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ABSTRACT

The question of whether unemployed youths would benefit from different pedagogical techniques when learning numeracy skills was examined in a multifaceted qualitative study. Data were collected from the following activities: case studies in which a kit of everyday materials was used to stimulate discussion about numeracy practices with 30 selected young people; interviews of the young people and their teachers; and in-depth interviews with and observation of a subsample of 15 of the young people who represented a mix of males and females from rural and urban environments. Special attention was paid to the ways selected structuring categories (gender, location and social networks, cultural background, and ability/disability) constrain and/or enable the range of numeracy practices available to some young people. Also highlighted was the interplay between mathematical concepts and numeracy practices on the one hand and social practices on the other. Implications of the research for teachers and curriculum designers include building conceptual and implementation bridges between mathematics and their students' social use of math. (The document contains 79 references. Appended are the following: questionnaire for participants; teacher questionnaire; profile of the young people studied; consent form; and logging grid.) (MN)

Adult Literacy National Projects

Numeracy in Practice

Effective Pedagogy in Numeracy for Unemployed Young People

RESEARCH REPORT

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Introduction

The Numeracy in Practice project grew out of a triple interest. The first, a pedagogical interest, arose from a concern about how and what to teach the group of young unemployed people who formed an increasing proportion of adult numeracy classes. As teachers we are concerned with the professional training of numeracy teachers who work increasingly with these young unemployed people in a range of contexts. What sort of mathematics was relevant to the young unemployed, what sort of maths did they need in their everyday lives? How could they learn effectively? What strategies did numeracy teachers need to develop? We saw that many teachers who were skilled in teaching the more traditional students of Adult Basic Education had few resources to draw on in their interactions with this new population of students. There was frequently a disjunction between the culture of the classroom and the culture of the student, with little relevant literature to inform teachers' pedagogy.

The second interest, which grew out of our own teaching, was a commitment to the importance of research as a way of informing teaching, leading to the question of whether we could develop guidelines that would be useful for teachers to research numeracy practices in their own many and varied learning environments.

The third interest was a fascination from a theoretical perspective with the concept of mathematics as practice , or numeracy practices, a concept parallel to the more theoretically developed and researched idea of literacy practices. Some research had been done on numeracy practices in the workplace (cf Scribner 1984, Lave 1988, Nunes, Schliemann & Carraher 1993), but very little on the numeracy necessary for effective participation in structures and activities related to community and organisations beyond the workplace. We were interested in practice, not just as 'what people do', but in how this doing is in fact shaped and constrained by broader social structures, such as gender and location.

In our research, we draw on a notion of practice developed by Connell (1987), who describes it as 'what people do by way of constituting the social relations they live in, 'seeing human action as involving free invention within structural constraints ("invention within limits", to use Bourdieu's phrase)' (ibid p95). Such a position presupposes both the person as agent, and the formative role of structure in shaping and constraining possible agency. Practice in this sense is specific, historical and constrained by structure. Connell argues that to describe the constraints of the particular situation to which the active individual responds is to describe structure:

> ...structure is more than another term for 'pattern' and refers to the intractability of the social world. It reflects the experience of being up against something, of limits on freedom; and also the experience of being able to operate by proxy, to produce results one's own capacities would not allow. (ibid p93)

To explore numeracy in this framework is to ask how numeracy practices are 'organised as a going concern' (ibid p62) and to investigate implications of this view for curriculum development. It is to work from the assumption that social structures are not given but historically constituted, an assumption that implies the possibility that different social interests and constraints may result in different organisations of the practice of numeracy. In Chapter 1 we explore further this notion of numeracy practices, relating it to both the literature on mathematics as practice, and to the intersecting research on literacy practices.

Our question thus combined pedagogical and theoretical interests. We assumed that young people work to make sense of their worlds, including the world as it intersects with mathematics, and that they bring significant skills and experience to the numeracy learning situation. We wanted to explore how numeracy practices are 'organised as a going concern' with young unemployed people in both urban and more rural sites, to tease out particular instances of how different social interests might result in different practices, and to help teachers use the awareness gained to value but also to extend the practices that students have already 'invented' within the structural limits that constrain their choices.

As we began to collect our data, talking to young unemployed people and some of their teachers, and reading the related literature, it became clear that the very category 'young unemployed' was itself highly problematic. Chapter 2 takes up this issue in its portrayal of the social and economic background of the study. 'Young' was clearly the result of a fairly arbitrary decision, but 'unemployed' was also a much more problematic category than we had anticipated and it quickly became clear just how the category was socially, politically and economically constructed. The research exploded the notion of a singular 'unemployed young person'. We started to see 'unemployment' as something more diverse and fluctuating with many of the young people interviewed swinging backwards and forwards between the categories of 'unemployed' and 'low-waged' within short periods of time. Clearly there is much overlap with those of 'low paid workers' and 'casual workers' in the context of a pervasive trend towards the casualization of work. In terms of numeracy practices, the categories had much in common, but we still wanted to ask how similar constraints shaped responses in different ways.

The methodology of the study, addressed in Chapter 3, was qualitative, and multi-faceted, developing out of work done in both mathematics and literacy. Most of our data was gained from case studies, using a kit of everyday materials to stimulate discussion about numeracy practices with thirty selected young people. We also interviewed both the young people and their teachers, and we made some use of journals. From the interviews that we conducted, we focussed particularly on fifteen in our analysis: these include urban and more rural dwellers, men and women, and range in age from 14 to 26. In the analysis of the data we logged numeracy practices from the transcribed discussions and interviews on a grid that cross-classified certain structuring categories against what we called 'sites' of everyday practice.

Chapters 4, 5 and 6 report on the findings, each from a different starting point. The direction of Chapters 4 and 5 is to move from the social into the mathematical; by contrast in Chapter 6 we proceed from mathematical concepts into their social embedding and realization. We start our analysis of the data by considering the impact of social practices more broadly on the numeracy practices of those we interviewed. We have pointed earlier to the complex interplay of structure and agency, the way in which structures constrain and shape action and the 'play' available to social agents within these constraints.

In Chapter 4, we look at how some of the structuring categories which emerged as relevant to our research can be seen to constrain and enable the range of numeracy practices available to some of the young people. The structuring categories we focus on are: gender, location and social networks, cultural background, and dis/ability.

In Chapter 5, we focus on some examples of sites of everyday numeracy practice - in this case, managing money, negotiating transport, and interacting with bureaucracies - to tease out a variety of practices involving mathematics.

In Chapter 6 our beginning point is mathematical rather than social. Focussing on particular mathematical activities, namely, counting and calculating, using fractions, and measuring, we analyse the data in order to trace the use and conceptual understanding of each one through a range of everyday social practices.

The final two chapters deal with the implications of this research for teachers. In Chapter 7 we discuss the implications for teachers interested in researching the numeracy practices of their students, and suggest some guidelines for doing so. In Chapter 8, we draw out some implications for curriculum design and implementation in numeracy teaching.

Chapter 1 Theoretical frameworks: The concept of Numeracy as social practice

Defining Numeracy

The notion of numeracy informing this project involves a conceptual understanding of and ability to use mathematical knowledge in the varied demands of the personal and work arenas rather than rote knowledge often without a conceptual basis and which is divorced from everyday life. This notion is synonymous with the alternative social practice account of mathematics which will be elaborated in this Chapter. Throughout Chapter 1 the terms numeracy and mathematics are used interchangeably.

A Research Framework

This chapter analyses some of the research which provides the conceptual basis for how we understand Mathematics or Numeracy in this Project, *Numeracy in practice*. It does this through an analysis of research studies which focus on the nature of mathematical activity in a range of every day contexts. Some of the studies reported are educational: Education and related pedagogical questions. Others, drawn from disciplines such as Psychology, deal with questions about the nature of cognition and transfer of learning across contexts. All the studies contribute to an understanding of the notion of Numeracy or Mathematics as a social practice and indicate methods which may be used to investigate the mathematical practices of particular groups. The literature examined is drawn mainly from studies in North America, South America and the United Kingdom.

In particular this chapter:

- describes the role, beliefs and attitudes about Mathematics prevalent in contemporary western societies, and some apparent contradictions inherent in those beliefs
- presents an overview of research which challenges the dominant understanding of Mathematics and in so doing contributes to a theorising of mathematics as social practice
- reports in detail on the methodology and key findings of selected studies, which illustrate the socially constructed nature of mathematical activities
- examines similarities between the notion of social practice as used in a mathematics context with the notion of literacy as social practice, commenting on parallels which may provide insight into adult literacy or numeracy pedagogy and finally

- summarises the key concepts and research methods derived from these studies which have provided the theoretical framework for our present project.

Social status of Mathematics

Two characteristics of the public face of mathematics appear to stand in conflict with each other The first concerns its status in our society. The discipline of mathematics occupies a powerful and privileged place in the hierarchy of valued knowledge and it is assumed that all citizens need a minimal amount of mathematical knowledge and skills to participate adequately in society. There is extensive literature which deals with the nature of mathematics and implications for curricula across all levels of education. Most of this literature is based on an understanding of mathematics as consisting of an accepted canon of concepts, skills and procedures, universally recognised and generalizable, and which once taught can be applied in any context. This dominant 'common sense' view of mathematics has been referred to as an **autonomous model of numeracy** which means that a clearly identifiable body of mathematical concepts and procedures can be taught and then employed across contexts and cultures - abstracted, context and value free (Baker & Street, 1994). Within this view the role of mathematics is often referred to as a 'set of tools for life'

The second and probably equally uncontested characteristic is the alienation that significant sections of the adult community experience in relation to mathematics practice derived from school- many people believing they were failures then and claiming to have little engagement with mathematics in their adult lives. Themes such as maths anxiety (Burton 1990) or gender inequalities in participation in mathematically related activities in our western societies, (Willis 1989) bear testimony to this second experience. One writer succinctly encapsulates these contradictions thus,

> No modern society can exist without mathematics, but the overwhelming majority of people in a modern society can and do live quite well while doing hardly any mathematics' (Chevallard, 1989)

Towards a theorising of Mathematics as a social practice

The issue of the apparent dichotomy or discontinuities between school and out-of-school mathematics and the apparent failure of the school curricula to produce 'mathematically literate' citizens has prompted government and educational authorities and researchers to investigate the causes of such failure.(Crowther Report UK 1959; Cockcroft Report UK 1982; Willis 1990; Harris 1991; Nunes et al 1993). Researchers working in other disciplines (eg, psychology, anthropology, social theory) and with different research motivations have also been able to offer plausible accounts as to why such dichotomies and contradictions may exist (Scribner 1984;

Lave 1988; Baker and Street 1994; Baker 1995).

Questions which have driven much of the research include: why does such widespread emotional disenchantment with school maths exist; why has the back to basics movement apparently failed to provide 'basic skills'; why do people not recognise the mathematics activities of their daily lives for what they are - ie mathematics; why do people who have supposedly failed or not even been exposed to school maths demonstrate considerable mathematical skill employing different procedures to the schooled algorithms; why do people employ different procedures or techniques on the same maths concept in different situations? Some of the research has been driven by broader questions to do with transfer of learning across contexts or about the very nature of cognition, with the subject of the study being the discipline of Mathematics.

Many of these studies examine how people use mathematics in a range of everyday activities, in and out of work situations - from factory workers, self employed artisans, domestic shoppers, cooks, to street child vendors.

From these different sources an alternative view of the nature of mathematical activity has emerged - one which challenges the immutable, decontextualised and supposedly universally accepted body of knowledge and procedures referred to above as the autonomous model of mathematics. Harris (1991) argues that these studies demonstrate that the mathematical content and techniques employed by individuals varies according to the problem situation and that people dealing with the same maths concepts generate different mathematical realizations depending on the purpose and context in which the maths activity takes place. This alternative understanding that the generation of mathematical problems, skills and procedures is in some way determined by contextual factors other than purely mathematical is variously known as cultural, ideological, contextualized mathematics or mathematics as a social practice. It is this latter term which is used throughout this Report.

The notion of **Practice** is used in a range of academic domains to grapple with the complexity of relationships between the personal and social in human endeavours. As noted in the Introduction the concept is not simply about examining what people do but how the 'doing is shaped by broader social structures' (see Introduction for an elaboration of the theoretical concept of Practice)

In various branches of Psychology the term is used to explore questions about the nature of intellectual activity and the relationship between cognitive processes and the socio-cultural contexts in which the learning takes place. Terms such as 'cognition-in-practice theorists', a 'theory of practice' (Lave, 1988) denote this interest in the broad role of culture and specific social activity in shaping skill formation. For one psychologist, whose work is outstanding in this area, the concept of practice

> offer (s) a possibility for integrating socio-cultural and psychological levels of analysis and achieve(s) explanatory accounts of how basic mental processes and structures become specialised and diversified through experience' (Scribner 1984:13)

In the context of education and learning theory, some researchers acknowledge the famous Russian psychologist of the 1930's, Vygotsky, whose work provided a basis for exploring the socially constructed nature of learning (Dowling in Harris 1991).

In discussion of mathematics research, teaching and learning, Harris explains that the term, **Practice** encapsulates the change of perspective from learning a decontextualized, discrete and universally applicable set of skills to the dependency of particular skills 'on the social organization of the activities in which they (are) practiced' (1991: 203).

Baker (1995) a contemporary mathematician in Education, elaborates on what is meant by a social practice account of mathematical activity with a personal anecdote. A local community needed to build a sandpit and the mathematical problem was how to ensure that the hole was square. There were 2 competing choices of strategy for solving the problem- one, proposed by a professional mathematician and agreed to by the community was to use a protractor and set square to ensure correct size of angles - the other proposed by the builder was to measure the diagonals. Baker suggests that a number of non mathematical factors were brought into play in the decision to choose one or other of the strategies - for example the community's beliefs about what constituted 'legitimate maths', (formalized protractor method versus practical measuring) and values to do with social relationships and status of the individuals involved, (mathematician versus builder). Baker cites this incident as an example of mathematics as a social practice by which he means that the practice of mathematics around any given concept will not invariably follow the same procedures but will vary according to the particular purpose and context in which the problem is set, the beliefs that individuals hold about true maths, and the power relations amongst the participants involved in the problem (Baker 1995). He further identifies the different nature of some of those values - they might be performance driven, personal/social or mathematical. In the sandpit building problem the builder was influenced by practical mathematical values, while the community was influenced more by social ones.

Dowling (1991), in reviewing the literature on the emerging theorising of mathematics as a social practice has identified three phases, since the early 1970's, which he refers to as Utilitarian, Mathematical Anthropology and Cognition in Practice.

The first phase, Utilitarian, was marked by the research of the Cockcroft Report,(UK 1982) which defined numeracy as, 'at homeness with numbers'. This group of researchers attempted to identify the mathematics required in everyday and work contexts with a view to making school curricula more relevant. However, although the objective was to give people tools for everyday mathematics, school type abstracted algorithms were used as the yardstick for measuring the everyday maths activity. This unwittingly contributed to the pathologising of the everyday and indeed to pathologising the people who could not recognise the 'essential' maths in their everyday activity. According to Dowling's analysis this functional approach to contextualizing mathematics merely highlighted the discontinuities between academic and practical mathematics.

The second phase of research, **Mathematical Anthropology**, was associated with a group of researchers who conducted studies of the mathematical practices of other societies. This work has provided a broader perspective on the culturally different structures, functions and values attached to mathematical practices in societies other than western ones. Such studies for example have documented differences in the language and structures of counting systems or the different spatial relations observed in geometric designs/art across cultures. These studies record differences across cultures but in the main do not pursue the question of if or how such differences are implicated with other social activities of the communities. Whether looking for the maths in local or far afield situations Dowling argues that both Utilitarians and Mathematical Anthropologists reduce or perhaps gloss over the rich complexity of situationally specific activity by trying to describe it in abstract generalized mathematical formulae.

The third phase, **Cognition in Practice**, Dowling identifies as neo-Vygotskian in theoretical orientation. Broadly this approach is concerned with the nature of intellectual activity, the relationship between cognitive processes and the socio cultural context in which they operate. While their work has been conducted in many different cultural contexts these researchers are not concerned with cross cultural comparisons of mathematical activity. Rather their 'sites' are the everyday situations in which people engage in intellectual activity and their objective is to investigate the nature of these cognitive processes in practical situations. As noted earlier much of the work associated with this third group has been concerned with questions beyond mathematics curricula or pedagogy. Mathematics has been a favoured medium of intellectual activity to analyse because its relatively clearly defined language and structures can be observed both in and outside laboratory settings.

Although not concerned primarily with mathematics curricula or pedagogy the work of this group has provided a very rich basis for the development of a social practice approach to numeracy pedagogy. The three studies to be examined in the next section could be categorised in this third group of Cognition-in-Practice theorists. All have made a significant contribution towards establishing the research basis for describing Mathematical activity as socially constructed.

Research studies of Mathematics as social practice

Each of the studies draws on quite diverse situations to provide compelling evidence for rethinking traditional notions of what constitutes mathematical activity and approaches to mathematics curricula and pedagogy. The **Scribner study (1984)**, motivated by questions of the relationship between culture and cognition, demonstrates that cognitive skills are shaped by and indeed develop out of wider social activities in which these skills are deployed, a finding in opposition to the notion that an individual's mental skills develop in the head and are then applied to situations requiring them.

The **Lave study** (1988), also motivated by concerns about the nature of cognition, illuminates the view of mathematical practice as multiple - ie, practices. Lave observed that in any given situation, the actual mathematical activity was but one of a number of ongoing activities carried out in pursuit of broader social purposes and that the nature of the mathematical problem and strategy for solution were very much shaped by these other activities. As with the Scribner study the work reported here is based on adults in a North American urban context.

The final study, **Nunes, Schliemann, Carraher** (1993), complements the other two in so far as it more directly addresses Numeracy pedagogy for children. The researchers identified three different kinds of maths activity; in-school, out-of-school and other everyday activities which contain maths, and the objective of their research was to analyse possible differences and to establish connections between them in the interests of improving numeracy pedagogy.

All three researchers share broadly similar **methodology** in which subjects were investigated in three situations. In one they were observed and interviewed about their everyday or work tasks which were subjected to rigorous cognitive analysis in relation to maths specific activities. Subjects were then usually requested to complete similar mathematics tasks in a simulated, more controlled situation and finally they carried out a number of school-type written algorithms and word based problems. Again tasks in the last situation involved the use of similar maths concepts to the everyday activities observed in the other two situations. In brief the researchers' interest was in comparing the nature of mathematical activity across the different contexts - what contextual factors are brought to bear on the generation of mathematical problems and selected strategies for solving them? Methods used in our Project, *Numeracy in Practice*, have focussed on gathering data from the first of these situations, namely some everyday tasks of the young people.

All focus on arithmetical aspects of mathematics, a feature which Harris (1991) laments as she claims that such a narrow focus distorts the breadth and scope of mathematics. This criticism underlines the need for further research into the role of other aspects of mathematics in everyday life. All three studies indirectly acknowledge the political power associated with achievement in formal mathematics and share an egalitarian concern to challenge inequalities based on it.

The Scribner study (1984)

The Scribner study (Rogoff & Lave 1984) was conducted in an urban industrial setting - a milk processing plant, which required a range of blue and white collar jobs, such as machine production, warehouse distribution, clerical and computer operations. Four common blue collar tasks were selected for cognitive analysis:

i) product assembly - performed by pre loaders
ii) counting product arrays - performed by inventory people
iii) pricing delivery tickets
iv) using a computer form to represent numbers - both performed by wholesale drivers.

All tasks involved operations with written symbols and numbers.

Clerks from the office section of the plant and students from a nearby highschool were used as comparison groups.

The objective was to describe skilled performance on each job and identify its systematic characteristics with a view to understanding more clearly the development and deployment of cognitive skills. Here it is sufficient to report on only one of the task analyses- the pre-loader's job - to illustrate the context specific nature of mathematics procedures in contrast to the autonomous canon of skills and procedures.

The pre-loaders were classified as unskilled and were the lowest paid workers at the plant. Their task was to make up orders for delivery drivers. This involved collecting and reading the 'load out order forms' generated by the plant computer and then gathering and transporting the required quantity of product to a common assembly area. Drivers placed their orders in quantities of units required - eg x half pints of milk, y quarts of skim milk etc. However the plant did not operate in units but rather in standard case sizes and the number of units each held varied according to the unit container (ie, one case equals 4 gallons, 8 half gallons, 16 quarts, 32 pints, etc). The computer generated the information for the preloader in case lots or when it was not a round case load that was required, then in mixed case and unit quantities. It was expressed as x cases plus (+) if the left over amount was half a case or less and Y cases minus (-) if the left over amount was more than half a case. For example a 'load-out order form' showing 1+3 quarts (16 quarts per case) meant 19 quarts or 2- 5 quarts meant 27 quarts.

Obviously there were a number of arithmetical calculations required in this task and questions of interest to the researcher included: how did the pre-loaders manage mixed numbers; did they follow instructions literally, adding or subtracting units as instructed or did they find alternative solutions; if the latter what were they and what circumstances dictated choice of strategy; what strategies did the comparison (novice) groups use compared to the experts (pre-loaders)?

Rigorous analysis of the tasks led Scribner to a number of conclusions relevant to an understanding of mathematics activity as highly contextualized, variously requiring different sets of skills depending on circumstances rather than a single solution approach to each problem. The literal solution strategy for these pre-loaders was to either add or subtract units from cases as instructed to make up the required order. For example if the order was 1- 3 then the literal solution required the pre-loader to take 1 whole case and take away 3 of its unit containers. However Scribner found that pre-loaders used a large repertoire of solution strategies, not simply literal addition or subtraction of units from cases as instructed. Non-literal solutions involved transformation of problems (more mental effort than simple execution of literal solutions) as well as the saving of physical effort in what appeared to be on the surface unskilled and repetitive work.

> For example if an order is 1- 6(10) quarts and the preloader has the option of using a full case and removing 6 quarts (the literal strategy) or using a case with 2 quarts already in it and adding 8, the literal strategy is optimal from the point of view of physical effort: it saves 2 moves. If the partial case, however has 8 quarts and only 2 quarts must be added, filling the order as 8+2 is the least physical-effort solution (the saving is 4 quarts)' (Scribner 1984: 21-22).

Of particular interest was the finding that the solution strategies of the comparison groups (office workers and school students) were largely literal, showing little tendency to adapt the strategies to the properties of the problem at hand. The school students in particular were single solution problem solvers and although accurate were inefficient in choice of mode of solution. On the other hand pre-loaders were observed carrying out a recurring order for 1-6 (quarts) in 6 different ways, all guided by the time and energy efficiency principle but only on two occasions following the literal order. When these tasks were transferred to a simulated setting the pre-loaders still out performed the more 'highly skilled office workers' and students who were well versed in formalized school mathematics. These findings led Scribner to hypothesise that:

> skilled practical thinking is goal-directed and varies adaptively with the changing properties of problems and changing conditions in the task environment. In this respect, practical thinking contrasts with the kind of academic thinking exemplified in the use of a single algorithm to solve all problems of a given type (Scribner 1984: 39).

The single algorithm solution strategy, characteristic of the autonomous model and valued for its generalizability is clearly challenged by Scribner's work.

