over to the coloured sheet of paper.

Thank you very much for your help.

Kate Patrick

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APPENDIX 3A: History exercises - Hinton

The extract below describes some of the experiences of women in a Chinese village called Long Bow, and how their lives were affected by the Chinese revolution of 1945. It comes from a book by an American, William Hinton, who lived in the district of Long Bow in 1947.

Please read the extract first. Then turn over to answer the questions about it.

How sad it is to be a woman!
Nothing on earth is held so cheap.
Boys stand leaning at the door
Like Gods fallen out of heaven.
Their hearts brave the Four Oceans,
The wind and dust of a thousand miles.
No-one is glad when a girl is born:
By her the family sets no store.

Fu Hsuan

While the incidents of the ‘settlement of accounts’ and the ‘distribution of the fruits’ unfolded like the intricate plot of some day-long Chinese opera, another struggle began whose object was the liberation of women from the oppression of their husbands and from domestic seclusion.

A few poor peasant women in Long Bow, the wives of leading revolutionary cadres, early organized a Women’s Association where brave wives and daughters-in-law could voice their own bitterness against the traitors, encourage their poor sisters to do likewise, and thus eventually bring to the village-wide gatherings the strength of ‘half of China’, as the more enlightened women, very much in earnest, liked to call themselves.

But the women found as they organized among themselves, attended meetings and entered into public life, that they met more and more opposition from the men, particularly from the men of their own households. Family heads, having paid sound grain for their women, regarded them as their private property, expected them to work hard, bear children, serve their fathers, husbands and mothers-in-law, and speak only when spoken to. Many young wives who insisted on going to meetings were badly beaten up when they got home.

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Among those who were beaten was poor peasant Man-ts’ang’s wife. When she came home from a Women’s Association meeting, her husband beat her as a matter of course, shouting, “I’ll teach you to stay home. I’ll mend your rascal ways.” But Man-ts’ang’s wife surprised her lord and master. She went the very next day to the secretary of the Women’s Association, militiaman Ta-hung’s wife, and registered a complaint against her husband. After discussion with the members of the executive committee, the secretary called a meeting of the women of the whole village. At least a third, perhaps even half of them, showed up. In front of this unprecedented gathering of determined women a demand was made that Man-ts’ang explain his actions. Man-ts’ang, arrogant and unbowed, readily complied. He said that he beat his wife because she went to meetings and “the only reason women go to meetings is to gain a free hand for flirtation and seduction”.

This remark aroused a furious protest from the women assembled before him. Words soon led to deeds. They rushed at him from all sides, knocked him down, pulled his hair and pummelled him until he could no longer breathe.

“Beat her, will you? Beat her, and slander us all, will you? Maybe this will teach you.”

“Stop, I’ll never beat her again,” gasped the panic-stricken husband.

They stopped, let him up, and sent him home with a warning.

From that day onward Man-ts’ang never dared beat his wife, and from that day onwards his wife became known to the whole village by her maiden name, Ch’eng Ai-lien, instead of simply by the title of Man-ts’ang’s wife, as had been the custom since time began.


[Now please turn over.]
There are no definite right or wrong answers to these questions. Please write as much as you like - use the back of this sheet, and another piece of paper if necessary. We are interested in your ideas.

1. What is this extract about? Imagine you were going to describe it to a friend who hadn't read it. What would you say?

2. Did you notice any specific examples of how women's lives were limited in the time before the Revolution? Turn back to the extract, if you like, then list the ones you can find.
3. Hinton wasn’t in Long Bow at the time these events took place. Who do you think might have told him about them?

4. Why does Hinton tell the story of Ch’eng Ai-lien and Man-ts’ang?

5. Would you expect things to change for other women in Long Bow village, after the incident described here? If so, how and why? If not, why not?

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6. Do you think Hinton is taking sides? (Turn back to get examples to back up your answer.)

7. Did you find any of these questions difficult to answer? If so, it would be helpful to have your comments.
The following extract comes from a book by the historian David Garrioch on local communities in eighteenth century Paris.

Please read the extract first. Then turn over to answer the questions about it.

People’s quest for the esteem and recognition of those around them meant that they needed the rest of the community.. [but it also] pushed them into competition with others, forcing them to defend their position strongly and to combat the pretensions of those around them.. The admittedly numerous quarrels [did not] divide or weaken the local community. On the contrary, they served to strengthen it further, for people’s behaviour followed clear patterns and rules which permitted the expression and resolution of grievances with the minimum of damage both to them and to the group. We must, in order to see how this happened, turn to the form of disputes and look at the way they were conducted, at the weapons used, and at the reaction of the rest of the community to them.

A typical example of the disputes recorded in the papers of the commissaires took place in the rue Tiquetonne near the market, between the wife of a public writer and a pawnbroker from whom she had borrowed money. Seeing her in the street he had greeted her and stopped to talk. After a brief chat about his recent absence from Paris and his return, she said that she would like to reclaim the things she had pawned. They had been sold long ago, he replied. Well, he would have to get them back. ‘Old tarts like her,’ he retorted, ‘can go to hell.’ She should have reclaimed them before. But this had not been possible, she retaliated, during the two years he had been in the Bicêtre prison. This was too much: she had dared to insult him. ‘He had women at her place whenever he wanted... she had been in the hospital [where prostitutes were imprisoned] ten times, she was known for it, if her husband got what he deserved he would be in irons.’ At this she turned and walked off down the street with him following, keeping up a string of insults at the top of his voice. He put his clenched fist in front of her face, she pushed it away, he slapped her. At this point a soldier of the garde who was going past intervened to break up the dispute, and she went to the commissaire.