Lave (1988)

Lave's broad question of whether the nature or development of cognitive skills can be divorced from the particular kinds of contexts which give rise to them was investigated through detailed analysis of the arithmetic practices in selected everyday activities, namely shopping in the supermarket, and weight watchers measurement practices in cooking (Lave, 1988). She asks questions of more immediate interest for pedagogy than does the Scribner work, namely how is arithmetic used in each of these situations, does it play a major or minor role in the ongoing activity, what procedural differences in performance are there between these contexts and school mathematics?

Findings from one study - the shopping one will suffice to further illustrate the context specific nature of cognitive skill development in mathematics. Of relevance to educationalists was firstly the marked discontinuities in performance, errors and procedures noted between the supermarket and test arithmetic activities despite the fact that the arithmetic problems were formally similar and the people solving them the same. The subjects or JPF's as Lave calls them(just plain folks) were so unexpectedly accurate in the supermarket arithmetic that Lave suggests there may be qualitative differences in those arithmetic procedures compared to those in the test situation. She does not pursue why there may be such differences, merely commenting that the JPF's were experienced shoppers and may be they had forgotten school maths and so may not have considered school taught algorithms as method of choice. Possible reasons for such qualitative differences is elaborated in Nunes et al (1993) study below.

The value of her work for an understanding of mathematics as social practice, lies in the demonstration of just how contextualized is the nature of mathematical activity. She claims that in the description of everyday practices it is often difficult to detect conventional, scholastic problem solving activity. She agrees with Dowling that 'essential' or pure maths activity does not exist in real life situations - rarely do mathematical problems present themselves as discrete tasks. Two key terms which characterise her analysis of what is happening when people use mathematics to achieve social purposes are, 'structuring resources' and 'generation'. 'Structuring resources', which should not be confused with Connell's broader notion of social structuring, refers to the idea of multiple ongoing activities within the one situation. For example in the activity of going shopping a number of other activities may occur simultaneously - eg, arithmetical calculations, reading, planning menus, estimating food consumption etc. None of these 'structuring resources' occurs 'purely,' in isolation and each influences the shape of the others. It is the interplay of these various activities which 'generates' or creates the arithmetic problem and particular solution strategies. To illustrate her central finding of the situated specificity of procedures and solutions, Lave cites the following example of two maths problems both of which might have 9 for an answer.

The first is a school type word problem along the lines of; if 'A' has 4 apples and 'B' has 5 how many apples altogether? The real life problem, with alternative answers looked as follows:

> Shopper standing in front of the display counter, putting apples into a bag one at a time saying ... there's only 3 or 4 apples at home and I have 4 kids, so you figure at least 2 apiece for the next 3 days. These are the kinds of things I have to resupply. I have only a certain amount of storage space in the refrigerator, so I cant load it up totally ... Now that I'm home in summertime, this is a good snack food. And I like an apple sometimes at lunchtime when I come home. (Murtaugh 1985 b:188 in Lave 1988:2)

Lave reports that this same shopper's performance on the formal school algorithms bore little resemblance to the kinds of problems or procedures for solution presented in this supermarket situation. She goes on to say that in the supermarket situation,

> it appears that the problem was defined by the answer at the same time an answer developed during the problem and that both took form in action in a particular culturally structured setting. (Lave 1988: 2)

In other words the shoppers continually generated and regenerated the mathematical problems, depending on the ebb and flow of other activities going on. At times they consciously chose school type single algorithm solutions but at other times they invented quantitative units and alternative strategies. In Lave's words,

> All of the studies showed discontinuities in problem solving processes between situations and the uncoupling of maths performance from schooling except during tests (op cit, 68).

As with Scribner, the picture of the nature of mathematical activity emerging from Lave's work challenges the universalist, generalizable single solution approach of the autonomous model of mathematics. Instead variation in use of procedures is related to the situations in which they take place; there is a situational specificity about maths activity in which the relations among the persons involved, their different purposes in the activities, and other contextual factors are all implicated in the working out of the mathematics

Nunes et al (1993)

Over a period of 10 years a team of researchers from Brazil investigated the mathematical practices of children both in-school and out-of-school and adults working in a range of occupations. Their starting premise identified three 'types' of maths activity,

> the one constructed by children outside school, the one embedded in everyday cultural practices and the one that school aims to teach in the classroom (Nunes et al 1993: 5)

and they described the

> maths used in-school and out-of-school as different cultural practices that are based upon the same mathematical principles (Nunes et al 1993, frontispiece)

Their central questions focussed on how the two forms of mathematical knowledge were similar to and different from each other and how could an understanding of these differences help educationalists to bridge the gap or overcome the apparent 'wastage' that goes on in formal school mathematics. The researchers quoted figures that claimed disturbing failure rates in school type maths and yet it was these same kids who could use street maths successfully (Nunes et al, 1993).

The researchers do caution that to use the terms, 'in-school and 'out-of- school' is rather simplistic but suggest that such 'false dichotomies are a necessary evil (Carraher in Harris 1991: 170). They argue these terms capture a great deal of what characterises the single solution, generalizable written algorithm approach of school mathematics compared to the context driven, often oral, multi-strategy approach characteristic of many practical everyday, or work situations, where the mathematics may play either a major or minor role in accomplishing the task to hand.

From a number of separate studies Nunes et al (1993), report that self discovery, invented methods, and the ability to develop complex mathematical concepts and abstractions does occur in both schooled and unschooled children and adults. These studies include proportionality with fishermen, builders and farmers, the mathematics of buying and selling of candy sellers, area and length with farmers, and probability with bookies.

Only two studies are reported here in support of a social practice account of mathematical activity - one the documentation of five street sellers' money transactions and the other a formal study of the out-of-school problem solving strategies of sixteen third graders, under more controlled conditions. The methodology was similar to the Scribner and Lave studies with one distinguishing feature, namely that all problems were presented orally with children having the choice of answering orally or with pen and paper

Broadly the results about performance, errors, and procedures replicate those of Lave, in so far as success rates were highest in the real life problems (street exchanges and simulated shop situation) and lowest in the test like computation problems. Similarly they noted that the discrepancies in the error rate was both across the 3 situations and within individuals. For example in the first study of street sellers the same children scored 98% in the street situation but only 36% in the arithmetic calculation,(the 3rd graders' results while not as marked showed the same pattern of difference) despite the fact that both situations required the same mathematical knowledge. However Nunes et al made another interesting observation which propelled them to further analyses of the children's protocols.

They observed that the out-of-school tasks were accomplished orally, while the school like problems (word problems and straight computations without reference to objects) were done using written algorithms. Detailed comparative analyses of the protocols of the children's procedures when they used oral and written modes of solution led to the hypothesis that two characteristics of the children's organization or structuring of the procedures when working orally accounted for the high success rate compared with the written mode. These were firstly, when working orally the children moved from the larger units to smaller ones and secondly they preserved the relative value of the numbers they were dealing with. For example:

Experimenter:	what is two hundred and fifty two minus fifty seven?
Ch:	take away fifty -two, that's two hundred, and five to take away, that's one hundred and ninety -five (Carraher in Harris, 1991:176)

In contrast when using the written mode they worked from the smaller unit to larger, ie right to left (with the potential for magnifying the margin of error) and maintenance of the relative value of the numbers was signified only through position, ie,

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The researchers argued persuasively that the behaviours associated with their oral procedures helped the children to maintain links with the meaning of what they were doing, whereas these links were not visible in the written form. They suggest that the difficulties experienced in school maths is

> related to the deployment and meaning of particular procedures and representations... rather than to the fundamental arithmetical logic of {in this instance}addition and subtraction'
> (Nunes et al, op cit 183)

In other words they claim that abstracting procedures from the problem situation to which they relate and losing touch with comprehensible units caused the high error with the children.

Nunes et al go on to substantiate that these claims of differences between street and school maths, hold true across a range of everyday mathematical activities carried out by adults as well as children. Through studies with other students, fishermen, farmers, carpenters, bookies, candy sellers they persuasively put the case for the two forms of practice as;

> different cultural practices, [in which there is] a trade off between preservation of meaning (in the street maths) and potential for generalization (school maths) in mathematical knowledge

(Nunes et al 1993: frontispiece)

These researchers do not want to pose an either /or approach to street or school maths but like other researchers they distinguish between conceptual and procedural knowledge and stress the importance of developing conceptual knowledge as a basis for truly 'numerate' behaviour as Johnston describes it (Johnston, 1994). The pedagogical implications of these findings about the nature and reasons for differences in performance between street and school mathematics are followed up in Chapter 7 of this report.

In summary the concept of Mathematics to emerge from these studies is one of multiple practices, shaped in part by the broader social activities of which they are a part rather than one of an immutable, discrete set of mathematical concepts and skills. The concept of social practice refers to the fact that choice of particular mathematical procedures to solve a mathematical dilemma in any given situation is influenced by other social cultural factors in the immediate and broader context. These factors include; purpose-ie whether the maths plays a major or minor role in the activity, the roles and relationships between participants and their views about maths and other values (Baker 1995). In other words, the choice of particular procedures or skills for solving problems of a similar kind is not immutably fixed but as Lave said in reference to the arithmetical activity of her shoppers that,

> the math appears to have a generative relation with the on-going activities and at the same time to be shaped by them (Lave 1988: 68)

Parallels with literacy as a social practice

Obviously there are levels at which literacy and numeracy as conceptual entities are not parallel. The recognised subject of mathematics (basic arithmetical calculations, geometry, algebra, etc) is a subset of language in so far as the mathematical ideas are largely communicated via the medium of language. However the theorising about the nature of mathematical activity as social practice can be parallelled and indeed to a considerable extent has been preceded by extensive research in language studies which has similarly demonstrated the socially constructed context specific nature of literacy skills - ie the user's choice of particular language structures and employment of literacy skills (cf mathematical procedures) is influenced by other non linguistic factors in the specific and broader cultural contexts in which the language is being used.

The terms autonomous and ideological (sometimes referred to as cultural) were used by Street (1984) in tracing the paradigm shift from the traditional concept of literacy as a set of static, decontextualised skills, to the socio-cultural approach to literacy studies. It has only been more recently that the terms have been applied in parallel fashion to the changing conceptions of

Mathematical practice (Baker & Street 1994).

Studies within and across a range of disciplines (linguistics, sociolinguistics, anthropology, social psychology, education) have contributed to a new understanding of literacy which

> stresses the sorts of social practices in which reading and writing (and talking) are embedded and out of which they develop rather than the private cognitive 'skills' of individuals (Gee 1990:49)

The growing body of literature on the politics of literacy (which traces the ways in which achievement in certain valued forms of literacy is used to maintain power relations in our society) is also predicated on an understanding of literacy as socially constructed. We will now briefly examine two of those studies which show quite striking parallels with the Mathematics research reported above - similarities in purpose, research method and findings about the processes of literacy development. Such similarities point to shared understandings about the pedagogical implications for literacy and numeracy education.

One of the leading researchers on mathematical practice, the social psychologist, Scribner has already been referred to (Scribner, 1984). In their seminal work, *The Psychology of Literacy* Scribner & Cole (1981) set out to investigate the cognitive effects of literacy, motivated by the ongoing debate as to the supposedly higher cognitive abilities accrued through development of literacy skills per se. Working with the Vai people of Liberia, where three scripts are used, English, Vai and Arabic, they tested this assumption by attempting to identify the cognitive skills associated with the uses of the three different literacies. In brief their findings challenged the long held belief of generalised cognitive abilities resulting from literacy training per se. Of particular interest to our comparison of notions of literacy and numeracy as social practices, was their finding that each literacy was associated with quite specific skills, not all of which were evident in the practice of the other literacies. In other words the broader social purposes for using Vai or Arabic or English influenced the choice of skills employed in each instance. As they did in the Mathematics study Scribner and Cole rejected the more discrete term 'skill' in favour of the more inclusive word 'practice' to

> highlight the culturally organised nature of significant literacy activities and their conceptual kinship to other culturally organised activities (Rogoff & Lave 1984:13)

and they were lead to what they called a 'practice account of literacy', to consider multiple sets of literacy practices and to,

> approach literacy as a set of socially organized practices...{and} The nature of these practices... will determine the kinds of skill (consequences) associated with literacy (Scribner & Cole 1981: 236)

In summary Scribner and Cole and others (Rogoff & Lave 1984) through empirical studies of some every day practices of both numeracy and literacy activity demonstrate the essentially 'socially situated' or context specific nature of these practices. While their work has contributed to the broader field of what Lave calls a **social anthropology of cognition** they have challenged the autonomous views of literacy and numeracy as each consisting of abstracted sets of skills, universally recognised and generalizable across contexts.

We will now report briefly on one other study, which, from a different perspective and using a different research methodology, offers further empirical evidence for a social practice account of literacy. Heath (1983) motivated by concern to account for differences in the apparent 'success and 'failure' in literacy achievement of children from different local communities when they proceeded to the 'mainstream school', undertook a longitudinal ethnographic study of the literacy activities of preschoolers from three local communities. The groups were; one middle-class mainstream and two working class groups - one black and one white. Lave's 'maths activity' embedded in other activities(eg, shopping) can be equated with Heath's 'literacy event' which occurs within other socialising activities or interactions between parents and children.

Rather than using the term, skill to describe the cognitive processes involved in the children's literacy activity Heath used the phrase 'different ways of taking meaning' to encapsulate the cultural origins of the distinctly different behaviours or cognitive skill development of these groups of children. Again this echoes the search of the other researchers to find a more meaningful way to express the 'quintessentially social' nature of the cognitive activity occurring (Lave 1988: 177)

From these two brief reports it should be clear that as Heath says;

> A unilinear model of development in the acquisition of language structures and uses cannot adequately account for culturally diverse ways of acquiring knowledge or developing cognitive styles.

and that

> Literacy events must... be interpreted in relation to the larger socio-cultural patterns which they may exemplify or reflect (Heath in Street 1984:125)

Conclusion

The Scribner & Cole (1981) and Heath (1983), studies, seminal in their impact on the shift from an autonomous to socio-cultural theorising of literacy as a social practice highlight significant parallels in the reconceptualising of both numeracy and literacy. From their different research perspectives, disciplines and purposes both fields of research point to culturally relative and situationally specific multi-strategy practices, rather than canons of culture free decontextualised single discrete sets of skills .

It is this notion of practice applied to Mathematics that has guided the investigation of the numeracy practices of the young people in this study Our project has also employed a methodology similar to that of Scribner, Lave and Nunes et al - ie observation and interview of 30 young people about the numeracy practices in various aspects of their everyday lives. The next two chapters elaborate on the socio-economic context of this study and detail of the methodology used.

The General Economic Climate

Trends in unemployment

As Burgess (1994,103) points out, 'Profound and widespread workforce restructuring has taken place in nearly all OECD countries over the past two decades'. The experiences of the Australian workforce of such restructuring have been similar to those in other countries. A significant number of full-time jobs have been lost altogether or converted into casual and part-time ones by the decisions of private and public enterprise management. These decisions have affected the labour force profile across occupations, industries and whole sectors.

Between 1992 and 1995 the general rate of unemployment declined from 11.2% to 8.5%. Until the September quarter 1997, the trend was an increasing one, with 810000 people, or 8.8% of the workforce, unemployed. Between September 1996 and September 1997, there had been a fall of 40000 jobs. But the most recent quarter statistics, December 1997, indicate that there has been a fall in the rate to 8.1%. Given the economic crises in some of our major trading partners in the region, this may only be a temporary drop in the level of unemployment.

This average figure of 8.1% masks the high rates faced by particular age groups in the economy. Both older people and younger people have been faced with difficulties in either maintaining their job or in obtaining employment. Between 1970 and 1994, the proportion of 60-64 year-olds without a job rose from 30% to 65%, 55-59 year-olds rose from 12% to 40%, and 45-54 year-olds rose from 6% to 20% (SMH 13-6-97).

The long term unemployment rate has increased in the last twelve months from 27% to 32% of all unemployed. The age group that appears to be the most affected by long term unemployment is the 34-54 year-olds, with an average duration of unemployment of 73 weeks. The 20-24 year-olds and 15-19 year-olds have a duration of 39 weeks and 24 weeks respectively (SMH 4-8-97). However, the real situation of the intractability of young people's unemployment may be hidden by their movements into and out of the casualised labour market.

The 1991 Census data put the youth unemployment rate (as a percentage of the teenage workforce, not the teenage population) at 17.4%, by 1993 this was 18.3% (ABS Survey of Training and Education Experience (TEE) 1993), in June 1996 it was 19.4%0.

In 1995 (September) young people were 26.7% of all people unemployed, and by May 1996, this figure was 30.9% (SMH 10-5-96).

The 1991 Census data indicated that for youth born in Australia, the unemployment rate was 16.7%; for those born in a non-English speaking country it was 25.8%; for Aboriginal youth it was 42%; and for Torres Strait Islanders it was 29.3%.

Australia has been ranked ninth highest out of twenty nations in a UN Report on youth unemployment (SMH 24-7-97).

Underemployment

Of those in employment in 1995, the highest proportion employed part-time (28.4%) were the 15-24 year-old group (Junor et al, forthcoming). It appears that there is significant underemployment of the age group.

There are two forms of underemployment, the visible form which reflects an insufficient volume of paid work for those who seek it, and the invisible form which reflects underutilisation of skills and experience.

The first form describes involuntary part-time workers, and the most recent (June 1996) survey of involuntary part-time workers indicates that whilst the national average of involuntary part-timers is 6%, the youngest age groups (15-19 and 20-24 year olds) contribute 16% and 18% respectively of involuntary part-time workers. This means a total of 34% of all involuntary part-time workers were aged under 24 years.

In 1996 an average of 79% of unemployed persons are looking for full-time work, but of all unemployed 15-19 year olds, only 59% were registered with the CES, reflecting a relatively high proportion are looking for part-time work. It is interesting to note that 61% of 15-24 year olds left their last job involuntarily (ABS 1996, catalogue 6222.0).

Such underemployment must also be taken into account if we are building a profile of unemployment trends amongst young people.

Restructuring of work

Occupational restructuring

The six fastest shrinking occupational groups between 1986-87 and 1995-96 have been miscellaneous clerks, construction and mining labourers, metal fitting and machine tradespeople, machine operators, farmers and farm managers, stenographers and typists (SMH 20-6-97). Most of these are blue collar and lower-grade service jobs.

The seven fastest growing occupational groups in the same time period have been personal service workers, business professionals, medical and science technical officers and technicians, miscellaneous professionals, social professionals, data processing and business machine operators, and teachers and instructors (SMH 20-6-97). Most of these are professional grade and some lower-grade service jobs.

In terms of occupations, the majority of working class and lower middle class school leavers in the 1960s and 1970s obtained work as clerks (both females and males), tradespeople (mainly males) and stenographers and typists (mainly females). These occupations are rapidly declining, for example clerks decreased by 41.3% in that time (SMH 20-6-97). The fastest growing occupations do not utilise the same skills and, in the professional category especially, attract a more highly educated, mainly middle class group.

Industry restructuring

The industries which offered work to this same group of school leavers in the 1960s and 1970s were retail and banking/finance (both females and males) and manufacturing (mainly males). It has been the overall decline in the number of manufacturing businesses (due, in part, to tariff restructuring) which accounts for many job losses in that industry. In the banking/finance sector and in the retail sector, however, it has been employers' restructuring practices which accounts for most young peoples job losses. In the banking/finance industry, for example, employers have restructured in a way which utilises the competencies and life experiences of mature age women, mainly on a part-time and casual basis, to save on the costs of training up younger people for customer service work (Junor, Barlow and Patterson, 1993).

Any positive industry growth in recent times has been in sectors like communications, construction, agriculture and transport which are now highly capital-intensive (SMH 5-6-97). According to the NSW based Australian Business Chamber's policy manager, Mr Paul Orton, most investment spending taking place in the economy at present "means reducing rather than increasing jobs" (SMH 13-6-97).

Public sector restructuring

The number of federal public service jobs for young people has declined significantly. In 1985 the total number of public servants under 25 years was 28,609, but by 1994 this was 11,290, with NSW experiencing a 65% decrease, from 7,614 to 3,706 (SMH 4-10-95).

Categories of employment

The loss of jobs from many industries and occupational groupings is also related to the restructuring of full-time work into part-time and casual jobs. Many full-time jobs have been redesigned to enable the combination of new technology and part-time and casual work to maximise productivity.

Between 1980 and 1995, part-time jobs grew at an average annual rate of .7%, compared with 1.1% for full-time jobs (Junor et al, forthcoming).

Between 1995 and 1996, fifty percent of the new jobs created were part-time and casual. The number of part-time and casual positions grew by 16% in the three years to 1996, but many of those in these jobs would have preferred full-time employment (SMH 9-2-96).

The ABS categories of "employed" and "unemployed imply that discreet groups of people belong to the two different categories. This may be misleading for particular groups of young people, like those in our study. The boundaries between the categories appear to be quite fluid. Many young people seem to move in and out of unemployment and casual, part-time, and sometimes full-time work.

A significant majority of the 18 to 26 year old unemployed in our study had experience of at least one job, and in many cases there were multiple job experiences. Most of the jobs they had held had been casual and of fairly short duration, although there were two exceptions, where the young people had worked full-time for a number of years before being retrenched.

Our study did not capture any extensive details about the nature of the (mainly) casual work done by the young people. However, most seemed to move back and forth between unemployment and casual work, rather than from one casual job to another more permanent job. It appears from our study at least, that the notion that young people are more employable if they have had work experience is not borne out.

Whilst the common features of casual work are the short-term nature of the contract, and the impermanence of the arrangement, some people who work as casuals are full-time and others only work a couple of hours a week. Some casuals have a guaranteed minimum number of weekly (or monthly) hours, so they know how much their minimum income will be. Others do not have such a guarantee in their award, enterprise agreement, or individual contract (Junor et al, 1993).

Since the deregulation of the labour market, what often distinguishes full-time, part-time and casual employment is not necessarily the total number of hours worked in a week or a month, or how those hours are arranged, but the differing conditions attached to the job (Burgess and Campbell, 1993; Blyton, 1992; Junor et al, forthcoming). In some industries, like the retail sector, full-time employees are now expected to work the types of flexible hours normally associated with part-timers and casuals (Deery and Mahony, 1994), although their benefits (at this point in time) are better.

Profile of young unemployed

In 1993 the TEE Survey indicated that nearly 50% of unemployed youth had been unemployed under six months, and that less than a third fell into the category of long-term unemployed. However, even a short period of casual work changes the statistical calculation of long-term unemployment. The restructuring of full-time jobs into part-time and casual work may be hiding the reality of the underlying long-term unemployment problem, especially for young people.

A 1995 Social Justice Research Foundation report (cited in SMH 19-7-95) points to the collapse in demand for young adults as well as for teenagers. It indicated that more than two thirds of teenagers were full-time students with casual and part-time jobs which had formerly been full-time jobs held by a different group (mainly from a lower socio-economic category) of young people.

An Australian Council of Educational Research Longitudinal Survey of Australian Youth (cited in SMH 2/8/97) found that most of the students doing casual and part-time work came from better-off families. These more academic young people appear to have a double advantage. They are more successful at school, which eventually gives them access to tertiary education, and because they're seen as potential or indeed successful tertiary entrants, they are given preference by employers for casual and part-time work.

Those young people without post-compulsory education are the most vulnerable, since they now compete with full-time and part-time tertiary students for the few casual and part-time jobs on offer. It is obviously to the cost advantage of employers to take on tertiary students, who need less or no training in practical numeracy and literacy skills.

Sweet (cited in Horin 1996) comments on the results of a survey of 18 and 19 year olds conducted by the Australian Council for Educational research (ACER). Summarising the position of this age group in the workforce, he says that despite high overall unemployment rates for youth, long periods of uninterrupted unemployment were less typical than frequent movements around the margins. "Though many get some casual or part-time work, it doesn't seem to help them to secure a full-time job." More than 25% of the youth spent nine months on the fringes - neither in full-time work or study -over the two year period of the study. Youth from disadvantaged backgrounds were more than twice as likely to be in this situation.

Of those unemployed youth who had had a permanent job, the vast majority had worked in low skilled occupations. The most often cited jobs were as labourers and related workers, followed by, in descending order, salespersons and personal service workers, tradespersons, clerks, plant and machine operators and drivers, with very few people nominating jobs as para-professionals, managers and administrators (Training and Education Experience Survey (TEE) 1993).

So it is important not to assume that the group we call young unemployed have never had work.

Those studies of youth unemployment which focus on the characteristics of the unemployed rather than on the features of the labour market itself, often point to the lack of experience, skills and training as a cause of the employment problem.

Given that just under 70% of those aged 15-24 in employment had no post-school qualifications, compared with just less than 85% of the unemployed in this age group (Census, 1991), this "characteristic" of the unemployed cannot be used as the main factor to account for their unemployment.

The Junor et al (ibid) study shows the wide range of skills and experience held by "flexible" women workers that is often unacknowledged in the perceptions of them as marginal workers.

To some extent, the same may be true of many of the older group of young unemployed people who have moved in and out of the workforce, but seem only to be able to form marginal attachments to work, given the nature of the labour market.

According to Junor et al (forthcoming) and others (Hall and Fruin, 1994), considerably fewer part-time and casual workers participate in the negotiation processes involved in wage-setting.

This has important implications for young peoples knowledge and experience of working conditions issues, given that the majority of them in work are part-time and casual.

Whilst Junor et al's work considers the blurring impact of enterprise bargaining on categories of work, another factor blurring the distinction between full-time and part-time and casual work is the governments reorganised assistance to the unemployed. The three new categories of so-called "intensive" assistance to go to the unemployed will be based on agencies' ability to secure jobs of 15 hours or more per week for their "clients" (see chapter 6). Whether this is a recognition by the government of the lack of full-time employment opportunities for these types of "clients", or an industrial relations strategy to put pressure on unemployed (and other) people to accept less than full employment as the norm, it will, by default, change the definition of full-time work in some sectors of the economy.

Income support

It may be misleading to categorise young people's income support into the clear categories of either paid work or government financial support. Young people appear to juggle a number of different income support arrangements over time.

White (1997) utilises five categories for examining young people's sources of income support. He speaks of the formal waged economy, the informal waged economy, informal non-waged economy, government assisted economy and the criminal economy. His study of 550 young people found, amongst other things, the following characteristics of young people's income arrangements:

- "the under-18 year olds relied mainly on their families for income support, with further support provided through work or government benefits.
- the under-25 year olds relied mainly on government benefits and paid work as their main source of income.
- those young people employed in the formal waged economic sphere were rarely employed on a full-time basis.
- the times and hours of work varied and there were few instances of standardised work times.
- for many young people work in the informal waged economic sphere is an important way to supplement their income.
- the main types of criminal activity engaged in for money were those of theft and drug dealing."

At this point in time the main forms of government income support that young unemployed people use are the Youth Training Allowance (YTA), the Newstart Allowance, the Sole Parent Benefit, and the Disability Support Benefit. Some doing a formal, longer-term training course receive Austudy or Abstudy for the duration of the course. Many young people move between these different forms of government income support and mainly casual and part-time work.

Whilst it is too early to judge the new Centrelink, Public Employment Placement Enterprise (PEPE) and Employment Placement Enterprise (EPE) arrangements, the previous Department of Social Security (DSS) system was very difficult for many to work within. The system predated the new work environment of proliferate casual and part-time arrangements, and did not easily adapt to the situation of people moving regularly between casual and part-time work and support. If you were an intermittent worker, it took fairly highly developed literacy and numeracy skills to understand the complexity of the system, and then work out the best way to maximise your total income and associated concessions.

Changes to the CES and DSS

At the time of writing, the federal government had decided to separate policy and service delivery in both the Department of Employment, Education, Training and Youth Affairs (DEETYA), which was responsible for the CES, and the DSS, with the policy areas having to purchase services from both private and public providers.

All job placement, case management and labour exchange services previously delivered by the CES are currently being put out to tender. Services like registration for employment and payments will be delivered by a new Commonwealth Service Delivery Agency, and the new public and private Employment Placement Enterprises will deliver employment services on a fee for service basis (PSRC, Contract Monitor, 1997).

The federal government's plan is to pay employment services $250 for each person that is placed in a job, with the stipulation that at least 50% of placements are to be in full-time, permanent jobs, the definition of which is not stated. The other placements have to be in what is defined as a 'real job' of at least 15 hours over a 5-day week. This definition of a 'real job' is controversial for a number of reasons. Firstly, most people will not be able to survive on the income from a job that is effectively just over 1/3 of an 'average' job. Secondly, such a low threshold allows placement agencies to talk employers into dividing what may have been a full-time (35 hours/week) job into two part-time ones and collect two fees where there might only have been one. The third implication of this government definition of a 'real job' is the weight that it adds to the already slippery notions of full-time and part-time work, as we have discussed earlier in this chapter. Not only have employers been restructuring work to create more 'flexible' part-time and casual jobs under recent industrial relations arrangements, but government employment policy may also begin to encourage that restructuring via its employment placement arrangements.

The government's Youth Training Allowance (YTA) imposes restrictions of such payments to those under 18 years, in an effort to force more young people to remain within the education system and be supported by their families, if they have them. It has been estimated that up to 27000 additional students per year will stay on at school as the income support for unemployed 16 and 17 year-olds ceases (SMH 4-8-97). The government's YTA is only available to 16 and 17 year-olds who have completed year 12 or are in full-time education or training.

The government's controversial work-for-the-dole scheme will apply even tighter restrictions on conditions for the granting of the Newstart Allowance.

White (1997) cites many writers who have shown that the level of government income support for young people is consistently below the Henderson poverty line. In that study about 38% of the older age group relied on government support as their main form of income.

Those young people we spoke to who were on benefits said they find it very difficult to be independent. One woman in the study pointed out that the only way you could survive on the dole was to live with your family (if you had one) or with a number of other people, at least one of whom had to be in full-time employment. The young people in Lithgow were finding it particularly difficult to remain independent on the dole, given the dearth of even casual employment in the locality.

In this context, the work for the dole proposal may be misguided. It is partly premised on the notion that young people are work-shy or have had little work experience. The surveys seem to indicate this is not the case. The proposal was viewed by a number of the young people in the study as offering little positive benefit over the types of arrangements they had managed to put in place for themselves.

A significant proportion of the young people did not have families with resources to maintain them for any length of time, indeed a number of the families had long-term unemployed parents.

Geographic location of the study

The fieldwork for the study was carried out in a number of Sydney's inner suburbs and in three regional cities in the central western part of New South Wales, these being Lithgow, Orange and Bathurst.

Lithgow, approximately 140 kilometres west of Sydney, with a small population of 19,200, has a fairly narrow economic base. The automation of its coal mining industry, has seen a consequent loss of jobs. The recent decision by Berlei to close down its underwear factory within six months will mean a loss of 184 (mainly machinist) jobs. According to a SMH (14/8/97) report, 2000 jobs had been lost in Lithgow in the past few years. 45% of its current workers are employed in the industries of mining, retail trade, manufacturing, and health and community services, in order of numbers employed (ABS 1996 Census, Table B01).

Bathurst is 205 kilometres west of Sydney, has a population of approximately 28,800, and offers a broader economic base than Lithgow. 52% of its workers were employed in four industries, these being retail trade, manufacturing, education and health and community services in that order (ABS 1996 Census, Table B01).

Orange also lies west of Sydney, at approximately 60 kilometres from Bathurst and 266 kilometres from Sydney. It is the largest of the regional cities studied, having a population of about 34,000. Its economy depends on a similar range of industries as Bathurst's: it also had 52% of its workers employed in just four industries, these being manufacturing, retail trade, health and community services and education in that order (ABS 1996 Census, Table B01).

Each of the three rural towns had a similar income profile, with an average of 67% of income earners getting $499 a week or less, and an average of 58.5% of them bringing in $399 a week or less (ABS 1998 Census. This compares with the national average weekly gross earnings of $582 (August 1997) (ABS 1998 telephone information).

The unemployment rates for the three towns are currently : Bathurst 8.5% (national average); Lithgow 10.1% (1.6 above national average); and Orange 8.2% (.3% below national average) (ABS 1996 Census, Table B19).

While there are features of the Australian economy and the labour market which many young unemployed people face in common, there are some features peculiar to these outer-lying regional cities. The greater area of Sydney has a more diversified range of economic activities which offer work potential. However, the three regional cities have a narrower economic base than Sydney, and thus offer a more limited range of employment opportunities. This is especially true of Lithgow, which lacks farming, and industries traditionally associated with the tertiary education sectors of Bathurst and Orange, and has seen the automation of mining decrease the traditional levels of coal industry demand for labour.

Both the collection and data analysis methods for our study grew out of the review of the literature dealing with mathematics as a social practice, and that dealing with sociological notions of practice. Our aim was to capture and understand those numeracy practices used in young peoples' everyday life. We were not just interested in the different types of mathematics in use, but in the role of numeracy in daily life and how it interacts with other social practices; in how numeracy structures peoples' lives and is itself structured by living in particular circumstances. As the social practice literature indicates, particular mathematical skills seem to depend on the social organisation of the activities in which they are practised (Harris, 1991, 202).

To engage with these issues, we needed a naturalistic type of method which would enable us to get as close to young peoples' everyday practice as is possible for university researchers, given the realities of life for many young unemployed people. We wanted to ask what was and had been happening in young peoples' lives in order to identify the sort of numeracy practices they engaged in.

We used a qualitative multi-strategy method - involving observation, journals, and interviews of teachers and young people to build a series of case-studies - to create a richer picture of our research site than might have been possible with a single method. Although we recognise that it is not possible to generalise broadly from case study data, we argue that the very fact that some have used mathematics in a particular way means that this may be a possible way for others to follow - it can work as an opening up of potential, an increasing of the capacity for action. As Frigga Haug argues in her discussion of the memorywork method:

> [t]he number of possibilities for action open to us is radically limited. We live according to a whole series of imperatives: social pressures, natural limitations, the imperative of economic survival, the given conditions of history and culture. Human beings produce their lives collectively. It is within the domain of collective production that individual experience becomes possible. If then a given experience is possible, it is also subject to universalisation.... our focus of interest was not unique personalities, but rather general modes of appropriation of the social. (1987, p44)

The major challenge facing the research team was how to actually get behind the numeracy activities, and determine the ways both the individual and the situation are constructed. In other words we were asking how does social practice influence and shape numeracy practices? Baynham (1995, p. 245) has noted, for example, when researching literacy practices, that there are myriad ways in which 'broader socio-cultural categories impinge on and shape literacy practices, through social power relations, the impact of institutions and teachers of literacy, the situated nature of literacy practices and thus the crucial role of context in understanding literacy in use.' A similar view has been adopted in the attempts of this research team to understand the numeracy practices of young unemployed people.

Data collection

The primary data was collected from interviews with young people. The biographical data, and teacher interviews, assisted in locating the young people in their social contexts. The journals, kept by the researchers, helped them tease out and record their own numeracy practices. In so doing, they became acutely aware of the complexities and nuances involved in trying to capture mathematics as it worked in practice. Thus, data was gathered in the following ways:

- following an in depth literature review of research into numeracy practices, we carried out pilot interviews with a selection of young unemployed people
- from the interviews we developed a kit to stimulate discussion of the nature and incidence of numeracy practices
- we trialled the kit in several sites, refined it and developed guidelines for its standardised use
- we developed a questionnaire to enable researchers or teachers to document the young peoples' backgrounds and previous mathematics experience
- we designed a questionnaire to enable exploration of the approaches to curricula and teaching used by adult basic education teachers working with these young people
- as researchers, we maintained journals of our own literacy practices during the project
- we used the kits and questionnaires to gather data in a variety of selected field sites

Development of the Kit

As previously noted, there are a number of studies which utilise 'naturalistic' methods for studying numeracy practices. Because this project is exploring the numeracy practices of young people, many of whom may have been maths phobic, and possibly previous school resisters, it was important to find a non-threatening, non-judgemental method of collecting the data. However, most of the work already mentioned studied adults in work settings (Lave, 1988; Scribner, 1984) or children (Nunes et al, 1993), and whilst their methodologies were naturalistic, none seemed appropriate for the group we were interested in. However, McRae (1995) had developed a method for use with the assessment of her own TAFE NSW students, which consisted of a 'kit' of everyday items. These included, amongst other things, household bills and receipts, newspapers, timetables, menus and banking slips. She used these to provoke discussion about the students' use of the mathematics involved.

The research team realised that the concept was a useful one, and could be adapted for the research purposes of this project. We decided to interview a small number of unemployed young people (three women and three men), from two different TAFE (NSW) colleges and a Skillshare centre, about their everyday lives. Open-ended questions were asked to ascertain those activities which commonly involved use of mathematics. The data obtained from these interviews were analysed, and used to identify a number of key activities which could be represented by a collection of articles in the kit. These common activities included: public transport and car travel, cooking, banking, time-telling/keeping, measuring, form filling, game playing (eg cards, computers). We compiled a kit of items which could be used to stimulate dialogue about the numeracy practices involved with these types of activities.

Trial of the kit

We used the kit to encourage a number of young people in two Skillshare centres to engage in a dialogue about their everyday practices. It was important for the researchers to follow the dialogue closely and ask relevant questions if we were to elicit the potential richness of data. Lave's (1988) two terms 'structuring resources' and 'generation' (see Chapter 1)are an attempt to tease out the way other social activities intersect with and influence mathematics and generate particular responses. The interview dialogue attempted to understand why a particular mathematical procedures were chosen, by attempting to gather information other activities of which the maths may only have been a part , and other cultural factors in the immediate and broader context.

At the end of the pilot, we made some adjustments to the kit, adding one common question for all respondents to answer, and some open ended questions for possible use.

The final kit items included:

bus/train/ferry timetables
recipes
ATM receipt
shopping docket/lay-by docket
street directory
digital and/or analogue watch
calculator (simple)
medicine glass
lotto forms
phone card
tape measure
pack of cards
tax form
DSS or CSA form
dressmaking, knitting, woodwork patterns
calendar

Due to constraints of space, finances and time, some potentially useful items that were not included were: weather maps, thermometer, postage scales, computers, mobile phones, personal organisers, music and chord charts. The research group was mindful that there also exists a vast array of other items that may involve the use of mathematical practices of everyday life of young people.

The following common question was developed, and all young people interviewed were asked to respond:

> When a group of people go out together, they often share costs of food and such things in lots of different ways. If you were out with two friends and bought a pizza for $16.90, how would you share the cost?

Interviews

The use of the kit as the basis for interviews with the young people was the major but not only source of our data, others being interviews with teachers, some teacher interviews with students, and journals.

Questionnaire for participants

A questionnaire was also developed for use by the researchers or the teachers of the young people, designed to give background biographical information.

The questionnaire also included questions related to the participants' previous experiences of mathematics, both in and our of school. The questions were structured using the strands of mathematical meaning developed by Johnston (1995) in her exploration of mathematics as a meaning-making system. Accordingly, the questions were based about numeracy issues relating to the following strands:

meaning through ritual
meaning through conceptual engagement
meaning through use
meaning through historical and cultural understanding
meaning through critical engagement.

The questionnaire, which also poses questions about general background, is included in the appendices (Appendix 1). Students enrolled in the Graduate Diploma in Adult Basic Education (ABE) at the University of Technology Sydney, many of whom are TAFE or community college teachers, were given the option of participating in the research as a component of their own course. Two chose to do this, and used the questionnaire to interview a number of young people each. The remaining participants were interviewed by the research team, or by local ABE teachers. The interviews were either taped or recorded in written form.

A kit interview data

Guidelines were developed for standardised use of the kit in the field, since there were to be four researchers collecting the kit interview data. The agreed process was that objects would be laid out on the table and the young people asked to indicate which ones they commonly used and to talk about their use. It was decided that a few objects would be used for every young person interviewed, so that direct comparisons could be drawn between all subjects. These items were: timetables, ATM dockets (to pick up banking issues), and the pizza question. Approximately one hour was allowed for the kit interview, and the young people were paid for their participation. The interviews were recorded on audiotape, and later transcribed.

Questionnaire for Adult Basic Education teacher

We constructed a set of questions to be used with the teachers of these young people, designed to give some background information on the curriculum content and practices employed with these particular types of students. (Appendix 2).

Journals

The four researchers kept a short-term journal of their own numeracy practices in order to understand the complexities of numeracy use and the 'taken-for-grantedness' of much practice.

Shadowing

It was initially planned that a small group of people might be asked to keep a journal or make a tape recording of activities where they use maths. It was also considered that the individuals in this group might be shadowed by a researcher while carrying out a number of everyday activities, such as shopping. However, it was eventually decided to abandon the shadowing exercise, partly because it would be daunting to some young people (RIUMET, Update No 2, Jan 1996), and partly because it was difficult to arrange within the time and place constraints of the project. However, we feel that it would be a very useful technique in a further project, as it allows the researcher more direct access to numeracy practices as they are enacted, rather than as they are reported.

Profile of young unemployed people in the project

With eight or nine exceptions, all the young people in our study had been employed at some stage in a combination of full-time, part-time and/or casual jobs, and in a few cases in volunteer (unpaid) work. In the locality with a very tight labour market, Lithgow, volunteer work was seen as a very valuable source of experience and training by the young people we spoke to.

Overall, the profile of the group studied was as follows (see Appendix 3 for complete data):

Age

The ages of the young people ranged from 14 to 26 years, with 6 being in the age range 14-16 , 10 in the 17 - 19 age group, 6 in the 20 - 22 age group, and 3 between the ages of 23 and 26.

Gender

There were 11 young women and 14 young men in the study.

Cultural background

Most of the young people were from a mainstream Anglo-Celtic cultural background. In addition, two were Kooris, one came from an Italian background, one from a Scandinavian background, one had been born in Vietnam and one in the Philippines. The cultural profile of the young people interviewed in the three rural towns reflected the cultural composition of those places, where each had an average of 88% of the population Australian born (ABS 1996 Census, Table B01).

Location

Research sites were selected to ensure that an even spread of urban and rural participants were used to observe numeracy practices, because it was considered that the geographical and demographic location of young people may influence the types of numeracy practices employed in everyday life. As well, participants interviewed included a number of young people who were furthering their education in basic skills in TAFE classes, or were attending Skillshare Centres to acquire more vocationally oriented skills. As well, a number of the young people interviewed were not studying, and were resident, or casual, at youth refuges. All the interviewees were classified as unemployed at the time of the interview. The letter we used to gain permission from those we talked to to use their conversations in our research is included in Appendix 4. Of the case-studies used, 16 were of young people living in or near the country towns, 9 were of young people living in metropolitan Sydney.

Schooling

3 of the young people had left school by the end of year 8, a further 9 had left by the end of year 9. Only 3 went on to do years 11 and 12. Two of the young people we do not have data for.

Living arrangements

16 of the young people lived at home in some sort of arrangement with their parents; 6 or 7 lived away from home, with a partner, child, other relative or friends, some sometimes returning to the parental home. One was homeless. The arrangements of two young people were unknown.

Benefits

10 young people received either Newstart or Jobsearch allowances. One was on a disability pension, another on the sole parent benefit, one on Abstudy, and one on Austudy. Three received no benefits, and survived on casual work; eight others probably survived only with parental help.

Analysis of the data

Considerable time was spent by the research team in debating an effective way to analyse and tabulate data so that it might be easily accessible and presented in such a way as to facilitate analysis. We felt that there was value in mapping data into categories in order to facilitate the interpretation of data in practice, and to highlight problems, lacunae, and contradictions.

We had three perspectives from which we wanted to examine our data. Firstly, we wanted to look at the enabling and constraining effects of social structures such as gender and power, and how the young people negotiated these structures through mathematics. Secondly, we wanted to examine clusters of everyday practices, and to explore these as 'sites' of mathematical activity. Thirdly, we wanted to focus on a few mathematical concepts, and tease out whether and how they were used across the spectrum of everyday sites.

An analysis of some of the taped conversations with the young people was carried out, and we constructed a grid to help us probe the nature of the practices we had identified. On the horizontal axis we plotted those most everyday 'sites' in young peoples' lives which seemed most commonly to give rise to numeracy use. We started initially with the more physical sites like geographic location and access to resources, and then moved onto more abstract notions like interactions with bureaucracies. A simple version of the grid (see Appendix 5 for the full version) is below:

sites of practice ⇒ structuring contexts ⇓	geographic location	resource access/use	personal/ physical	family	personal activities	interaction with bureaucracies
power						
work						
etc......						
mathematical activities						
counting						
calculating						
etc						

The categories were:

geographic location
resource access/use
- travel/transport
- housing
- income & expenditure
- other eg computers

personal/physical
- health
- disability

family
personal activities
- leisure/hobbies
- informal skills acquis'n
- cash generative

interaction with
- school
- other bureaucracies
- further education

The vertical axis was divided into two distinct categories. The first, influenced in part by the work of Connell (1987), consisted of a number of key contexts which we saw as potentially structuring the numeracy practices of the young people. In his work on gender, Connell suggests that four structures currently play an important part in influencing practice: power relations, production and consumption, emotional commitment and symbolization (1996, p10). He goes on to suggest that practice can be explored at different levels and proposes a simple grid cross-classifying structure by level as a way of systematically assessing issues in gender relations. With some evidence from the literature and our pilot study, we therefore proposed a similar grid cross-classifying structure - in this case, power relations, work, social networks, and affect - by 'site', as a tool to systematically survey the data we had collected.

The second category consisted of specific mathematical activities, the choice influenced in part by the work of Bishop who argues that 'mathematics is a cultural product... developed by engaging in various environmental activities' (Bishop, 1990). He identifies six 'universal' activities, which, he claims, appear in all documented cultural groups in some form. They are, in brief: counting, locating, measuring, designing, playing and explaining. After working on some of the pilot data, we chose counting, calculating, locating, measuring, representing and explaining as categories that seemed to be offering rich data. We also included a category in which to log language and literacy issues as they arose across the sites.

We ended up with a grid (which enabled us to listen to the taped interviews and to 'log' practices of each of the young people into one or more of the 'cells'. Thus we filled in a separate grid for each of the 25 people.

To enable us to both build a picture of the different practices and to some extent compare practices, we chose to examine those clusters of cells which appeared to have the richest data. These were clustered around work, income earning/spending, cash generation, interactions with bureaucracies/ further education, and disability. We were interested in understanding how the various 'influences' structured the numeracy practices of particular young people, and how they shaped mathematics. To a large extent ours was thus a case study approach. The grid was a tool to help us organise this particular data; in another study, and having used it once, we would refine its categories.