Each move in this dispute was staged for maximum effect. The voices were gradually raised, a signal for the passers-by to gather round. Their attention attracted, open insults broke out, many of them fixed expressions: ‘she had been in the hospital ten times’ is just one of a whole arsenal of standard phrases. Although not mentioned here, it is at this point that the parties usually begin to use the familiar

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(and in this context insulting) *tu* to each other. Her moving off down the street was both a sign of contempt and a measure of prudence, but it also provided the maximum audience possible and gave her the appearance of the innocent victim, pursued by the aggressor. Then there is the threat of violence as he shakes his fist under her nose, and pushing the fist away provides the actual physical contact which permits the escalation to the next stage, the slap. Each move is open, theatrical, carefully timed.

Nearly all reported disputes follow this pattern. There is maximum emphasis on noise and publicity: disputes occurred, with the sole exception of family quarrels, in the street or the market-place, in the courtyard or on the stairs of a house, in wineshops, but very rarely in rooms or workshops... A dispute was a public performance, noisy and animated. It contained a strong element of ritual and symbol... The aim in a dispute was not usually physically to punish or to injure one’s opponent so much as to force him or her to give way by drawing public attention to one’s grievance and if possible by publicly humiliating him or her... [The onlookers] were content to enjoy the performance but intervened to prevent serious injury. The public violence of disputes helped to preserve the community by channelling discontent and frustration into forms which the public could control with the minimum of damage to the individuals and to the group.

APPENDIX 3A: History exercises - Garrioch

QUESTIONS

Name  .....................

There are no definite right or wrong answers to these questions. Please write as much as you like - use the back of this sheet, and another piece of paper if necessary. We are interested in your ideas.

1. What is this extract about? Imagine you were going to describe it to a friend who hadn’t read it. What would you say?

2. Why does Garrioch describe street quarrels as theatrical?

3. What do you think would have happened if the soldier of the Garde had not intervened?

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4. Why does Garrioch tell the story of the woman and the pawnbroker?

5. Do you think Garrioch is taking sides? (Turn back to get examples to back up your answer.)

6. What can you find out from this extract about life in Paris in the eighteenth century?
APPENDIX 3A: History exercises - Garrioch

7. Did you find these questions difficult to answer? It would be helpful to have your comments on the questions and also on any points you could not understand in the extract itself.

...
The following pages provide the introductory instructions, texts and questions used in the Physics exercise.

In first semester, half the students were asked to do the Two Boats and Ball on Train problems, and the other half were asked to do the Box and Motorboat problems.

In second semester, all students were asked to tackle all four problems.
The following exercises are part of some research I am doing at the University of Melbourne. I need you to write your name, so I can ask some of you to talk to me later, but I shan’t be using anyone’s name when I write up the research.

There are two Physics problems for you to do. The two problems describe a situation and ask you to answer some questions about it. When you have answered the questions, could you please go on to explain what you have written? It may help to imagine that you are writing for another student who needs your help to understand the problem. If you need more room to write, please take another sheet of paper.

When you have finished the Physics problems, please turn to the sheet of coloured paper.

Thank you for your help.

Kate Patrick
Two boats are being pulled together in calm water. What would you need to know to calculate the point at which they will meet?
APPENDIX 3B: Physics exercises - Ball in Train problem

NAME..........................

A ball inside a train is rolled towards the back of the train.
It travels 2 metres along the floor in 3 seconds,
while the train travels forward at a constant speed of 10 metres/second.
Discuss the displacement of the ball in the 3 second interval of time.
Please state Newton's Third Law, and identify on the drawing the pairs of forces involved.
A motorboat with its engines running at a constant rate travels across a river from dock A to dock B in a straight line, as shown above. Compare the times taken for this journey when the river is flowing and when it is not. Fully explain your answer.
APPENDIX 3C: Sentence completion prompts (Australian History)

The following pages provide the sentence completion prompts as used in the History exercise, printed on yellow paper. Physics students completed a set of corresponding questions, printed on green paper.

Note that in first semester only the first three questions were asked.
APPENDIX 3C: Sentence completion prompts (Australian History)

YOUR YEAR 12 AUSTRALIAN HISTORY COURSE

Could you please complete the following sentences?

1. In our Australian History classes this year we usually ....

2. When I am studying Australian History I usually ...

3. In studying Australian History this year, what I want most is ...

(Term 4 only)

4. FINALLY: How would you describe what your Australian History course this year has been about? (It might help to imagine that you're telling a friend what your teacher has most wanted you to learn.)

Could you now please check back that you've answered all the questions and written your name on the top right hand corner of your paper?

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APPENDIX 3C: Sentence completion prompts (Australian History)

THANK YOU VERY MUCH
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