Writing up the data

It would of course have been impossible to include all the data in this report. Because of the richness of data they offered we have chosen to focus on a few sub-categories from each of our major categories. From the structuring practices, we have chosen to focus on gender and dis/ability (as aspects of power relations), cultural background and location (as aspects of social networks) - Chapter 4. From the everyday sites, we have chosen to focus on the practices involved in interacting with bureaucracies, negotiating transport and managing money - Chapter 5. Changing direction, and working from the mathematical concept back towards its social embeddedness, we have chosen as our focus from the range of mathematical activities, counting, using fractions (as an aspect of calculating), and measuring in Chapter 6. It is also in this chapter that we explore the answers to the kit item asked of all participants, namely the pizza question.

Implications for teachers wanting to do similar research are drawn out in Chapter 7, followed by a chapter on general pedagogical implications, Chapter 8.

In this chapter we start our analysis of the data by considering the impact of social practices more broadly on the numeracy practices of those we interviewed. In the Introduction we pointed to the complex interplay of social structuring and individual agency or control exercised by socially positioned individuals. One of the most clearly identified and best documented 'social facts' or structurings has been the constraining and shaping influence of gender on the agency that is available to individuals, and so in the first part of this chapter we examine the gendering of the numeracy practices identified in our study. The second and perhaps less obvious structuring category but one which was nevertheless strongly indicated in our data is the influence of physical and social space, on the numeracy practices of those we interviewed. Physical and social space refer partly to geography but also to the network of relationships in which the young people are located. Two other structuring perspectives from which we have examined numeracy practices of respondents are the influence of dis/ability and cultural background. Of course none of these categories can be treated as discrete entities since any individual takes on multiple roles or personas. We examine the data to identify the impact of these four significant social structurings on the numeracy practices of the respondents in order to further our understanding of how social activities constrain and enable specific numeracy practices and thence to inform curriculum design. We begin with gender, one of the most pervasive social categories which shape practice.

Gender

Whilst age, class, cultural background and the availability of parental support could be used to account for some of the differences in the range of life experiences, interests and responsibilities, and their related numeracy practices, there was a dimension of difference which notions of gender assisted to explain.

The young women in the study who were older (19 or more) and had lived or were living away from parents, indicated fairly sophisticated use of numeracy which gave them a certain degree of control over their circumstances. There was a sense in which these young women utilised their numeracy in a "politically" personal way, to obtain or keep a degree of independence or power. At the same time their strategies were also "responsible" in the sense that they were clever at juggling small amounts of income to make ends meet both for themselves and their partners and (in one case) offspring. These women displayed a certain amount of pleasure in describing their budgeting strategies, but at the same time you could see there was pain in the struggle to manage.

Sam, 19, lives with her boyfriend and her sister in a flat in one of Sydney's middle Western suburbs. She left school at 16, at the end of year 10, to work in the large multinational fast food retailer which had employed her on a casual basis since she was just under 15 years old, and still at school. Sam had worked in a number of different locations with the same company over a two and a half year period, but it appeared from what she said that by the time she was 17, she was tired of a work culture where you couldn't take any of your own initiative.

She had subsequently worked in a service station, where she had injured her back, and as a child care assistant. She said she had found it difficult to get work since she turned 19, because she is too old for the sorts of casual jobs she did as a younger person, even though she has plenty of experience. She had enrolled in TAFE to get some credentials to give her a better chance in what she saw as a difficult job market, and is currently dependent on Austudy for income support.

Sam does all the household's budgeting and bill paying, and before her sister had moved in, her boyfriend's mate had been the third person in the flat. She had budgeted for that combination of people as well. She said she likes to be the person in charge of budgeting because it gives her control over her circumstances.

> If I'm doing supermarket shopping and I'm in a hurry, and I've got a lot to do, I use a calculator. If it's only five items I do it in my head........I do a lot of budgeting...personal loans...you work out how much to borrow, how long to pay it off.......I bought my car on a personal loan...I got my teeth done on a personal loan. Then I combined them and worked out how to pay it off......How much extra registration is....those sort of things. The bank worked out the interest rate....I worked out how much I could afford each month....I try to repay everything as soon as possible, so I try to push everything into one year. Working out whether you can afford to pay something off in one year is quite difficult, especially when you only have a small amount to work with. You've got to cut things you don't want to cut ...I sit down and work it out on paper....My partner has an income.........I'm juggling the budget......Basically, if I give him the money he spends it. The money goes in the bank, and basically I say this is how much you can spend.....there are three people in the house so I have to work out the bills and shares....I do all of it.......I like to have control over everything, I like to know what's happening.........keep an eye on the bills to make sure they're right....I always question the amount.

Sam took great delight in describing how she had managed a household budget since she left her (single) mother's home at 16. Given that most of the paid work she had done had been in the casualised labour market, she has obviously juggled limited amounts of money well enough to pay for orthodontic work, rent and a second- hand car. She said her mother could not afford to have her daughter's teeth straightened, so she herself had to cover that expense once she had left school.

Even though the boyfriend is older and in full-time employment, Sam had taken the full responsibility of managing their joint expenses and incomes, and had done so for a number of years.

Angie, who is 19 lives in Orange, has a young child two years old and is expecting another. She is in a relationship with the second child's father, but it appears to be a precarious one, since she is trying to keep her own rental accommodation going, whilst living part of the time with the boyfriend in his rental property. Like Sam's partner, Angie's also has a job, but he gives her little money for their daily living expenses. She says he spends most of his income on himself, whilst she juggles her sole parent benefit to pay rent, and their food and other bills, including medical expenses for her child. Any spare money goes towards the costs of preparing for the new baby. She told the researchers that the money paid to her for the interview was an unexpected bonus, and would be used to purchase some new cloth nappies.

Angie also took her responsibilities very seriously, and used her budgeting skills to make the most of a very limited income. Like Sam, she did not have family resources to fall back on. Angie's life is currently very bounded by the nature of her income support. She relies on the sole parent benefit and to some extent her partners income, but at the same time she is being realistic about the possible collapse of that relationship, and the need to be as independent as possible if that happens. She has a young child, is enrolled in a TAFE course, she says to get some training for her future, and is attempting to keep her own separate accommodation because of a judgement about her relationship; she is thus juggling a number of different people's needs at a time when the local economy does not really offer many work opportunities and the state income support system is becoming more punitive.

In summary Angie is involved in a rather complex financial tracking of three sources of income- her own unemployment benefits, child endowment, and her own and her partner's domestic budgets. On top of this she must ensure that none of these separate sources push her total income over the departmental formula. In fact the personal decision to form a family unit with her boyfriend is influenced by financial concerns.

Both women, have taken on a lot of responsibility for their household budgeting, indicating a fairly competent usage of money. Both have done so to gain some control or power in their personal lives, yet their lack of paid employment means the amount of control has fairly strict boundaries that are proscribed by the state's income support mechanisms.

Another young woman (14 years old) who still lived with her parents and eight brothers and sisters also appeared to have taken a responsible role towards her family. When asked to describe what she would do with a $1000 lotto win, she says she would get the family's second car fixed so that all of them could go out at the same time, in two cars, and she would pay the outstanding household bills.

Haug's (1992) notion of the "masochism of responsibility" can be used to help make sense of the tensions between these young women's pleasure at their ability to budget, yet their pain at the unfairness of having to take on a lot of responsibility. According to Haug, women take a certain degree of pleasure in being seen as reliable and responsible in their actions, but at the same time this sense of responsibility locks them into modes of being which limit their life choices, opportunities, and to some extent affects their personalities. She implies this sort of internal conflict may make women unhappy with themselves because they become resentful.

By way of contrast, many of the young men, including those not living with parents, appeared more "cavalier" in their budgeting practices. Although most of the young men we spoke to were also on limited incomes, more of them had only a vague awareness of the exact amount of their allowance, rent assistance, or weekly costs. Very few of them described the use of calculators to do the shopping or the budgeting, unlike many of the young women. There was a certain nuance that it was 'unmasculine' to be too careful about one's income and expenditure amongst most of the young men. In a number of cases where the young men did display detailed numeracy practices these were related to certain hobbies or areas of formal study, not in practices related to household budgeting.

These gender distinctive attitudes to domestic financial responsibilities are exemplified in the case of David, aged 27, who lives in Lithgow, currently with his parents, although he has lived in a number of other types of accommodation with friends. He is currently in receipt of Newstart Allowance and said that he withdraws most of the benefit on the day it is paid into his account, and then has to borrow through the rest of the fortnight to get by.

> ...Oh, I usually borrow a bit ...off me parents...and usually pay them back and then usually try and buy everything I need when I get paid, like pay everyone back, depending...not all the time I borrow, but sometimes I have to and if I don't borrow I try and stretch it out for as long as I can.

It appears that part of the culture of the young men David mixes with is to lend each other money, and be reasonably confident that on balance the arrangement works to the advantage of all.

> ...Oh sometimes I write it down. A lot of times I just keep it in my head, depends how much I owe. If its five dollars or something here and there I write it down 'cos you lose track of it but if it's 40 bucks..30 or 40 bucks you sort of can remember it.

This gendered dimension of the attitude, 'she'll be right mate,' is taken up again in the discussion of the shared pizza in Chapter 6.

Tom (19), who had left school at the end of year 9 aged 16, lives in Orange with a friend. He has had numerous part-time and casual jobs, but is currently doing a course at a community college. Even though his only means of support is the Newstart Allowance, he is fairly vague about the amount of money the allowance gives him, and the details of its mechanism. This is in strong contrast to the women. Tom said he never used a calculator for shopping, the only use was to "play around with". At interview he spent a fair amount of time displaying his main use of the calculator, which seemed to be related to the types of macho jokes that were a part of his cultural group.

However, there was one exception to this gender specific approach to income and budgets. Matt, 22, who had lived on his own for some time, a few kilometres out of Lithgow, displayed a great deal of pleasure in his ability to budget wisely and to exercise a certain degree of control over the limited resources at his disposal.

He had not had paid work for quite some time, but had done numerous short training courses in an effort to get any type of work. At the time of interview he lived on the Newstart Allowance, and, even though he ran an old car, he had very little in the way of resources to fall back on. Like Sam, he also took delight in describing how he managed to do his weekly budgeting, especially the shopping and banking aspects.

> Well, I'm used to shopping. Usually when I go into the store I look for the bargains like everyone else does.....Usually I'm a Coke drinker so generally stick to that brand. I'll go for the small bottles because they're easy to store ....I have a small (bar) fridge. So I'll buy eight and put two in the fridge. When they're gone I'll replace them....Usually I'll go along with the pamphlets they put in the mail or I often go to the cheapest stores to see which bargains they have on their wall before I go in. That way I have a warning whether its going to be cheap for me to shop there.

Matt's ability to take advantage of the bargains his storage capacity. He says his accommodation is small, with very little storage space in the kitchen and only a bar size fridge. Like many people on minimal incomes, he has not been in a position to equip himself with the household goods which may assist him to buy in bulk and budget even more effectively than he currently seems to be doing. He says he has to be careful in working out how much he will save by driving the half hour it takes to Bathurst, because that is $10 in petrol costs.

> .....It all depends how far you've got to go to get the bargain. To see if its worth putting $10 worth of petrol into the car to get there, because you could get something cheaper in at Lithgow at Best and Less which could save you that ten dollars which you could put towards food and to save you the trip to Bathurst.

As one way of keeping control over the amount of money he allows for spending each week, Matt uses a bankbook rather than a credit or debit card. He says he can keep track of the small amount of money he has in this way.

> With a key card I'd probably lose all of my receipts or even my key card, so I'd rather have a bank book, even though you've got to fill out a withdrawal form, it's much easier for me because

> I can keep an eye on it and can ring the bank whenever I want a balance....I've had one of those (cards) before and it affects me in different ways because you've got to keep an eye on your banking 24 hours a day. With a bankbook you always have it there handy, without having to go through your receipts and your wallet. With a bankbookmyou've got all your information in one book.

Matt's need to have control over his limited resources is similar to Sam's, and concern with the finer details of budgeting may be seen by some as unusual for a young man. It certainly stands in stark contrast to a number of the other young men we spoke to, many of whom appeared much more nonchalant in their attitudes to money. All the young women in the study who had experience of paid work also appeared "responsible" with their budgets.

There is a clear gender divide in terms of the hobbies that the young people do, although we do have a theoretical problem with dividing the time of young people whose work attachment is so fragmented into leisure and work categories. As we have indicated a couple of the young men associated their non-paid interests as potential income earning sources.

For example, Kevin, aged 14, has been living at a youth refuge on and off for a short period of time. He hasn't officially left school, but has been finding it difficult to meet the attendance criteria. He spoke a lot about his interest in making cement pots and as the following excerpt indicates he had thought about making a little money from them.

Kevin	Lately I've just been selling them to like me friends and stuff like that for their gardens and stuff...
Interviewer	Do you have a bank account?
Kevin	Oh I used to have one, but I don't any more, but I'm going to get one so for when I get - with my pots and that. So, when I leave school I want to try and turn it into a business and so I'm going to get a bank - and I want to get a bank account for that so I can put money from making the pots into the bank.

Several other young men were rediscovering the importance of maths in their hobbies-for example the measuring and timing involved in track and field sports, or the mathematics required in learning about hydraulics, to exploit an opal holding at Lightening Ridge.

When Sam was asked about her hobbies which include cross-stitch, long-stitch, sewing and crocheting, she began to explain some of the maths calculations she needed to do. She follows a pattern for some work, but makes up her own patterns for the needlework or crocheted rugs she makes because she likes them to be original. If she is following her own patterns for these she has to work out the quantities of material and thread required.

Interviewer	So, you follow a pattern ... do you actually work out the material that you need roughly? How do you work it out?
Sam	You work out how much you need and depending on how much length you've used you never know if it's going to be enough or it's going to be too much material. So, you've got to work out exactly how much you'll need for that sort of area and how you're going to - the length between that part and the next part.

The sort of grid system she was familiar with from her cross-stitch experience was utilised when asked to locate a specific street and suburb in a street directory. Sam indicated both an understanding of the nature of a grid system, and use of the terminology as well.

Interviewer	SH3 wasn't it. So, what you were down the bridge and across ---
Sam	Well, it doesn't matter, you can go across and then down.
Interviewer	So have you used grids before?
Sam	Yeah. I use grids because I've done embroidery and stuff.
Interviewer	So, they work on a grid system as well?
Sam	Yeah

In summary, there was quite a range of different interests and hobbies amongst the group, most utilising a wide range of numeracy practices, many significantly gender specific. None of the young women spoke of interests which they saw as potential income earners, unlike a number of the young men.

Space, Location and Numeracy Practices

In this section we examine the impact of space, both physical and social, on the numeracy practices of the young people we interviewed. As explained in the introduction this notion of space is partly to do with the geography, both physical and social, within which the respondents operate. But it is also to do with the social networks within which they are located. So what is the impact of space, place, location, or dislocation on the numeracy practices of the young people we talked to? Cameron lives with his family in a comfortable North shore suburb. His friend Tranh is homeless and finds it difficult to locate exactly which suburb he lives in: "I live roughly around Cabramatta". Kylie has moved from Minto on the outskirts of Sydney to Woolloomooloo, yet goes back to Minto frequently to do her shopping. All of these young people are located and locate themselves, are 'at home' in particular spaces. Where you are at home can be dividing up dress making tasks with your mother like Alicia, or using your mother's recipe books to cook up a meal when you're at home alone in the middle of the day like Cameron. For Tranh it can be staying up all night with your mates drinking in the cemetery. With the sense of location comes the possibility of dislocation, with the sense of place, displacement.

In the previous section Matt's precise 'responsible' domestic budgetary practice was described as an exception to the gendered division in reference to domestic numeracy practices evident in most other respondents. However when viewed from the perspective of the influence of physical and social space his practices could as readily be attributed to the fact that he lives alone. Or in the case of Aidan who, although he alternates between living with family and elsewhere, has a strong desire to live independently and so dreams of how he would use $1,000 in housing. The influence of social networks, from comfortable suburban parental living arrangements to what could only be described as homeless states clearly impacted on the numeracy practices of respondents. A consistent finding was the finely tuned awareness of budgeting and bonds, rent or mortgage repayments, that accompanied those who had or desired 'a place of their own'. This knowledge was not a part of the world of either the men or women we interviewed who lived at home.

We will examine the influence of space on numeracy practices chiefly with reference to two of the young people - Jonathon and Aidan. Jonathon lives with his family in a small holding outside a small town with a history of mining, but in which the main industry is now timber. He is caught up in the duties of an older child in a large family, with family chores to do and animals to feed. He seems to have mainly outdoor tasks. He lives in a place where his parents and grandparents lived before him - he is someone with a strong sense of place and also strongly located in his family network. By contrast Aidan's lifestyle is more nomadic, with frequent moves from one family member's house to another, interspersed with periods in a youth refuge and in shared houses. Yet there are phases of his life which have similarities with Jonathon's, and he also locates himself as a country rather than a city person.

Jonathon has a passion for both geology and the weather, closely related to the landscape in which he has lived all his life . He can talk in detail about what sort of precious or semi-precious stones can be found around the area, and where they might be found. He knows something about their weights and values, and how they came to be formed. In fact his fascination with geology and earthquakes links for him into a passion for understudying tornadoes and the weather more generally. In the course of interviewing him it became evident that this interest engages him in a complex array of mathematical activities, reading temperature charts and TV weather charts. His media derived knowledge intersects with highly localised knowledge as can be seen in the following extract:

Interviewer	Do you watch the weather on the television?
Jonathon	Yes, I do yeah.
Interviewer	Do you understand all the charts and the diagrams?

Jonathon	Yes, the high and lows and - and troughs and yeah, cyclones and all that, I know them... like one {storm} we had a couple of months ago...it could have been the start of a small tornado... it started off a little pimple in the sky... miles and miles a way, then it got up closer to a pretty big storm front and then right out of the middle, I don't know why, it took about five minutes for it to happen and then there's just this big swirl of cloud just went straight up in the sky... it took about five minutes to reach as high as it could and then it was like that for the rest of the day... at night I was still studying it. Usually I do find an answer for most questions... I think the storm front came up and we had a low draft coming along the ground and it must have hit... mountain and went straight up.

Jonathon went on to give his explanation of why on this occasion the lightning apparently moved from the ground up rather than the usual movement of lightning appearing in the sky and moving downwards. Perhaps his explanation was not accurate from a scientific point of view but the point to make here is that his attempts to describe the meteorological processes provide a starting point for explicating mathematical and scientific concepts. Similarly his predictions about what a 22 degrees temperature and impending storm front coming in from Sydney might mean on the western side of the mountains indicate intimate if intuitive knowledge of the causal factors of weather patterns:

> ... it can mean one of three things depending on how much speed it picks up when it comes over the hills... decreases in temperature can turn into hail, but if it stays the same it will just be heavy rain... if it goes high it will turn to a static electricity storm.

One of Jonathon's household chores is to measure and record the rainfall:

Interviewer	How do they measure the rainfall?
Jonathon	We measure that in inches.
Interviewer	So, who measures the rainfall?
Jonathon	Um usually I do.
Interviewer	Do you keep a record of it?
Jonathon	Yeah, yeah, we have a { recording sheet} like a you get one from the Land newspaper. We usually buy one off them. I just get up and always write down... We probably need another, depending what do you want it in inches or centimetres?

Later speaking about the amount of rain he says that:

Jonathon	All right, we probably need another 150 or something centimetres.
Interviewer	Really?
Jonathon	Yeah, which is probably three inches, four inches something like that. No, hang on 1, 2, 3, 4, 5, 6, yeah probably about 6 inches, like for out here to catch up to last year's record.

Gathering and recording the rainfall involves Jonathon in complex mathematical activities:

Interviewer	Tell me how you record on the chart?
Jonathon	The rainfall.
Interviewer	What's it l- is it like a calendar or what?

Jonathon	Yeah, it's like a calendar. Okay this is 97 okay and you got all your line there and days and whatever. Um now you add up - say that's your first one you write all your numbers down, how much rainfall you had. So say on the 5th of April from 9.00 o'clock on the 5th of April you had rain up until um 9.00 o'clock the 6th of April.
Interviewer	24 hours, in effect?
Jonathon	Yeah, right 24 hours, you don't write it for the 6th of April you write it for the 5th. So, say all together in this month you had say 6 and blah, blah, blah, all the way through and what you say is a grand total of say 71 inches, all right, okay.
Interviewer	And that would be for a month or a week or a year?
Jonathon	Say that's for the year 71 inches. Now that's quite a lot, but not - it's a fairly rough guess. Well, last year okay and then say for 97 you only had say 29 see now you're down behind average for that year.

As he talks, however, despite the impressive range of information and understanding about the weather and rainfall that he demonstrates, gaps and limits in his knowledge become evident. He doesn't understand the concept of averaging rainfall over a number of years and treats the rainfall of one year as the average against which the next year's rainfall is measured. Often he can carry out a mathematical procedure, such as measuring, without knowing the technical term for what he is doing or the instrument he is using.

What is important here is to understand how the mathematical activities he is engaged in are highly situated in different ways: in the local knowledge of the weather he observes as he stands on the porch or looks out of the window; the scientific media-derived knowledge of the weather he gains from the weather reports every evening; his own scientific, but also highly localized measuring and recording of the rainfall: all of this is evidence of the significance of rainfall for farming communities in rural Australia generally. On the coast a good shower of rain may mean a day you can't go to the beach. In the country it could mean the difference between crop failure and harvest.

Social networks are important: there is another set of practical mathematical skills Jonathon learns through helping his uncle out with panel-beating:

Jonathon	... I'm doing metalwork. I'm building metal frames and stuff like that.
Interviewer	What type of frames do you build?
Jonathon	I haven't done so much as in the frames yet because I'm starting a course up at TAFE very soon and it's a two year metal fabrication, but I've done - done cars and that with me uncle because he's a panel beater. So, I've kind of like - I have done welding panels onto cars and welder up patch work so it's not - it's not so much it's difficult it's just that you've got to get the pieces of metal lined up right into your ...... it could be a fraction of that out - you got to get it to the end and it could be that much out. Like say you're out that much down here and you want to weld a piece over to there and back here and then you go to weld it here and you'll find that it will kind of like that much because it's bent out so you're kind of like have to start all over again. That's why ever seen those - what are they called tri-rules, what they are is a tri-ruler is just a basic square ruler like that, a ... ruler. What you do is you sit it in your corner and then it makes you're um metal plumb, so when like - so when it goes in ---

Interviewer	It's straight, yeah?
Jonathon	Your plumb is not straight and then you got your - I forget what it's called like a 45 degree angle um rule, what you can do your measure around.
Interviewer	Is that a square is it?
Jonathon	Yeah.
Interviewer	Ora compass?
Jonathon	Yeah, a set square and compass, something like that. Like that just gives you a 45 degree angles, 95, 90, 60, whatever, whatever you want.
Interviewer	So, you've got to be really accurate?
Jonathon	Yeah, you've got to be spot on accurate because if you're not you can be out two inches at the end or an inch or half an inch or whatever.
Interviewer	And do you help your uncle or does your uncle let you loose and let you do what you want?
Jonathon	Oh depending on what he's doing, like um I've made um you know those car rims, made a set of them before. That's just basically lining up your - bending your metal to what you want on the slope and then up onto your part and then basically bending bits of metal and cutting them with your grinder and then bending it by your angle and that.
Interviewer	So, how do you measure them? What's the sort of - - -
Jonathon	How do you measure it, it's basically get your little thing like the sort of thing you got here, whatever it is.
Interviewer	Tape Measure?
Jonathon	Tape measure thing, actually we use metal and um what they actually do is you know they one's you fold up, those metal rulers that you fold up.
Interviewer	I know, yes.
Jonathon	Yeah, well we use them. What we do is you get - you can get really small one's, what you do you go line the top up and then it's evened out and then catch up angles in with the grinder so when you bend them you're not bending the metal out, you're just cutting it just fine. There's your piece of metal there, you cut a bit of um metal out there so you can bend it in, so it sits like that and that way you're not going to be bending metal out this side or up the back which is what that's called is a fault line there, if that happens. Because it bends out and if you put weight on that it's more likely to bend out a bit more and fall out and break or whatever. Basically, yeah.

Again gaps can be seen in Jonathon limited use of relevant technical language for tools and procedures but the basis for developing mathematical knowledge is present and is leading him to take up a metalwork course at TAFE. His numeracy practices are situated in a specific geography and climate, a specific set of economic pressures, in the network of family relations and duties, but also in his passion for the weather. Numeracy and mathematical learning and knowledge more generally are often portrayed as passionless and rational. It is interesting to see how they also engage with passionate interests.

The profile of Aidan's numeracy practices some of which are similar others different to Jonathon's also show the influence of the physical and social spaces he inhabits. For example his carpentry interests resulted from staying with his sister whose boyfriend has a carpentry business:

Interviewer	Tell me about the carpentry, do you do any of the sort of measuring up or is that does your sister's boyfriend do that?
Aidan	Yeah, I do most of it.
Interviewer	Tell me how you do it? Supposing you had to make - sort of make this table, how would you do it?
Aidan	Oh I'd have to go across here and see what the measurement is from there to there and then same up there to make sure that it's all even and then from there to there and then from here to there.

Interviewer	Have you got any idea of how big this would be? I mean just guess it?
Aidan	No
Interviewer	Do you measure in metres or - in metres and centimetres or in inches and feet?
Aidan	Oh mainly inches.
Interviewer	Right. Is that what you were taught at school or did you sort of pick it up sort of —
Aidan	I was taught at school like centimetres and metres and inches. It was all new to me, but I finally got the hang of it after a while.

Here numeracy activities such as measurement are related to informal helping out with work tasks in the different places that Aidan ends up staying, interrelated with the network of relationships which is part of his social space. One significant contrast between Jonathon and Aidan, however, is precisely in their respective senses and place and location. Jonathon is located within the duties and responsibilities of a large family, Aidan is more restless, moving from place to place, his belongings scattered here and there, yet with a dream of a "place of his own". This leads to a keen interest in topics of rent prices and budgeting.

Interviewer	What would you do supposing you won a thousand dollars on Lotto, how would you spend it? Have you got any thoughts?
Aidan	I would move into me own place, like get a place to rent, there's your bond and your electricity and your gas already put on.
Interviewer	How much would you pay for a two bedroom flat here?
Aidan	A two bedroom flat, well we had a three bedroom house down in Mort Street, that was $125 a week and plus the bills.
Interviewer	So, who is we?
Aidan	Me, me brother and me - one of me ex-friends, Phil.
Interviewer	Right. So, how did you - who paid the bills? who sort of —
Aidan	I paid the rent and Carl and Phil went in with the bills and food.
Interviewer	And did that work out more or less equally?
Aidan	Yeah, it worked out pretty much like equal each way.

Later he compares prices between country and city:

Interviewer	Well, I tell you what if you ever came down to Sydney the rents there are just extraordinary, they're sky high?
Aidan	Yeah, my brother he's paying $220 a week, yeah a week.
Interviewer	That would be right. Where is that?
Aidan	Penrith.
Interviewer	Yeah and for what?
Aidan	It's for a three bedroom house.
Interviewer	Right. Well, down in the centre of Sydney you'd be paying $250 a week for a two bedroom flat
Aidan	Wow
Interviewer	And if you really wanted to go upmarket you'd be paying that for - you, a bedsit. It's crazy.
Aidan	Yeah, like a bedsitter here like you can get a two bedroom flat here in Lithgow for Department of Housing for $50 a fortnight. So, I was living at Jacksons Flat, straight across the road from McDonalds and like it was $50 a fortnight each so there's $100 a fortnight on the rent in between two people and that's really good and then the food would only be another $100 between the both of us and the bills - our gas bill was only about $23, phone bill was about $26.
Interviewer	You could budget for that?
Aidan	Yeah.

We have been able to see how the factors of geography and social networks can exert identifiable influences on the nature of numeracy practices used by these two young men. Of course as we have reiterated at various points in this report, we cannot simply attribute particular practices just to these factors but this analysis should heighten awareness of curriculum developers to the impact of such factors when selecting relevant curriculum content.

Dis/ability

Physical and intellectual disability is a factor circumscribing the range of choice in dealing with the demands of everyday life, including choice about what maths is necessary, and how it is used. Deafness, dyslexia, seizures, mild intellectual disability or special learning difficulties affected about a quarter of the young people interviewed. The process of 'inventing their lives within limits' must therefore includes these limits.

For some respondents there was a direct relationship between disability and work opportunities and subsequent numeracy practices such as David who would have followed his father into mine work but for deafness. At the time of interview he was pursuing a hydraulics course at TAFE and loving it. Or another young man whose work opportunities were severely constrained due to serious and constant seizures which have left him with impaired memory.

Apart from the ways in which a particular disability may itself affect choices and practices, we observed that often the young people's opportunities to use or develop mathematical skills was shaped by the marginalising behaviours of others towards them. For example in regard to mild intellectual disability or learning difficulties over protective parental behaviour limited or encouraged independence: Melanie was encouraged to develop a strategy for ensuring she would not get 'ripped off:'

> Normally dad gives me so much money and then I take the calculator with me and um then I add it up and then see how much it is, I've got that much money, have a look, yep and so I'll go to the cash register and see how much they had and if they're wrong I tell them - I'll say this is this and then they go, no, that's wrong and then I have an argument with them and then they say, okay, you're right so they do it again and then um I'm right then. ...

A frequent and often bitter lament from some respondents was the labelling behaviours of teachers towards them during their school years- behaviour which deprived them of learning opportunities. For example Liam, who described himself as a slow learner and who had been in an OA class in Highschool said of his teachers:

> {they}'didn't know how to teach OA... we were put in a room and basically we didn't do much...we were basically doing kindergarten work. Teachers got frustrated at us. It takes time to go over and over, but if you do you can eventually learn. We're not dumb, we just take longer to learn.'

Sam reported that she had been diagnosed with dyslexia at school:

Sam	Um they sent me to Macquarie University. The professor was doing the same sort of thing you were, with dyslexia and uh I actually - I got really upset with him because he said that I could never go on any jobs or have anything to do with reading .... like that and uh only recently I've just gone back to school, like I took three years off because I was so emotionally screwed up um —
Interviewer	So, was it Macquarie Uni that they told you were dyslexic?
Sam	Yeah
Interviewer	Did they give any - - -
Sam	Documentation or whatever?
Interviewer	No, ways to overcome it or find ways around it?
Sam	No.
Interviewer	And that made you angry?
Sam	They couldn't solve the problem, they just ......
Interviewer	they didn't show you a way around it .... people find lots of ways around dyslexia?
Sam	No, everything I worked out, I worked out myself.

Not surprisingly, Sam preferred maths to English at school. In fact she reported:

Sam	I learnt that at school and I quite enjoyed Roman Numerals. Sometimes I get them confused say a four or a six because it's the opposite way around, but not very often. ... I think it just appealed to me because I have a lot of problems with figures and I used to get my numbers mixed around - back to front and um I remember having problems like that ... but when you've only got three figures, using just those figures to work out the whole thing it is pretty simple to learn. Where I've seen other people that get totally confused by them.
Interviewer	...And that wasn't a problem for your dyslexia?
Sam	No. Because to me it's a whole new pattern. It's like learning a whole new language and just using the same three digits um over and over again in different patterns is quite easy, you know what I mean? Rather than changing the whole digit ... Well it was - I suppose being dyslexic it was an easier way to understand, rather, where I found growing up like really small I used to be very confused with 11 and 12 because you have your tens and they're not tens, they're in between that and I always get that - I used to always get that confused - it's just the way it is.

One interesting tendency amongst this group identified as having some form of disability seemed to be their liking for maths. When asked what their favourite subject had been at school all except two replied 'maths'. Responses included:

> To be honest maths because I had a good teacher who always encouraged me, and always pushed me along the way.
>
> Because it was easier than English.
>
> It was easy to understand. English was boring.
>
> Because I could do it really good.
>
> Now, I'm not the greatest mathematician, but I enjoy it.
>
> I was good at it and it gave my brain something to do. It was stimulation. I could do it quickly

Tom hadn't liked any subject, but later said that he liked numbers, it was the words that were difficult. His competence with numbers became evident in a discussion about darts:

Interviewer	What's the highest score you can get?
To	My highest or the board's highest?
Interviewer	The board's highest and then your highest?
Tom	About one... - 6 x 20s, what's that, that's 5 x 20s are 100 - you can get up to 180 the highest score.
Interviewer	On one throw?
Tom	On the - that's the highest.
Interviewer	How do you get that?
Tom	Um 3 x 20s. Three triple 20s I should say.
Interviewer	A triple 20?
Tom	Yeah.
Interviewer	Wouldn't that just be---
Tom	No, <u>three</u> triple 20s.
Interviewer	How can you get 3 triple - oh you mean if you're allowed to have three shots?
Tom	Yeah.

Interestingly this skill does not carry over into other areas of Tom's daily life requiring mathematical practices. He described various activities such as paying off a car loan, shopping, cooking, getting take-away in which he showed little knowledge or interest in managing the budget side of things. About buying coke he said:

Tom	We always go for the three litre, they last longer
Interviewer	Are they cheaper?
	Yeah, well sort of. I don't know. I wouldn't have a clue.

When evaluating Tom's apparent lack of skill in these activities account should also be taken of purpose and motivation as powerful factors in the acquisition of or application of maths skills (see Chapter 5, Managing money for further discussion of motivation). With reference to Liam again who said, 'we're not dumb we just take longer to learn': he felt that an understanding of maths was very important in being able to check costs when shopping, being able to estimate and budget, and being able to challenge bills, although he thought the need for these skills had been partly eroded by calculators and computers. Liam demonstrated 'at-homeness' with the numbers and measurements of field and track events - he is a keen athlete and at TAFE he is studying persistently and achieving good results.

Only David named English as his favourite, and maths as his least favourite subject, although ironically, he is the only one now engaged on a trade course in which mathematics is a core component. In fact, not only did almost all of the young people in this group name maths as their favourite school subject, but they were the only ones who did so. Maths did not emerge as a favourite for any of the other young people we interviewed, and for a considerable proportion it was their worst subject.

The maths education literature has much to say about 'maths anxiety': the focus is often on groups of students who are otherwise doing well at school eg high achieving girls and the question is why these groups should suffer from 'maths anxiety'. There is little to be found about the preferences and attitudes of those like Sam, Mick and Liam who are not doing well. If their positive attitudes to maths are more general then we need to tease out answers to the related question of why they don't in fact suffer from a similar anxiety. Several times an unsolicited comparison with English emerged and often the nominated 'worst subject' was English. For those diagnosed dyslexic or those having trouble with reading it is possible that maths offered participation in a different world where literacy was not such a powerful pre-requisite. As well as this negative reason ('I like maths because it's not English') it is also possible that there are positive reasons: Mick's 'It was stimulation' gives a glimpse of what these possibilities might be. This somewhat surprising finding that these mildly intellectually disabled young people nominated maths as their favourite subject yet felt frustrated and somewhat bitter at teachers' treatment of them should be cause for concern for teachers and curriculum developers. It is sadly often the case that the coping mechanisms of teachers under pressure, create more barriers rather than less for the learning opportunities for this these people.

The 'mildly intellectually disabled' label is hardly hard and fast when the level changes each year as available funding fluctuates and certainly there is no clear line between many of the experiences of the young people who were identified as disabled and many of the others we interviewed. For all these young people their disability is permeating their lives, constraining the choices they make on a daily basis. However this data also reveals the complex overlay of multiple factors impinging on numeracy practices- factors ranging from personal motivation to limitations imposed by others.

We will now turn to the fourth and final structuring category cultural background, to examine its impact on numeracy practices of the young people in this study.

Cultural Background

It became apparent, from an analysis of the data, that cultural background has the potential to impact on the numeracy practices available to, and utilised by, the young unemployed people interviewed in this research. This is not to argue that cultural background is the only factor that constrains or influences numeracy practices, but more to contend that cultural background may serve, in part, to create the limits within which choices concerning life space and agency may be made. As has already been observed elsewhere in this report myriad factors impact on the practices adopted and used by young people.

A limitation of this study relating to cultural background is that it has only analysed data from respondents belonging to cultural minorities. This is not because we are unaware of the structuring influences of mainstream culture (unlike one of the Anglo-Celtic respondents who claimed he didn't have one when asked what was his cultural background!) Rather the task of investigating ways in which socio-cultural factors of respondents belonging to the mainstream group, influence their numeracy practices is beyond the scope of this study.

We begin by examining Rashid, who emigrated with his family from Cebu, in the Philippines, when he was about seven years old. Although he only spoke this mother tongue when he left the Philippines, Rashid demonstrated fairly strong control of spoken English during the interviews, but did use some non-standard grammatical forms. However, his comprehension of spoken English appeared to be quite low at times, and he frequently required questions to be rephrased so that he understood.

Although his difficulties with comprehension appeared to be largely due to language difficulties, it is also possible that they may have been influenced by more general difficulties at school. This emerged as an issue when he was discussing the difficulties that he experienced in mathematics at school. After explaining that he found school difficult in Australia when he arrived, because he did not speak English, Rashid then indicated that school had also been difficult for him in Cebu. This suggests that not all Rashid's problems with education may be attributed to his understanding of English. However, he does also note that his education became easier as his English improved:

> I learnt more English, and then it got easier for me.

What is interesting, however, is that all Rashid's difficulties in numeracy have been attributed to language problems. When he was asked what procedures he would use to subtract thirteen from sixteen, he replied:

> I just like put lines on the paper, I'll put 26 and cross off 13 of it.

It is unlikely that such a strategy to solve fairly basic subtraction problems is entirely caused by language difficulties, considering that Rashid has been in school within Australia for nearly ten years. In other words, it is very likely that both language and more general learning difficulties are impacting on his numeracy practices, and each factor is clouding the other.

Rashid counts in English, does not know the multiplication tables, and has only a very limited understanding of the purpose of measurement, other than to determine height or arm girth. Interestingly, although he had been enrolled in Commerce at school, he had almost no understanding of issues relating to taxation, loans, or financial interactions, beyond the complexity of lay-by. He was able to use a redi-teller machine to ascertain how much money he had in the bank, but did not understand how to use train timetables. He had limited understanding of bus timetables.

His understanding of measurement related to the way measurement tools were used in his childhood. He recognised a medicine glass as being for "when I used to have a cough", and that his mother used a tape measure when she sewed. However, he demonstrated confusion about different measurements, such as 'tablespoon' and 'dessert spoon'. He believed of the tablespoon:

> It's the one you eat dinner with.

This misunderstanding may well be due to cultural background, because Tranh, from Vietnam, also had problems in this area. He commented:

> Oh yeah, because I think a tablespoon is one of the small ones... It doesn't make no difference to me. You know the rich people all have their different ones.

When the interviewer explained that tablespoons were large cooking spoons, and teaspoons were the small ones used to make coffee, Tranh replied:

> Yeah. What's the difference with tablespoons? They're all the same to me.

A different picture of the way cultural background impacts on numeracy practices may be gained by a consideration of a young person such as Terry, who was of Aboriginal descent. Terry had moved from rural New South Wales, to live with cousins in an inner urban Sydney suburb. At the time of interview, he was completing year ten equivalent in a TAFE college in a class specifically for Aboriginal students. For Terry, this had made a vast difference to his attitudes to schooling, and had, in turn, influenced his numeracy practices. When he was at school in the country town, he was apparently often in trouble, and feels that the teachers blamed the Aboriginal students for the difficulties they experienced in mathematics classes, rather than providing them with the necessary assistance. He commented:

> Certain teachers that we used to have, you know, they'd be on your case and stuff all the time. Couldn't really get into the learning process kind of thing, you know. They'd be on your case all the time about little things.... Oh it was all right I guess, maths. I used to get into it a fair bit. I was pretty good at maths actually. I had a few problems with, you know, same again just teachers and that. I had one teacher there where, you know, where I - if I go the littlest thing wrong, you know, he'd blow your head off.

This echoes the lament of respondents with mild intellectual disability who claimed that they were disadvantaged, not by their disability per se but because of the marginalisation they experienced as a result of their difference.

Since enrolling in the TAFE college however, where the focus has been on helping Aboriginal students, Terry feels his mathematics has improved a great deal, and that he has a much greater understanding. This change in attitude apparently began when he was in trade classes, learning to become a carpenter, and found that once the mathematics he was being taught had a clear purpose, it was easier to understand the processes involved. He explained that:

> Oh actually after I left I was doing a building course and I - and there was a fair bit of maths to do in that.... they was pretty hard calculations. Lot to do with areas and you know, stuff like that. ...Yeah, quantities, like you know how much tonnes of cement and that you would need and stuff like that. The width of it and the length and ... You know like once you got into it it was pretty easy, the maths part of it, ... and the teacher, Dave, yeah he was really good. He helped us all the way through it and he made it - he made it, you know, easy to understand and so it was good.

Although he didn't consider his skills in mathematics to be comprehensive, Terry demonstrated good levels of understanding when the numeracy practices related to his everyday existence. He noted that racist interactions in the wider community often included Aboriginal people being cheated in shops and bars. He related a story, for example, of being denied the right to drink in a bar, and of the bar staff charging outrageous prices for beer to take away:

Terry	I had this really bad one time um me and four of my mates we went into a pub there and I said to this woman I said give me four stubbies, you know and like these people just didn't like us from the start, as soon as we walked in. She goes oh you know, you're going to have to take it away, you can't drink it in here.
Interviewer	You're kidding?
Terry	Yeah
Interviewer	Where was this?
Terry	Oh it was back in Glen Innes uh because we wanted to have a few beers in there and just have them and have a game of pool and that's all we went in there in the first place for and uh they said no you'll have to take it away. So, she give me the four stubbies and I give her a $20 note and she comes back and gives me about $1.00 something change and I'm thinking what? You know I knew it was wrong straight from the start, you don't think we're that dumb do you? $4 you know four stubbies couldn't cost what $18.00 something like that.
Interviewer	Did she give you a chance in the end?
Terry	Yeah. She just goes oh that's it, I thought no way I want my money back, take your stubbies and you know.
Interviewer	They .... aren't they?
Terry	Yeah. Oh you know this was - I think they might have been racist, you know.

As well as having an in-depth understanding of the way racism impinged on everyday numeracy practices, Terry commented on the invasions of privacy implicit in the way bureaucracies monitor family background before providing financial support. In his discussion of the provision of Abstudy, for example, he observed that his parents income was analysed, even though he did not live with them, had been an independent worker, and the Abstudy allowance was being paid to him:

> They go right into your bank account details, money you've been earning a couple of years ago and stuff like that....And then they want your parents uh income details and everything. It's bad....but I haven't bothered to give them to them because I don't really see any reason why I

should. You know, they're paying me not my parents.

For Terry that the numeracy practices he employed were very closely linked with the way Aboriginal people are constructed within a predominantly white culture, and that this impacts on available agency to change life circumstances and life spaces. However, in many ways, the support of cultural networks, such as relatives with whom to live in the city, expands his choices. Further, Terry was able to draw on a number of well developed skills taught to him from early childhood- skills that appear to be caught rather than taught. For example, when he wished to watch a cousin play basketball in the stadium at Homebush Bay, he had no map, nor any idea of public transport options. However, he caught the train to Homebush, and relied on his understanding of direction to walk to the stadium. When he was presented with a street directory during the interview, he was able to show the interviewer the path he took to walk to the stadium, even though the event had taken place some months before.

In contrast to Rashid and Terry, Teresa came from an Italian background that was, in many ways, resource rich. Coming from an apparently middle class background, she had attended a Catholic girls private school, where she successfully completed the Higher School Certificate. From there, she had gained employment in a clerical position, left home and bought her own car. After some time, she had been retrenched from her position, but had decided that this gave her the opportunity to improve her skills. She moved back with her family, so that she did not have any financial difficulties, and enrolled at a Skillshare in order to expand her skills, including those in the numeracy areas. This included, for example, learning how to use data bases and spreadsheets. Along with access to middle class cultural capital Teresa also had the experience and skills to make use of all the resources the system had to offer. In this way, she is more like several of the Anglo-Celtic young people such as Cameron, who came from middle and upper class suburbs of Sydney, and were able to draw extensively on their educational and family resources to enable them to overcome the problems of being unemployed. It is notable that the numeracy practices of this group tended to include more advanced skills in areas such as banking, but often less sophisticated skills in managing budgets.

Through these case studies of Rashid, Terry, Tranh and Teresa we have sketched some of the ways in which specific cultural factors may impinge on numeracy practices. Although the issue of cultural influences, like the notion of culture itself is pervasive we hope to sensitise teachers and curriculum developers to its influences on their students' learning.

Conclusion

In this chapter we have presented evidence to show how four social structures - gender, location, disablity and culture - work to shape the mathematical choices that individuals have made. We have tried to look here at 'human action as involving free invention within structural constraints' (see Introduction): at how and why Angie chose to budget carefully when David didn't; at how the physical and social location in which he lived fuelled Jonathon's curiosity about the science of weather; at how diagnosis of dyslexia coloured Sam's attitude to herself; and how Terry found school an 'uncomfortable' place for learning. The shaping wrought by social structures is at times clearly constraining, at other times enabling, but it always present.

From a pedagogical perspective, it is to be hoped that data in this chapter will help teachers to value, and then to extend, the practices that students have already 'invented' within the structural limits that constrain their choices.

Chapter 5 Everyday Sites of Numeracy Practice

In this chapter we examine the data from the perspective of three key everyday sites where the young people involved engage in some mathematical activity. These sites are: interacting with bureaucracies, negotiating transport, and managing money. A close examination of the broader social activities in which mathematical activities occur can generate an understanding of why particular responses occur and why particular strategies are used. It can also provide teachers with a rich source of authentic mathematical starting points to use in curriculum development. In each site, excerpts from the data have been selected to demonstrate the variety and complexity of the mathematical responses, and to illustrate the different ways that the young people invented or appropriated mathematical procedures to solve their problems and to communicate to others. The first site investigates how numeracy was implicated in the dealings of the young people with a range of bureaucracies.

Interacting with bureaucracies

The institutions which young unemployed people had had most dealings with were the education system, including schools, TAFE colleges, community colleges and Skillshare centres; the banks; the Department of Social Security (DSS) and the Commonwealth Employment Service (CES); the Australian Tax Office (ATO); and, for a small number, the law courts.

Those bureaucracies which required the most sophisticated numeracy practices are the DSS, the CES and the ATO. Our study indicated that the younger people and some of those with an intellectual disability or a reading disability found it quite difficult to 'navigate' their way around the complex 'formulas' of these institutions. Without adequate assistance, there is no way some of these young people can check whether they are being treated fairly by their benefit arrangements. The recent pressures of restructuring in the DSS and CES (see Chapter 2) have meant that staff, especially in busy offices, do not have the time to explain carefully the workings of the 'formula' for each change to benefit arrangements. Many of those having difficulty understanding benefit 'formulas' indicated they had reading difficulties. The forms appeared quite complicated to some, and there was a degree of anger expressed by a few who felt they had not received the assistance they required.

In many cases the main 'positive' engagements were cited as occurring with TAFE, community colleges and the Skillshare centres. The DSS and CES especially seemed fraught with 'negative' reactions. The majority of the young people we spoke to had a reasonable understanding of the broader role of the DSS and CES (as at early 1997), and of the tax system, but their personal interactions with these institutions seemed in many cases to have been difficult.

Given that young people who move frequently between benefits and mainly casual and part-time work will have multiple, on-going dealings with the DSS and CES, it is not surprising that many of them recorded some negative experiences. The constant rate of organisational change to these two bodies appeared to play a part in the frustrations expressed by some of the young people. Some stated that they had to constantly try to keep abreast of the new arrangements. Staff in public institutions undergoing rapid reorganisation and philosophical realignment may also be frustrated and demoralised by the changes, so the interactions between the two groups could understandably be difficult in many cases.

The findings from our small number of interviews do not appear to be unusual. The study by White (1997) involving in-depth interviews with 550 people aged 14 to 25 years old about what they liked about their dealings with the DSS, found that 37% of 14-17 year olds and 41% of 18-25 year olds, said 'nothing'; 43% and 25% respectively claimed the thing they disliked the most was the 'waiting'.

The Department of Social Security

Those young people who relied on the Newstart Allowance, the Youth Training Allowance, the Disability Support Benefit, or the Sole Parent Pension described a complicated system of arrangements which they had to monitor to remain legal and to maximise the amounts of money received (for some, in order to survive).

Some of the young people were fully conversant with the amount of their fortnightly payment and the accompanying income test. Others were more vague about either the entitlement or both the entitlement and income test of the benefits - this was more likely to be the case of those living with parents. It appeared the majority of those living away from home at least knew what their basic entitlement was.

The current organisation of the DSS requires people to make appointments with an officer to discuss certain changes in their circumstances, for example, stop/start new job, increase/decrease income beyond a certain threshold, significant increase/decrease in bank account holdings, changes in marital status (including de-facto). Missed appointments jeopardise the payment of benefits, as does multiple rescheduling of appointments (even if you're a casual worker who does not know in advance changes to work schedules).

There is a complex formula for payment of each of the different benefits, taking into account a range of factors: age, marital status, income sources, assets, payments from the Child Support Agency, rental situation, hardship provisions, number of dependent children, physical mobility, family payment arrangements. Some benefits are taxable, others not.

At present (August 1997), the income test:

- deducts 50 cents for each dollar earned between $60 and $140 a fortnight and
- deducts 70 cents for each dollar earned over $140 a fortnight (for Newstart and YTA).

Given these conditions, and the low level of the current allowances (see Chapter 2), it is very difficult for young people without family support to get out of the poverty trap associated with benefits. For an under 18 year old away from home the benefit cuts out at $1102 p.a. Because of tax and work-related costs, young people living away from home need a job paying more than $20000 to make it possible to get off benefits. The youth labour market offers very few jobs with incomes in this range.

In relation to the present study, what struck us the most about these complex arrangements and the way the young people experienced them, was the nature of the DSS formula. The DSS rules and their mathematical reductionism do not easily fit the reality of people's lives. Those young people who had had several casual or part-time jobs voiced a frustration with the 'rules' that required them to maintain a constant 'pipe-line' or an 'attachment' to the system. Every time they started/stopped a job, or reapplied for an allowance, or discontinued a relationship, they had to notify the DSS, depending on the type of benefit they were receiving. Every change of circumstance apart from minor ones meant a reassessment of the benefit paid.

A few said they could comprehend the rules and work out whether the DSS officer had got the recent changes to their situation correct; others were obviously having problems.

Jonathon (16) also indicates that he has problems reading parts of the DSS forms. He thinks he understands the formula for working out his income test, but in fact he has doubled the income amount you can earn before the benefit is affected. The mistake seems to emanate from a partial understanding of the income averaging rule. Here he was talking to the interviewer about whether the Newstart Allowance is taxed:

> Yeah, depending on what you earn like, there's different earnings you can earn. Usually mine's only about $10 a fortnight. [You can earn] up to $60 a fortnight, but you can - like if you don't earn anything that can come off that - the first $60 goes onto the other $60 and in a fortnight you can earn $120. If you've got a job you can earn $120 without - you don't even have to notify the dole office that you actually went out and earned that money. Yeah, they explain all that. They're pretty helpful.

In fact the income test is much stricter than this, with benefits reduced by 50 cents, then 70 cents in the dollar, after earnings of $60 a fortnight, although earnings can be averaged out for a set period agreed to between the DSS officer and the benefit recipient.

Tranh (21), doesn't understand how he is meant to work out the amount of tax if any he may want deducted from his benefit. The interviewer asked how he knew how much tax should be taken out of his allowance:

> [These forms] make - it's really hard if you don't know what you're doing. Like if you're filling it in yourself for the first time it really complicates your mind..... I usually - I got no tax. I don't want no one taking my money... It's like saying, here take my money. Give me some and then take some of it out.

Sam (19) explained how frustrating she found it both to rely on others to survive if you are only getting benefits, and the lack of assistance for those with a reading disability. The interviewer asked if the dole was enough for her needs:

> Not really, no. I stayed with Alex my partner rather than going back to my mother, um, due to my background that wasn't a good thing. ... [A single person could survive] if they were boarding or something like that; whereas I was actually paying rent, paying the food, bills, it's not....you can't live.... I found over the years the whole time that I was always depending on someone, I always had to lend money off someone. Another thing is that when you're on Austudy or the dole you can't get anything like a loan or anything like that. If you don't have family you're nowhere basically.

Tom (19) who supports himself, has moved a number of times, mainly because the shared arrangements did not seem to work out very well. He was getting tired of the need to constantly update the information for his rent assistance, and sometimes in fact didn't get it:.

> All depends if I put the rent - sometimes I do, sometimes I don't. If I put a rent receipt in...You need to put in one receipt every time you move. Every time you change your address you have another receipt in... Social Security just stuff you around. Go here.. when I went down there one time they told me to go to the CES, do this and come back, and do that. They just make me run up and down, up and down all day.

Schools and further education

Very few of the young people told of good experiences with their schooling, with the exception of the two young women who had completed year 12. One of the older people we interviewed, Teresa, aged 24 , had obviously enjoyed her schooling and said she had a family with the financial ability to keep her at school. She had completed her HSC, gone into a full-time job, was retrenched after five years, moved back home with her parents, and was on the dole for some time before starting a training course. She gave the impression of making the most of whatever training the DSS system had to offer, having done several courses including a number of computer courses to enhance the skills she had picked up in the workforce.

Liam (26) on the other hand was one of those with less positive experiences of school. He had problems with his reading and said he had been in a 'slow learners' class, which he seemed to imply had really been a 'babysitting' exercise. Another young woman, Sam (19) had mixed reactions to her schooling. She liked maths....

> I enjoyed it, um I suppose it's because of the teacher, most of the way, and it was something that I was good at, yeah.

But she was angry that nothing had ever been offered to help her with her dyslexia:

> They didn't solve my problem, they just crushed my dreams... No, everything I worked out, I worked out for myself.

Jonathon describes his dislike of school and his need to leave early, yet he can understand the need to ensure that you have the basic skills before you leave. At TAFE however Jonathon has found a new love of maths , because he wants to get into metal fabrication, and is doing a TAFE course in metal work. Like Terry (Chapter 4), Jonathon is finding that having his own purpose for learning is making a difference:

> I don't really know how I got into it. It's just like one day I found out that I had the talent, that I could write off maths quicker than I ever could... I was thinking about getting into metal class, you know how you build metal chairs like that, sometimes you see on um home improvement shows like where they got the metal and they twist and that, I was thinking about going into that profession.

Liam has also discovered pleasure at doing Maths at TAFE and says it is because the teacher is patient:

Liam	..I'm just starting to use Maths to work things out, like percentages, my budget, and a rough idea of how much I'd need to take, you know if you need to buy something.
Interviewer	And are you learning that at TAFE or have you learned by life experiences?
Liam	Life experience, but also a bit more at TAFE because the Maths teaches me percentages, I need to know this.
Interviewer	Were you confident with percentages before?
Liam	Well, I never really thought about it before. Now I'm more aware, cautious.
Interviewer	Is this because you've got a bank account?
Liam	Yeah, um bank account, also my dads got a farm and um one day I will have to run it, or I will go into business as well. I have to be better at maths.
Interviewer	What about fractions?
Liam	Yeah, I've learned a lot through here [TAFE] as well. I was really bad at fractions.

The White study (1997), found that most young people's criticisms of their schooling related to...'institutional processes, including issues related to curriculum and the pressures associated with formal structural learning processes....and.... negative experiences with teachers'(p 100).

These types of schooling experiences probably account for the comparative popularity of TAFE, Skillshare and community colleges as sites of learning, for the young people in our study. These institutions (especially the latter two) are less formal than schools, and seemed to offer smaller classes and the opportunity for the one-to-one type learning experiences that most schools are unable to offer these sorts of young people.

Banks

Some of the young people exhibited a high degree of control over the way they made use of banking services, as can be seen in Matt's comments (see Chapter 4, gender section) where he explained that he doesn't like a credit or debit card because a passbook account gives him a clear picture of his savings. A number of the people kept all their ATM receipts on file to check against their bank statement (monthly or quarterly). Some kept only the most recent one until the next transaction, as a way of checking their account balance.

Mary (24) was very conscious of her need to keep an accurate account of her bank balance and to have a strategy for managing bank charges, especially when she was on benefits. The interviewer asked her whether she used ATMs and whether she checked her statements:

> Your receipts? Yea, all the time. [I keep them] always, for your record. Sometimes they (the bank) make a mistake. I've looked at my statement, said there's something wrong here. I went to the bank...I get a statement once a month from the bank and I check to see the deductions are right, all the charges are right - the hidden charges they don't tell you about....I know roughly what should be in there. When I was on the dole I'd go to the ATM and pull out the money all at once, because if you use it [ATM] regularly they charge you. That's what kills your balance. Take it all out, leave it at home and take it as I need it. Even when you get petrol, whatever you're buying with [a card] they're charging you.

The Australian Tax Office

Very few of the young people who had been or were currently in formal paid work gave an indication of understanding their own tax arrangements. Some said they relied on a tax agent as a mediator to do their tax return. Others said they didn't bother with one. Sam, who appeared to be an astute budgeter for herself and her household of three adults, said she had never understood her tax arrangements.

Sam	Um, I've never really understood my tax form and I never really understood how to calculate any of it either. I don't think I've ever had them fully explained to me.... I tell you honestly I haven't done one since...well I've never done it.
Interviewer	So you could be owed money and not able to get hold of it?
Sam	Yes.
Interviewer	So you haven't thought of using a tax agent...?
Sam	Well, I'm looking back now about five years, so to get all the documentation I need, I'd be running around.
Interviewer	So you don't have the group certificates?
Sam	I have maybe one or two of them, but I moved around a lot over the years, so I don't think they've actually ever caught up with me.

Interviewer	Are you worried about putting one in now because you haven't in the past, or is it the maths of it?
Sam	A bit of both. Because I don't understand it, is a big factor. Because no-one ever wants to help you with it because it's so confusing, um so because I'd have to trace everything back so many years........Well, I know they owe me money because most of the time I was unemployed and I always put down the tax bracket for some reason. So I didn't understand tax, and I'd say, take out more than needed. I wasn't earning enough to pay tax really. I didn't earn the price that um...
Interviewer	So they were actually taking out more than they...
Sam	Take $20 out of it a fortnight, stuff like that and then I was working at Macdonald's and I was still below the price or whatever it is.
Interviewer	The tax threshold.
Sam	Yeah, I don't understand any of that.

The courts

Two of the young people had come into direct contact with the legal system. Both were young men. Tranh (21) did not wish to reveal any details of his encounter, although he said it was related to drug activities. The second, Mick (20) has had a health problem requiring several operations and which seems to have left him with serious memory difficulties. Some of his financial problems have arisen from a court imposed fine due to non-appearance. He said he did not remember to keep an appointed hearing date because of his disability. The community college he is currently attending has taught him to keep a daily diary, including entries related to the amount of fine money he has been paying back regularly from his benefit. The diary was one tool he had learned to use to assist his numeracy practices, amongst other things.

> Yeah. I've got a daily planner....Because of my forgetfulness, yes....A little bit before it I was forgetting little things and now last week or the week before, I think it was, I had to go to court for break, enter and stealing, I'm on a two year good behaviour and I've got to find $1100....$50 a fortnight out of me pension and I was there and I just - one day I forgot to go to the probation board because I had to get a pre-sentence report done and it's over a certain amount of um days you go there that they do this pre-sentence report to find out oh does he feel sorry he's done this parole and stuff like that and the basic family — [and] it just slipped me mind.

Travel and transport

The second site of common everyday practice which was examined for insight into the numeracy practices of the respondents was negotiating transport - getting around. Although some of the young people interviewed drive cars, more often they are public transport users. The degree and manner in which they use various literacy and numeracy resources relating to travel and transport varies considerably, however. During the interview, they were asked about their use of train and bus timetables and street directories, in particular, although other areas of interest that related to these occasionally emerged, such as the skill of one informant in using maps for orienteering. The following excerpts reveal that a high degree of what is commonly called mathematical literacy was required to negotiate written texts related to travel.

Timetables

Interestingly, it was discovered that although many of the respondents travelled on trains and buses, timetables frequently proved difficult to read or understand. Particularly notable is that on occasion, the young people interviewed believed themselves to be competent timetable users, but showed little facility when presented with a practical task using a timetable. Tranh, for example, who used the train a great deal, claimed he could 'figure it out', when asked if he was able to use a train timetable. However, when presented with the timetable, he appeared puzzled, and had clearly not used a train timetable before. He flicked somewhat aimlessly from one page to another, and then noticed the 'Nightrider' bus timetable, and said: “This is a bus - even a bus table there.” Finally, the interviewer guided him so that he could complete the task of finding an appropriate train to catch from Cabramatta to Strathfield:

Interviewer	You go down to the front and what you need to do is find Monday to Friday, so you've got Monday to Friday over there.
Tranh	And you've got Liverpool to city.
Interviewer	Yeah, so that's going in the right direction and then what time of day - we're too late in the day, aren't we?
Tranh	Oh Liverpool to city.
Interviewer	There's Cabramatta.
Tranh	Yeah, now you want to go what time?
Interviewer	I want to be in Strathfield by the middle of the day. What time is - this is ---
Tranh	That's too late.
Interviewer	That's too late, yeah it is because that's PM. Let's go back a little bit.
Tranh	PM. Here we go. So, what do you want to do?
Interviewer	I want to be in Strathfield by the middle of the day, say by 12.00....Yeah, so what time do I catch it in Cabramatta?
Tranh	A Cabramatta one you would catch at um --
Interviewer	I can't catch this one, can I?
Tranh	Wait there, Cabramatta, no. You've got to figure out the time now.

It is clear from this interaction that not only did Tranh have little idea how to use a timetable, but that he also had difficulty conceptualising the task. Yet once he was helped through the task, step by step, he was able to look at the time of departure from Cabramatta and arrival at Strathfield, and comment:

> So, it would take about 20 minutes to get from Cabramatta to Strathfield so I would catch the 11.23 one.

It seems likely that for Tranh, the lack is really not so much in the mathematical skills involved, as in his lack of familiarity with the genre of timetables, and presumably, his lack of need for them in his everyday life. When questioned about whether he actually used train timetables, he commented:

> No, I just look at the boards. But the bus timetable is like - it's just simple like you know that you've got to look through and you've got to go through certain things, but the bus is just one

page, you know how it's got the little board."

Cameron was also unfamiliar with train timetables, although he regularly used bus timetables. When asked if he could read train timetables, he replied:

> Yeah, actually I'm quite good with them. Not - I've never read a train one, but bus ones I read every day. I never knew they [train ones] existed."

However, unlike Tranh, when given a quick explanation, Cameron was able to generalise from bus timetables to train timetables. He commented:

> Yeah, that's the same as my bus... Chatswood to Gladesville and then Gladesville to Chatswood on half. Yeah... actually they did put in a new one, like I think it was this year and I just found that like I used to have it up at Town Hall and the old one I used to go up and read it clear, but for some reason this one just the way they set it out and I just really - like I could understand it, but it took me a little bit just to understand.

When asked to perform an actual task using the train timetable, he was able to integrate timetable use with an understanding of time, and the possible need to get to a destination by a set time. He asked: "Are you going to be in a rush?" He then used this information to decide whether it mattered if the station was reached very early, or just a little late. He then completed the task competently, with very little difficulty, and expressed surprise that other people might find the task daunting.

Young people from the country took quite a different approach to the use of train and bus timetables. Charmaine, for example, commented that the timetable in Lithgow looked unlike those for the city, when she was shown them. She explained that it was really quite simple to know what times to catch public transport in Lithgow because "down like my area of town to get up that end at quarter to, they leave down here at half past."

It seemed to be common knowledge locally that the bus ran at quarter past the hour, and until recently, there had been no bus timetable because it was unnecessary. However, now that the timetable was available, Charmaine would look up the times before catching a bus "just to make sure". However, although she did not know what time the return bus left her destination, she did not use a timetable: "I don't know, I've never looked it up before, I just usually wait a while."

When asked if she had used a train timetable before, she replied

> Well I go to Newcastle so I kind of know that... if you miss one that, you know, if you're - you've got to catch a certain number on the top of the bus to get to a certain place and like, you know, you've got to work it out. Go along with that number, I know how to do that. Like I don't know about this one.

Although the researcher gave her considerable guidance, Charmaine found the task of following a train timetable very difficult, and needed considerable support to complete the task. However, once again, this may not be so much a matter of not having the mathematical skills to complete the task successfully, but of being unfamiliar with the genre and not needing the skills in the first place, because of the way country public transport is organised.

Street directories

Although most people interviewed felt confident (often misguidedly) that they could read a train timetable if necessary, many were less confident when presented with a street directory, and it was not uncommon to find that the person being interviewed had never actually used a directory. This is probably not surprising, since they were, in the main, public transport users. However, most were willing to tackle the task, with somewhat mixed results.

Cameron felt quite comfortable using a directory, because he had done so many times before. He related how he had travelled overseas with his parents when he was ten, and that he had used maps then. When presented with a particular task, he found the suggested area immediately, and quickly adapted to the streets being at the back of the directory he was offered, saying

> Yeah, sort of the front or the back and you just - yeah, it depends If you like, you're like looking for a park you'd normally it should say park - see, it's even got the TV stations and like where to find them.

Cameron was also distinctive in that he used map reading as part of his recreation.

> And orienteering. I used to actually do that for a sport.... I went there once, first time I did it I went really good so, you know, everyone is going oh yeah, stay on, stay on, ended up coming - yeah, third or second in the state. Like I've got a certificate and that at home.

Charmaine, on the other hand, had negligible experience using maps or street directories. She commented that although she had not really used a street directory

> I know me way around. I've looked on the maps and seen where I'm staying, but that was just like to see one street.

Similarly, Rashid stated that he did not know how to use street directories, but rather

> I just ask for directions.... If I had to go to say um to Campbelltown or something - Campbelltown around there, someone like this street or that street, I would write it down, I go to Campbelltown and like I ask for this address.

Then he admitted, that by preference, rather than take a train to a place that he did not know

> probably - I'd get a friend probably would drive me down somewhere and ask where it is.

Tom also volunteered that he used a 'Sydney road guide' when he was down in Sydney, from the country. However, when questioned about where his brother lived on the map, he said: "I wouldn't have a clue". When reminded that his brother lived in Campbelltown, he replied:

> Campbelltown. I wouldn't know how to get there. I used to catch - he'd meet me at Lithgow and drive from Lithgow to where he is, even though I fell asleep after Lithgow. I wouldn't have a clue whereabouts it is.

In fact, it seemed that he had really very little understanding of how to use a street directory, despite his earlier confidence. He was, however, able to draw a map of his local area, and to comment on aspects of the area as he mapped it. When the interviewer questioned him about a street on the other side of town, he was able to draw her a map of how to get there, indicating a strong understanding of the nature of maps, even if he was unable to use a commercially produced directory.

> Oh god I'm hopeless at drawing maps.... That's Harris, this is the street, go straight along Harris Street, there's - that's - it's off Bell. Alcott - that's Bell Street, it goes Alcott, Princes then Mary Street.... It's - the same block as what the hospital has got there.... Just one big block. And you go up Princes - what's - which is the best way to get from here? There's about three ways you get into Alcott Street... You can go right down Harris till you get to Matthews Avenue and chuck a left and go straight up Matthews - go straight up Matthews Avenue to chuck a right then you're on Alcott Road.

There was clearly evidence that for this group of young people negotiating travel included a range of strategies, only a few of which involved recourse to written texts. That tendency was mirrored in the instructions given by the teachers we contacted, particularly those in the country towns, when they gave us instructions on where to meet them. We asked for maps and addresses, they replied with word pictures, locating the meeting place in relation to local landmarks, like the hospital in Tom's account above.

Managing Money: more or less mathematised approaches

In the final section of this chapter, we look at the ways in which numeracy practices are embedded in the very basic day to day use of money, in domestic income and expenditure, as well as leisure and vocational activities. We explore how the young unemployed people we talked to use mathematical knowledge and skills in terms of managing their income, from whatever source, and how they budget and spend money. Some of the case study data used here is also used in Chapter 4, from the perspective of gender and location issues.

As noted in Chapter 4, the life circumstances of the person make an impact on their everyday numeracy activities in many different ways. David and Cameron live at home, in comfortable circumstances with different kinds of support, while, at the other end of the scale, Tranh is on the streets. Others like Aidan, who lives a peripatetic life, partly at home, partly with other relatives, manage for themselves, even when staying at home with their parents.

In the following excerpts we look at a range of activities involving money - spending money (including shopping, repaying loans and budgeting), being ripped off, dealing with benefits and earning money. Some of the people we interviewed drew extensively on their mathematical knowledge and skills in response to one or more of these activities; others adopted more social, less mathematical strategies. We examine these responses according to the extent to which they are more or less 'mathematised', that is, the extent to which the young people used or did not use explicit, precise mathematical knowledge and procedures in their responses to the activities.

We also present evidence from the data to show how interest and enjoyment, as well as survival, are crucial factors in the degree of mathematisation of different activities.

Sam's practices epitomise the mathematised approach and she is also a person who engages in them with noticeable enjoyment. As we have seen earlier in relation to gender (refer to Chapter 4 for a more extended description), Sam uses a mathematised approach in most of her dealings with money. When asked how she had used maths since she left school she was quick to reply 'budgeting' . When she shops at the supermarket, she does the calculations in her head if she is only buying a few items, but to keep tally of a large number of items she uses her calculator. She also uses a calculator in the fairly complex calculations she needs to do in relation to loan repayments. She identifies herself as taking responsibility for budgeting both for her partner and in the shared house where they live. The sense of control that such careful calculating gives her is clearly enjoyable.

> I do all of it. I like to have control over everything, I like to know what's happening.

On the following pages we examine a number of activities to see how the young people draw on a range of on mathematical skills and knowledge. You will observe the presence of both precise, highly mathematised operations like Sam's above as well as more social strategies in these activities. You will also observe how the choice to use a more or less mathematised strategy is closely linked to other factors in the immediate situation - factors such as the number of people involved or the social relationships between them.

Shopping

In this excerpt from Matt's description of how he approaches the weekly supermarket shop you we see him use a range of mathematical concepts involving price, accuracy and volume.

Matt	Well, I'm used to shopping. Usually when I go into the store I look for the bargains like everyone else does. If say, I'm buying a Coke, I'll go for the cheapest. If I'm buying for a week I'll get three or four bottles to last me the week. Or if I'm expecting someone up for the weekend, I'll buy a box.
Interviewer	So tell me how you work out which is the cheapest brand or if it's on special.
Matt	Sometimes I take a small pocket calculator which I'll use if I'm doing a lot of shopping. If I'm only going in more or less every week or maybe for a weekend, I'll do it in my head. It all depends what type of shopping I do.
Interviewer	Does it depend on the quantities you're going to buy?
Matt	Yes it does. If I'm only doing more or less one weekend's worth of shopping, I just go in and say I'll have maybe a bottle of Coke, some ice cream and stuff like that to tide me over the weekend. Or if I'm going for a week or a fortnight I might buy two boxes of Coke and other things as I'm going along.
Interviewer	So you're standing in front of the shelf and you've got Pepsi on special or Coke on special and home brand etc, how do you work out if you haven't got a calculator how you work out what's cheapest?
Matt	Usually I'm Coke drinker so I generally stick to that brand. I'll go for the small bottles because they're easy to store in the fridge. I have a small fridge. So I'll buy about eight and put two in the fridge. When they're gone I'll replace them.

Melanie, identified as mildly intellectually disabled, does the family shopping, and uses the calculator to keep on top of the task:

> I always do shopping for mum and dad....We have a family meetings um me and my cousin, because he lives with us, he comes shopping and he wants everything on the shelves and he goes oh I want this, no. ... If I have money I will buy it, if I don't have money I'll just miss out....Normally dad gives me so much money and then I take the calculator with me and um then I add it up and then see how much it is, I've got that much money, have a look, yep and so I'll go to the cash register and see how much they had and if they're wrong I tell them - I'll say this is this and then they go, no, that's wrong and then I have an argument with them and then they say, okay, you're right so they do it again and then um I'm right then.

Matt, Melanie and Sam are all very interested in taking control of their own finances and use a high degree of mathematical knowledge and skills to do so.

Others just shop and don't count the cost, drawing more on social relations to solve problems rather than specific maths procedures. Their activities could be described as less mathematised. Tom, mildly intellectually disabled, has a much more laissez faire attitude. He goes shopping when he needs to, maybe once a fortnight:

> And it could be once a month. We just nick over to the garage and get what we need. And go over back home, just walk back across the road. [Sometimes] we just go down to Payless and grab .. like they've got real cheap butters. Then we go up to Franklins and do the rest of it.

When asked what he bought he said

> Bread, butter, Coke - Coca Cola when we have a drinking binge...We always go for the three litres, they last longer. .. I don't know [whether they're cheaper]. I wouldn't have a clue.

This is David's account of how he manages his shopping:

> I usually borrow a bit through the fortnight and - off me parents and that - and usually pay them back and then usually try and buy everything I need when I get paid, like pay everyone back, depending ... if I don't borrow I try and stretch it out for as long as I can, the money. I need cigarettes, I'm a smoker... Yeah I just sort of try and keep it going as far as I can. It doesn't go far, by the time you buy a drink here and a drink there and lend someone five bucks here and can't afford it but.... Sometimes I write it down. A lot of times I just keep it in my head, depends how much I owe. If it's five dollars or something here and there I write it down 'cos you lose track of it but if it's 40 bucks- 30, 40 bucks - you sort of can remember it.

David seems to extend similar social strategies to his dealings with expenses in shared houses and when out with his mates:

> Like me mates that I moved in with they were workers and it'd be fifty fifty and they'd throw in a bit extra because they're working. No-one's really ...like everyone's sort of 'yeah fifty fifty' or the workers they'll put in a little bit extra. Like me and an unemployed mate and a working mate went to Bathurst yesterday ...and we had a few beers, like I had 20 bucks, me working mate he bought a feed, I bought a feed and shouted the other mate, the mate who's unemployed. That cost 10 bucks for the feed and then the working mate, he'd already shouted a few beers so I just said 'here's 10 bucks' and we were both shouting the other mate. ... If you've got the money you go halves or close to halves.

Tom and David in different ways do not draw on their mathematical knowledge, in the way that Matt, Sam and Melanie do, dealing with these day-to-day budgeting problems. Their strategy is more to do with approximation, 'she'll be right', relying on social networks to sort things out. In these domains they are living in a less mathematised world, while in others, for example in the complex hydraulics equations that David does at TAFE and in the fine tuned knowledge of costs and profits on the drug scene that Aidan possesses, they are working in highly mathematised ways. This close association between purpose and choice of whether to use precise calculation or not, and the swiftness with which the user may move from one to the other can be seen in Aidan's account of shopping. Initially it would seem that he is not interested in careful planning:

> Yeah, I just go in and grab whatever I want and just go back home and stick half of it in the freezer.

Elsewhere however he talks about using a calculator to check his purchases:

> When I go shopping I'm always kind of carrying a calculator around. And like see how much everything is going to cost As I get item by item I put it all into the calculator and then by the time I hit the checkout I can give them the exact change.

The importance of non-mathematical constraints in the decision about how much mathematics will be used in a given situation is highlighted when Lynne distinguishes between times when her mum does count the cost (when money is short) and times when she doesn't:

> It all depends. It all depends, like mum did that once, like she's just grabbed all the groceries and then just went to the checkout. But when we've hardly got any money mum takes a piece of paper around and a calculator.

The distinction between more and less mathematised ways of approaching an issue like spending and budgeting comes out also in the way different people responded to the pizza question. Matt for example treats the pizza activity as something to be solved mathematically, although his solution is mathematically rather flawed. David on the other hand treats the question, in the same way that he does the issue of who pays what on the trip to Bathurst: as a social problem with a social solution, not as a mathematical issue at all:

> One of us might be a bit short and have only three dollars and the other two'd put in, you know, depends who's got the dollars at the time.

The different responses to the pizza question are analysed in more detail in Chapter 6.

Being ripped off

We find a similar distinction between more and less mathematised approaches to problems in the responses to the issue of being ripped off. Some told stories which demonstrated their ability to think mathematically on their feet, as this excerpts from Melanie shows:

> A lady tried to rip me off. She said no, this is the right price and I said no and then when I went home I had the docket - no, I looked on the shelf and seen how much it was and then I only bought one thing and it was $3.00 something and then she said, no, it's $4.00 and I said, no, you go and look on the shelves and you'll see it's $3.00 something. She said, okay, I'll go and look on the shelves so she was going to be smart and looked on the shelves and it was $3.00.

Charmaine on the other hand adopts a 'no worries' approach, similar to David's response to the pizza question:

> Sometimes you think oh I'm meant to have more money than what I have. Like my sister and I were sort of down town and she ..... put it through and she reckons like she mis-placed $30 and she's saying oh somebody ripped me off, somebody ... she didn't worry about it. She thought oh well, you know, she went and brought everyone a feed like me and my brother and a feed and she went and bought like - like she's pregnant, you know, she's growing out of her clothes so she went and bought tracksuit pants and big shirts and all that. She give me brother $50, so you know, like it could be, you know - she wasn't sure.

And Cameron , for example, doesn't count the cost of what he buys, although he perceives the dangers of not doing so:

> To be honest I sort of do it at the time. Like I don't - after while I don't really take notice of the docket but I know my parents do at the supermarket. It's only because there's such a large amount of things, they don't actually work it up in their heads to the exact like dollar. But yeah it's quite - a lot of people really don't know how to add them up and just always get rorted.

Understandings benefits

Just as we identified more and less mathematised approaches to other activities, we can similarly find these differences in approaches to benefits. In the earlier section in this chapter on interacting with bureaucracies, we discussed Jonathon's flawed but mathematical understanding of how much money he could earn in addition to the Newstart benefit. Angie also treated the question of benefits in a mathematical way, carefully working out how much she will earn with the pension and child endowment, and how factors such as her partner's wage would affect that total (for more detail see Chapter 4, section on gender).

Aidan on the other hand has a much more 'she'll be right' approach to the same question:

Interviewer	Are you on a New Start allowance, or what?
Aidan	Yeah, I think it's New Start.
Interviewer	Cos you're able to do a bit of work while you're claiming I think.
Aidan	Ah, I think you're only allowed to earn so much a week while you're on it, you're only allowed to earn a couple of dollars if it's a part-time, if it's full-time you get cut off, but if it's part time they've got it all worked out down there that you're allowed to get so much.
Interviewer	Do you know the figures, I mean how much it is, or...did anybody explain that to you?
Aidan	I think I can earn around part time, $200 a week, I think, a hundred or two hundred, I'm not real sure, but it's not much. And then once you earn so much if you go over that amount, for every dollar you earn then they start taking it off.

Earning money: passion and survival

Budgeting, loans, benefits were all ways of managing money related to survival. Earning money other than benefits brought up questions of both survival and motivation.

David was unusual in that his experience of work was largely through the formal wage economy, and he had his future planned to develop that involvement into more highly paid and rewarding work, through his study of hydraulics. A large number of others had wide experience of more casual work, sometimes paid, sometimes not, and a few had ways of earning money that verge on the illegal.

Some, like siblings Jonathon and Jillian, were paid for such things as some of the work on the farm their father managed, and for work for their uncle at the local agricultural show. In the casual work that people like Kevin were involved in we can begin to see how a commitment to the activity might stimulate a detailed understanding of whatever mathematics needs to be grasped:

> With the cement garden pots like I've got to use [maths] so I can work out how much sand and how much cement to use as well. Like if I'm using - if I'm doing a half a mix I've got to use half a bag of cement and that's 20 kilos of the cement and then I've got to do another three 20s of sand. If I don't do it like that like there might be too much cement or there might be too much sand and I won't get the right colour and that and - it probably just won't to stay together.

Tranh has a friend with money, who gives him money to place bets and he identifies this activity as one where mathematics starts to have meaning for him:

> I've got a friend right who's got - he's my age, exactly like me, left school in year 7 and he grew up with me and he inherited $114,000 and all ... No, no, he doesn't live on the street, his father passed away ... and he got all this money and where I get my mathematics is from is like he goes, "Tranh, here's $100, go put $25 on the gambling." Because he gambles a lot. And every now and then he might win, you know, Royal Flushes and all that?
> He'll win something on that and we'll figure out okay ... one credit is 20 cents, $1.00 is five credits. So, if you got 500 credits that's $100. That's how I get my mathematics. Because he gambles so much, I mean $300 or even more.... I mean like he spent thousands and thousands already and I get my mathematics from when he withdraws money. So, I keep like a - I don't know what it's called, but when you take money out I just - I let myself in my mind [take note] how much he spent, what he used it on and all that stuff.

The scope of Aidan's activities in the local drug scene range into the area of what White (1997) calls 'the criminal economy'. Prices and profits for speed and heroin play a key role:

> For a shot you're paying roughly around $40 a shot. And for cannabis you're paying $50 for 2 grams and 2 grams that only lasts me by myself - about two hours. I used to grow me own, but not no more. Considering the coppers found me last one. It was on the other side of the mountain and I had 250 plants and they found them - so, not doing that anymore. Just going to have to fork out the money. So, there's like a lot of kids that are doing it and they turn to like crime. Do break and enters, thieving, just to like supply money for their habit. So, no, I just to do it, but then I found a solution like you grow it yourself, there's going to be a hassle if you get caught, but like that's a risk that you're going to have to take. So, you can take money and eventually I thought after they found it, I thought no, not worth it. Just better off forking out the money and saving some. So, then like - it's pretty shocking because like $50 for two grams where you can go out and buy 7 grams for I think it's about 110. ...That's a quarter, a quarter of an ounce, 7 grams. For an ounce you're talking about 500 maybe 600 for an ounce. So, it's really expensive, but like something that I have to deal with because I can't grow it any more, because it's too risky and forking out too much money on it.

His attention to detail here is very different to the often 'she'll be right' attitude in other contexts.

Conclusion

There is an interesting mix of vagueness and precision in many of the young people's practices around everyday money management and budgeting. In particular it seems to be very activity specific. Aidan, who is vague about shopping and his Newstart allowance is very precise in his calculations around drug prices. David, who has the capacity to work out complex hydraulics formulae adopts a 'no worries' approach to everyday money matters and budgeting. Even in relation to the same activity, and the same people, specific factors can change the response as Melanie identifies when she shows how money or the lack of it leads to different ways of tackling the shopping. This links with the work done by Scribner, Lave and others (see Chapter 2) on situated cognition and the general emphasis in accounts of social practices on their situatedness.

An interesting point for teachers/curriculum developers to note from the data on Travel concerns participants conspicuous lack of engagement with the regular written texts (eg. timetables, maps etc). Although such texts are commonly used in Adult Basic Education curricula data from this study would suggest they are not necessary for survival.

The issue of survival is clearly core in the lives of most of these young people. We see how the focus on budgeting is sharply constrained by the amount of back-up available. For young people living at home, budgeting may be not particularly relevant. For someone like Matt, who has no back-up, Sam, who has taken on the task of managing the household money, and Angie, who has to provide for her child as well as herself, budgeting may be vital to giving them a sense of keeping control of their lives.

Survival appears to drive some of the detailed attention to the mathematics of particular situations, yet need doesn't provide the whole picture. Precise knowledge and the ability to operationalize it, seems to be in part a product of interest and passion. Matt is passionate about getting a good deal in his shopping, Aidan throws packets into the trolley and doesn't count the cost. David, who professes a lack of concern in most day to day aspects of numeracy, such as sharing costs with his mates, gets very precise when he feels he has been ripped off, while Charmaine brushes it off. Tranh, who is vague on just about everything recounts in loving detail the mathematics of how he places bets for his rich friend. And we have already seen the knowledge generated by Jonathon's interest in the weather (see Chapter 4). So if we want to develop an account of the numeracy practices of these young unemployed people we need to make it not only an account of what they need to survive, but also an account of what sparks them, what they are passionately involved in, what they desire.

So far, we have looked at the interviews from the point of view of how social structures affected the young people, what they did in their daily lives, and how this influenced their numeracy practices. We now want to use the same interview material to give us insights into how the young people understood and felt about particular mathematical skills or processes, starting by challenging the assumption that mathematical activities caused widespread anxiety. We look briefly at calculating procedures, in particular addition and compare two mathematical concepts/processes as they were used across the range of young people - fractions and measurement . We finish the chapter by examining the mathematical and social choices made in response to the pizza question.

Calculating Procedures

Playing with numbers

Although only six of the young people named maths as having been their favourite school subject, a number of others gained active pleasure from activities that could be labelled mathematical. Charmaine, Jonathon and Matt all became engaged with the calculations of the pizza question, playing with the numbers involved. Tom had fun with some rather sexist calculator jokes, where numbers are entered and the display, when read upside-down, gives a word. Jonathon's fascination with the weather, and his family's fantasy about floods, involved calculations that were clearly enjoyable:

> Me and me dad and me mum, like we were working out if we had 100 inches like which places would get flooded and which wouldn't. We reckon if we did get 100 inches Broadfields would be covered right up here, near the Barracks. The railway - you wouldn't be able to come on the railway because it would be flooded right out to - until the ground starts going up into the mountains. You know where Eversleigh, you know where Eversleigh is?... That would be gone. Rowntree would be cut off in several different places and Milson, there'd be only a little bit of Milson on top of the hill because it would be ...an island. And Benton would be completely under water.

Sam remembered Roman numerals with pleasure:

Sam	I quite enjoyed Roman Numerals. Sometimes I get them confused, say a four or a six because it's the opposite way around, but not very often... I think it just appealed to me because I have a lot of problems with figures and I used to get my numbers mixed around - back to front and um I remember having problems like that and with Roman numbers I never seem to have any problems, but when you've only got three figures - using just those figures to work out the whole thing it is pretty simple to learn. Where I've seen other people that get totally confused by them.
Interviewer	And that wasn't a problem for your dyslexia?

Sam	No. Because to me it's a whole new pattern. It's like learning a whole new language and just using the same three digits um over and over again in different patterns is quite easy, you know what I mean? Rather than changing the whole digit - things like that.
Interviewer	And that wasn't a problem for your dyslexia? .... The different combinations, using the different patterns, that's what appeals to you?
Sam	Yep.

Mick, faced by the objects in the kit, greeted the interviewer with the words: 'You want to know about maths? And you haven't even got a dartboard!'

He proceeded to discuss the mathematical challenges involved playing darts:

Mick	Because when you're playing darts you start - you've got multiple games, 301, 501, 801 for competition games.
Interviewer	That's your score that you're trying to get to?
Mick	You've got to start - you start at - say you're playing 801 you start at 801 and go down and you have to finish on a double - you play down to zero. You got your singles, your doubles, triples and your bullseye and the outer eye. [Mick draws a diagram of the board to illustrate.] ... Everyone plays for triple 20 because it's the highest score on the board.... Yeah, the bullseye is worth 50 points....Yeah, because everyone plays and it's everyone's idea they have to get 180 all the time, triple, 60, triple, 60, triple, 60. So, everyone plays ---
Interviewer	So, when you play 801 you start with -
Mick	801, and you've got to work your way down. Say you get down to 100 that's double - you got to finish on your doubles - so you go triple 20, if you hit your triple 20, you go double 20, that equals to 100 and you win the game. But yeah, if you get stuck on 35 it's 5 double 15 or double 17 - one double 17. Any type of mixture of numbers....
Interviewer	My brain is going hang on, hang on, let me work this out..
Mick	Fifteen double 10.
Interviewer	That sort of rule really means you have to ---
Mick	Finish on an odd number. Yeah.

Numbers afforded Mick much pleasure. He felt he was good at them; they gave him a sense of control, and he found them stimulating. Certainly not all the young people enjoyed mathematics as much as Mick, but he was not alone in the pleasure he gained from mathematical activities.

Counting and calculating

The kinds of calculations needed by the young people in the study ranged widely in complexity, and the ways that they were actually done were not independent of context. At one end of the spectrum of complexity that we encountered was David with his TAFE hydraulics course, and Jonathon with his somewhat erratic home-grown understanding of recurring decimals and averages.

At the other end of the spectrum were Rashid and Jillian, who both used tallying procedures to carry out addition. Rashid, asked how he would work out 'a sum like 26 take away 13', replied:

I just - no - I like just put lines on the paper, I'll put 26 and cross off 13 of it.

In a more contextualised situation, Jillian (aged 14), was asked whether she had other brothers and sisters; she replied:

Jillian	Heaps of them.
Interviewer	How many?
Jillian	I've got five, six, seven, eight and one on the way.

What is interesting here is the grouping of the five, and the counting on of the next three (or four). The background to this 5 + 3 + 1 process was illuminated as the discussion continued:

Interviewer	Really, so who is the oldest?
Jillian	Jonathon.
Interviewer	And the second?
Jillian	Anna, she goes to TAFE and then me, then my other brother Luke, he's in Melbourne, Sybilla, she's —
Interviewer	And how old is Luke? 12 or something?
Jillian	13. Then Sybilla, she goes to O'Connell school, she's 11, I think. Oliver, Hannah and Emily, they're only babies and —
Interviewer	Babies, sort of like early primary school?
Jillian	No, they're only ... The oldest one out of them is 4.
Interviewer	Right. They really are babies. So, there was a gap between - - -
Jillian	Hannah and - yeah.

There had been time to identify as a family of five. For seven years, that is what they had been: for Jillian the very formative years from the age of 3 till the age of 10. Since then, because a new child had arrived every year or so, the numbers had not stabilised. One-to-one counting, tallying, was still a necessary check, and the method of counting closely mirrored the social reality of Jillian's growing family.

The Meaning of Fractions: From halves and quarters to thirds

Teachers we talked to did not see fractions as simple. When we asked a teacher how she went about finding out what her students could and couldn't do, she said:

I tend to start with difficult addition and subtraction, multiplication. If they can handle that, then I go and do fractions.

So what did the young people in the study make of fractions? Did their understanding involve the same hierarchy of difficulty?

All the people interviewed used the word 'half' easily and frequently both in their everyday speech, and in more explicitly mathematical situations. They talked about 'half way there', 'half an hour', 'sharing half the bills', 'half a kilo', 'going halves in the rent', half the family'. Aidan, talking of his brothers and sisters said: 'Half of them like can't read and like half of them can't even spell.' Young Kevin spoke of making pots and the need for the proportions to be right:

> If I'm doing a half a mix I've got to use half a bag of cement and that's 20 kilos of the cement and then I've got to - do another three 20s of sand.

Most of them happily used the word 'quarter' also, although less extensively -'quarter past ten', 'I'm quarter Spanish' 'quarter of an apple'. Matt talked about how he had worked out how to share the price of a pizza amongst four. First he halved it: 'then I quartered it, I chopped [that] in half.' Mick was almost playing with the idea of a quarter when he talked about how he had done well in maths:

> It is, like when I was high school in year 7 I come into the top quarter of the quarter - in year 7 there was only a quarter of the people pass and I was in the top quarter of them.

In the case of both a half and a quarter the meanings shifted between what might be called a 'qualitative' understanding - two or four parts more or less equal - and an 'operational' understanding, the particular operation involving 'chopping in half', and for quarters, chopping in half again.

However, a substantial number of the young people floundered when confronted with the notion of 'a third'. There were a very few who were comfortable with the idea of finding a third. Mick says, with appropriate hand illustrations:

> Say I need to get a third of a cup of water or a third of a glass of water I visually cut into thirds and just fill it up to where I think.... I estimate everything.

Some simply did not know and had no answer. Many of them did not know whether a third was more or less than a half. Several thought it was bigger than a half, and Lars thought it was bigger than both a half and three-quarters. Some thought it was the same as a quarter. How would you work out a third of a cup of flour, the interviewer asked Sam. 'I don't,' she said:

> I try not to use measuring cups - I find - because my mother never used those sort of things. A third, how much - I'd get half and - I'm not quite sure. I'm not good with those ones, you know.

And Charmaine replied to the same question:

> Well, I'd probably just half fill the cup and half of that?

- a reasonable answer in practice, but perhaps not in the context of her answer to the following question asking how she would find a fifth:

Would that be half a cup?

This is the same Sam who budgeted in detail for her whole household. and the same Charmaine who could work out change in her head quite easily, using multiples of twenty-five cents, and could even justify her method as 'quarter[ing] it up'.

Interviewer	So let's say the checkout person says $7.35 please and you give her $10.00 how much change are you going to get?
Sam	$2 and 65 cents.
Interviewer	Okay, tell me how you did that?
Sam	Well, I just went like 25 cents, equals 25 cents, it would be 75 cents, then you take another 10, it would be 65....You know, quartered it up kind of thing. And $2....It seems simple.... Like you halve it and quarter it, and you quarter it again.

She is having some difficulty articulating her method, but what she does is clear, and it works. When Kevin shares out the pizza costs and tries to divide $10 into thirds, on his first attempt he is seduced by the process of quartering:

Kevin	I would just get $16.90 between three people - what I would do is first I would like with the $10.00 I would divide that by 3 and then with the $6.00 I would divide that by 3 again and the same with the 90 cents. Just do it like that.
Interviewer	... Okay, so how would you do that $10.00 by 3? What would you get for that?
Kevin	Um well for two people it would be 5 and then split that in half again, ...

After some confusion, Jillian described how you would make a third, and we can see that she too works from a good, operational understanding of a quarter - with a twist for thirds:

Jillian	Like an apple chopped up into four pieces and one's been taken away.
Interviewer	Right, I see and a quarter?
Jillian	And a quarter ... chopped in half and chopped in half again, yeah, four pieces.

Quarters are made by chopping the whole into four equal pieces, and thirds have somehow got to be three. Solution: make one of the four pieces disappear. Is she wrong? It depends on what the 'whole' is.

Matt was fairly sure that a third was less than a half, but his insistent return to quarters in the pizza problem made it clear that while he could probably work out a quarter, he had no method for finding a third. It was not clear either whether he understood how a third was related to a quarter:

Matt	I'd put in a quarter of that, which would only be about $7.90 roughly.
Interviewer	Why are you paying a quarter of the bill?
Matt	Because there's three people.
Interviewer	So there's three people and you're paying a quarter and a quarter of $16.90 is ...

Matt	I said $7, but more likely its just over $4....I divided it in half - $16.90 would be $8. You take the 10 and split that into five and you take the six and take away three, which leaves $8, so that's $8 for two, so you halve it again and double the amount and halve it and you get $4.
Interviewer	Have a go at three into $16.90 because there's only three of you. Do it out loud.
Matt	It would be roughly about $4.80 each, approximately.
Interviewer	So you took the $16.80 up to $17 and then what?
Matt	Then I quartered it, I chopped it in half.
Interviewer	Why did you do it in quarters again? You find it easier to chop it in half and chop it in half again?
Matt	Yes
Interviewer	How do you then make it a third rather than a quarter? Because you're chopping it in half and then again and ending up with a quarter share, not a third share.
Matt	You'd have to take that away, wouldn't you, so it would be between four and five dollars.

The method is wrong, if we are looking for division by three. The answer is wrong, if we are looking for equal shares - but neither the method or the answer are nonsensical. It is not clear from this argument just how Matt thought a third was related to a quarter, and in another part of the interview he in fact says explicitly that he doesn't know whether a third is, as the interviewer puts it, 'around about the same as a quarter, or less than a quarter or more than a quarter'. His reasoning suggests however that he does see some connection. Perhaps he understands *thirds* as requiring *three* steps- the whole, the first cut, the second cut... Or it may be that thinking about quarters is easier, and adjusting the quarter a little would give something near a third... a reasonable way to estimate, if that is what he is doing.

A spruced-up, articulate, accurate and practical version of this last argument is in fact put forward by Jonathon, as he describes how he would divide up the pizza itself:

> There's about 15 pieces in a pizza, depending on how they cut it. Well, actually what I'd do I'd get the person that was at the counter to cut it in four quarters, so you got four quarters. You'd give a quarter to each person and then divide the third - divide that fourth piece up into three pieces.

Why the difference in dealing with quarters and thirds: the comparative ease for quarters, and the problems with thirds? What is a fraction and how do we use them in everyday life? Cameron was one of several who argued that an exact fractional measurement in cooking was unnecessary:

> ... like I'll just work it out just by using my eyes and judging - that's more to do with - estimation, but you can - to be exact then, you know, it's a bit difficult. But I'm sure it wouldn't matter, you know.

And according to Mick:

Mick	You don't use them in every day life....You use your times tables and stuff like that [but fractions] you don't. Unless you're cooking.
Interviewer	Yeah, maybe. a third of a cup of something.
Mick	Yeah.

Interviewer	How do you work out a third?
Mick	I've got those cups that tell you a third.
Interviewer	Say you didn't have your cup that said that - - -
Mick	Sight.
Interviewer	So a third means what?
Mick	Part of.

Generating meaning

A fraction has the common-sense meaning of 'part of', and more particularly 'a tiny part of ', in the way that Jonathon uses it when he is talking about the need for exactness in measuring:

> ... you've got to get the pieces of metal lined up right - it could be a fraction of that out ...

Likewise, halves and quarters are concepts embedded in familiar actions, they are words for spontaneous understandings, as Vygotsky has called them (Boomer, 1986). They are things that we *do*, they have operational meaning in our everyday lives. But the meaning for thirds has never crystallised for these young people: they do not *do* thirds. Thirds have become a concept rather than an action (Veel, forthcoming) belonging with Vygotsky's formal concepts, and require pedagogical effort to make connections with spontaneous understandings.

Another way of viewing the difference in these understandings of quarters and thirds is to use David Bloor's (1976) discussion of mathematics as a social construction, where he develops J. S. Mill's argument that mathematics is a set of beliefs about the physical world, that have arisen from that world. They differ from the beliefs we have about scientific objects, in that the latter apply to a limited range of fairly specific objects, whereas the former, mathematical, beliefs apply 'indifferently' to very wide ranges of things. Taking the maths classroom as a place where we can see mathematical knowledge being created, Bloor merges the work of mathematics educator Dienes into Mill's argument, showing how a particular algebraic process can be seen as a shorthand way of describing a physical routine carried out with pebbles: this routine was not simply an *illustration* of the algebra, but can in fact be seen as constituting it. Mill's theory has been criticised in various ways; for instance, how could you experience zero or very large numbers, or for that matter the number one? That experience and arithmetic only overlap to a limited degree can be explained in two ways: as some have done, by claiming any overlap is fortuitous, or as Mill did, by claiming that the overlap was the generating and supremely important foundation for the rest of arithmetic.

Using this idea of overlap, we could argue that halves and quarters, overlapping the world of experience and the world of mathematics, are for many the 'generating' foundation of fractions, from which can be constructed the more abstract notions of thirds or fifths, and eventually even less experiential notions such as mathematical statements as

$$\frac{x+1}{y+1} = \frac{3}{5}$$

For most of those interviewed, it appears that the connections between their 'spontaneous' knowledge and the more formal mathematical knowledge of fractions have not been constructed. The concrete world of money and pizzas does not seem to be conceptually linked into a more generalised, abstract system beyond the concrete. The young people in the study have at best tenuous access to the world of mathematics that can be generated from their everyday experience of fractions.

A linguistic approach

In linguistic terms this overlap could be seen as the 're-use of non-technical terms as technical lexis'(Veel, forthcoming), where students in maths classes have to learn new meanings for such words as 'take away', 'power' and 'integration'. 'Half' and 'quarter' have non-technical, or less technical, common-sense meanings and their successful use in everyday contexts does not imply an understanding of the concept of fractions more generally.

It could be interesting to generate a collection of the everyday expressions in which fractions occur: 'possession is nine-tenths of the law', to mean most of the law; 'a hundredth of a second, a split second' to mean an extremely short instant of time. One intriguing feature of such usages is the way in which the actual but approximate size 'most' is given the authority of apparent accuracy - 'nine-tenths'.

Measurement

Interviewer	Do you know what Mum measures in?
Respondent	No.
Interviewer	Does she use feet and inches or centimetre?
Respondent	No. Only cooking utensils.

In the initial structured interview, we asked each of the young people how tall they were. Apart from this no direct questions were asked about measurement, but it emerged as a common focus in most of the discussions: weight, length, capacity, time, force, speed, temperature all aroused interest.

Metric or imperial?

No, I think she knows like pounds and all that. From the olden days, I don't know. [Charmaine]

First impressions would have led us to believe that almost all the young people still used imperial measurement, at least for length. Further probing however revealed a more complex picture. Most of those who knew how tall they were gave their height in feet and inches and with varying degrees of accuracy - six foot something, five foot six, five eight and a half; two or three knew it in both systems; one knew her height in metric units only. Straddling worlds, Angie gave her own height as five feet, and the height of her small daughter Kelly as 65 cms. Most were either unsure of how their parents measured their height, or quite clear that it was in feet and inches. One, Cameron, said he preferred imperial for height:

Cameron	I usually do work in centimetres. It's just that in height I'd actually just like to reach six foot, so I'd rather say I'm six foot than - yeah, it sounds - more - [impressive].
Interviewer	So, your parents probably use inches and feet too...
Cameron	Yeah, they would, yeah. I would have got it off them.

But for most measurements of length other than their own height even these apparently loyal imperialists are already members of that same metric world. They measure carpets, floors, material, wood, fences, metal and curtain rods with metric measuring tapes or rulers. Liam:

> We use metres because I do track and field and we use how many metres we got to run or we do a standing line jump, we use how many metres we jump. We don't have feet or yards.

Although Sam had no idea how tall she was, in either system, she had become quite at home with centimetres, though less so with metres:

Sam	... when I'm measuring things I do centimetres and millimetres and things like that. I've never had to do anything by metres or anything very long like that.
Interviewer	What sort of things do you measure ... ?
Sam	Like when I'm using material, like I sew and stuff like that... You work out how much you need and depending on how much length you've used you never know if it's going to be enough or it's going to be too much material. So, you've got to work out exactly how much you'll need for that sort of area and how you're going to - the length between that part and the next part. The same colour, but how far it is over the next bit, you know what I mean.
Interviewer	Do you use metric then because your parents use metric or did they use feet and inches or .....
Sam	My mother still uses metres and that other - feet and stuff like that. Metres and all that sort of stuff. I didn't really - I don't think I ever even had that at school. I don't know why, but - I just never got the grasp of it at school.
Interviewer	But you're using metric because you're using centimetres and millimetres. So, you must really know it?
Sam	I know the centimetres and millimetres because I learnt that .... I taught myself how to do that. But the others I never learnt so I don't really try and use it very often. But I'm starting to learn how to use metres more driving. Got to learn how far a metres is, 50 metres.
Interviewer	Because you've got your L's have you?
Sam	Yeah.
Interviewer	So you found that you need to judge distances?
Sam	Yeah.

Some demonstrate a confusion between the two worlds, an uneasy realisation of an unspecified relation between the two systems.

> ... they're about the same, centimetres or inches, yeah. Not real good on either of them... Yeah, me Dad, he does feet I think. Back in his age I think it was all foot, feet, and so many years that go past - I think they're sort of jumping back into different sort of, like metres and inches.

This was David, in some respects more at home with mathematics than many of the others, becoming at home with units of force, while still hazy about units of length:

> Yeah, like 800 times nine, you got 800 coming down times overall is nine and that gives you the 7200 newtons right, so that's your f - for that part, then pressure, they wanna know p. Force over area....Yep, they give you [area]... Yeah um, you gotta go 7200 divided by 3532 and that gives you...oh yeah, there's your force, there's your area then you divide them which gives you that... so p...if force is 7200, area is 3532 and then you divide them together which gives you 2.04

Thus, the choice of units for the measurement of length is embedded in aspects of everyday lives. As Porter claims in the quote at the beginning of the chapter, 'the rigour and uniformity of quantitative technique often nearly disappear in relatively private or informal settings'. We have seen that this is so in the variety of responses to the pizza question. The widespread measurement of height in feet and inches, and everything else in metric, is another conspicuous example. Height is personally meaningful, measured within the private realm of the family, where public change is slow to reach, whereas other, newer, length measurements demand more interaction with public systems. Measurements of cloth or fencing or carpet must be mediated by more public standards. We could surmise that the same would happen with other private or body measurements, such as weight - that personal body weight would be in imperial measurement, and other weights - used in cooking, making cement pots, taking medicine, buying dope - would be given in metric units. We did not collect evidence about the former, but certainly the latter were largely metric: Kevin used kilos to measure out the cement for his pots; Melanie used grams and kilograms in cooking cakes; Mick took 350 mg Dilantin tablets for his seizures; Aidan bought dope in grams, and was aware also of the imperial equivalent:

> And for cannabis you're paying $50 for 2 grams and 2 grams that only lasts me by myself that only lasts me about two hours.... it's pretty shocking because like $50 for two grams where you can go out and buy 7 grams for I think it's about $110... That's a quarter, a quarter of an ounce, 7 grams.

Measurement as a social process: a 'technology of distance'

At both a wider social level and a more individual interactive level, it can be argued that the development of the process of measurement is more than the development of particular logical or cognitive capacities. At the level of society, it can be shown that there are cultural and historical differences in the way in which measurement is used. One such study, of Inuit hunters, shows that measurement is not used if perceptual judgement alone is thought to be adequate (Denny 1986). When it is used it is very context sensitive, with units that vary from task to task and person to person. The maker of a canoe will use his or her own body measurements to make an appropriately proportioned craft. Denny goes on to argue that a complex society such as our own cannot survive with such flexibility, and needs to establish the standardised units that are necessary for the coordination of tasks.

At a more individual level, Piaget and his colleagues (Piaget, Inhelder et al. 1960) studied children's measurement of length by asking the children to build a tower of blocks on the floor, the same height as another one already built on a table nearby. From such work, they suggested that there is a progression of stages that characterises the logical development of measurement: children first use a purely visual estimation, then a direct comparison by putting the two objects side by side, followed by a comparison with some body part, and finally, a reliance on the use of an introduced 'symbolic object' which becomes a unit of measurement, and an indication of their understanding of the general logical principle of transitivity: A=B; B=C; therefore, A=C. (Nunes et al. 1995, p586)

Nunes, Light and Mason (1995) argue that there is indeed some progress in development along these lines. However, they say, the progress is not only cognitive, but can be seen to be social as well, a function of what they call a 'progressively more intersubjective approach' to measurement. They point out that neither visual estimation, direct comparison or measurement that relies on body parts are illogical in themselves, though they may be inappropriate in certain circumstances or for certain purposes: information may need to be communicated, measurement may need to be more precise, it may be important that know whether one person's hand span is smaller than another's. They conclude from their work that both the ability to make logical inferences and the understanding of the need for 'intersubjective reliability' are necessary in the development of an understanding of measurement: that is, we need to consider not only the cognitive but the social requirements of measuring.

If measurement is a social process as well as a cognitive one, then the needs of the particular social situation are crucial in working out what is an 'appropriate' use of measurement in that situation. It is not accidental that the word 'appropriate' emerges here. Like the 'mode continuum' in the linguistic context (Martin 1984, cited in Gibbons 1995), we might suggest a 'measurement continuum', along which particular practices could be arranged, in such a way that certain features of practice changed in predictable ways, as the contexts became increasingly context-reduced (for a more detailed discussion, see Chapter 8). The features that change along the continuum include:

- portability: whether you want to transport the unit from one location to another
- communicability: whether you want to tell someone else the result of your measurement
- precision: what degree of precision you want in the measurement
- meaningfulness: how meaningful the measurement is - whether it is useful, conceptually interesting, critically relevant, valid, reliable

Two interweaving dynamics - the logical and the social - are informing this progression. The logical dynamic grows out of the process of solving the question 'how can I measure those objects?' (look at them; put them next to each other; use units of some sort to measure them). The social dynamic grows out of the question 'how can I tell you my result?' (look!; use my handspans; use metres).

In the quote at the beginning of the chapter, Porter argues that 'quantification is well suited for communication that goes beyond the boundaries of locality and community', and in this progression of increasingly distanced statements we can see how this applies to measurement. Angie and her daughter are a poignant illustration: Angie, staying within her community uses the outmoded feet and inches for herself; with her daughter, she is pulled beyond the familiar boundaries of home, and uses the metric system.

Communication, and meaning, were important for Cameron: he wanted to be able to tell others about his impressive height and six feet was more meaningful than a mere 180 cms. Angie also gave her height in feet and inches, but for quite different reasons. She didn't need to know her own metric height. She was a product of her time, and her family, and their system of units; she was at home, for her own needs, with the imperial system. She did not compare Kelly with her own height, however, but with the official heights of other small children, as given from the moment of birth. Hospital measurements, clothing sizes, baby health centres all use metric truths, and Angie needed to relate to them. Kelly was becoming a product of the metric world.

Base-line measures: what units do you use?

Meaning, communicability and precision were also factors in such everyday negotiations as buying cheese or ham, estimating distances, or measuring out doses of medicine. The unit of measurement for some of these common objects and qualities was not always what was expected.

In answer to a question that arose about shopping - 'How do you ask for the amount of cheese or ham you want ?' - we initially expected an answer in weight, something like '200 gm'. But the answers were far more varied, including: '5 slices' - if the person was catering for five people; '$2 worth' - if it was the budget that was constraining; 'that piece', or even, 'a handful', if the estimation was easier as a visual one.

Similarly, a question concerning the distance from here to Ashfield, to Armidale, to Adelaide, to South Africa could elicit an answer in kilometres, but it was more commonly given in minutes or hours. One young woman was trying to work out a dose of medicine: 15 mls for an adult, and half that for a child. 'If it was money', she said, 'it would be $7.50.'

In all these examples, communicability was an essential element: the people involved had to read instructions from others, or make known their needs to others. In some form or another, sometimes an unexpected one, they were successful. Precision of weight, on the other hand, had lower priority in buying ham: the constraint might be the number to be catered for (number of slices) or budget, and it was these constraints that decided the choice of unit and the degree of precision appropriate in the context. In all the situations, meaning was crucial. Why would anyone want to know how far it is to Ashfield? Probably, so that they can go there - the important aspect of the distance becomes time. Long distances are for travelling. Short ones may be for ordering fence lengths, or planting rows of trees - in which case it would be metres, or yards, that would be more appropriate.

A comparable shifting of the unit of measurement to give a different and arresting meaning can be seen in the advertising hoardings in Sydney showing a picture of a speedometer with the needle pointing to 90 km/h, and a message to the effect that 'You are travelling at $179 '. It is the disjunction that is arresting: speed is being measured in terms of money. The similar flexible use of measuring units was a familiar strategy for the young people in the study.

The Pizza Question

At the end of the interview with the kit, all the young people were asked the following question:

> Say you went out with some friends, and you had a pizza and you're going to share the costs. When people do that they work out how much they're going to pay in different ways. So say it was you and you went with two friends, and the pizza cost $16.90, how do you think you'd pay for it?

The same problem elicited widely different responses; no two answers were exactly the same. As we argue in Chapter 1, using the work of Scribner (1984), Baker (1993, 1994) and others, practices relating to the same concept vary with the purpose and setting of the activity, the power relations amongst the participants, and the beliefs they hold. The answers to the pizza question show that even when the context seems the same it can be read in different ways, and include different relations amongst the participants, resulting in different strategies. In general the answers emphasised a rough fairness, over time, or according to capacity to pay. It would be interesting, but difficult, to try to place the responses on a continuum ranging from the 'more mathematical' to the 'more social': difficult because the two cannot be disentangled, and some of the more socially focussed answers were also very mathematical.

Mick disposed of the problem quickly, fairly and using no mathematics:

> I'd pay for it this fortnight and the next fortnight me mate will pay for it and the fortnight after he would pay for it....That's the easiest way to do it.

Rashid's estimate - 'Pay like um $6.00 each' - involved getting change, and deciding whether to share it out:

> No, we'd just - just whoever gives it gives it....If they got more money and you've got less they'll just say oh I'll just pay for these and all that stuff.

Liam's estimate was a little more accurate, but he did not go into the business of who would pay the last forty cents:

> You roughly say $17, then divide by 3. It's about $5.50 each. I did it 6 into $18, then dropped a dollar. Three times 6 is 18, but it's 17, so dropped off about 50c each.

David, Alicia, Jillian and Aidan were not too worried about being precisely fair, but said they would share out the amount more or less evenly each time and explained how they would do that. Terry offered two possible strategies:

> With two friends?...Three of us....I think like well, you'd probably just go five each and maybe one of us would jump in put in an extra $2. Extra $1.90....Yeah, well, that's you know usually you do it like that if we all chuck in 5 each, like if it was 16.90, you know - or maybe just one of us buy it and someone shout later.

David would have shared it in a similar manner, and here as in some but not all other circumstances, solidarity took precedence over mathematical precision:

> You know it wouldn't really matter, no-one'd flinch about paying an extra dollar ninety. One of us might be a bit short and have only three dollars and the other two'd put in, you know, depends who's got the dollars at the time.

Jillian's method, on the other hand, involved doubling and counting on, an element of 'guess and check' and a greater equality:

> Probably split it up and we'll see how much it cost up and then pay for it that way....Divided by three would be? I think 16 divided by 3 is 4 - 5. 4 and 4 is 8 and 4 is 16. No, 8... 9, 10, 11, 12....Each of them pay another dollar or so...5, 10, 15 and $1.90. So - well, we'd probably split the 90 up and one person pay the 90 cents and the other two pay 50 whatever each.

Kevin split up the larger amount into smaller, more manageable amounts, and like Jillian also used a 'guess and check' strategy:

> Between three friends?... Well, what I would do I would just get $16.90 between three people - what I would do is first I would like with the $10.00 I would divide that by 3 and then with the $6.00 I would divide that by 3 again and the same with the 90 cents. Just do it like that...about 3 bucks something into $10.00.... Well, I took a guess at first and then just trying to work from the guess and then if it's not right then I'd probably go over it again....and there's three of us and then there's $6.00 I would just like give $2 to each person...and [with the 90 cents] I'd have to do it like there's three people and then I just like oh do it like similar to the same way as I've done it like before, but add the extra three onto the end of it. Extra 30 onto it.

Lars's method was, again, slightly different:

> Probably cost $5.30 for each person.... 15.90. ... one of us would probably just put the other dollar in.

and when asked whether they would ever take it in weekly turns like Mick he said it was better to pay as you go and sounded a note of warning:

> Yeah, we do that, and when it comes to their turn people say I'm really sick of pizza, don't bother getting it this week. When it comes to the next week someone goes it's your turn to pay, oh no it was my turn last week.

This relationship of power amongst friends, and the importance of money, was made explicit by another:

> Sort of just divide between three people, I suppose....Yeah, I'd probably divide it evenly so I wouldn't get stuck with a bit more to pay than what they had to.

This was Angie, responsible for a small child, and unsure of any continuing support from her partner. The decision about the degree of accuracy, 'evenness', is a decision made within other socialising activities, including in this case the constructing of mateship, the earning of money, and the responsibilities of parenting. When she proceeded to work out an accurate answer, her careful use of long division failed her because her memory of the tables was wrong:

How Angie Did It

4.53 and 1 over	5.63 and 1 over
3) 16.90	3) 16.90
15	15
19	19
18	18
10	10
9	9
1	1
right method,	*right method,*
right working,	*right tables*
wrong tables	

And her understanding of the '1 over' reiterated her focus on an even distribution of costs:

> There's still remainder 1 so someone would have to get stuck with an extra 1 cent.

Some of the issues are encapsulated in Cameron's reply:

> Well, first of all I get my pizza for free. So, yeah, I've just - no, it's only for about a week now. I just got a job up at Pizza Hut...like when they have this actual - the area manager isn't there like I can go in and just make pizzas and all that.

So the question was not of pressing relevance. Secondly, he asked,

> I just want to know is this more of a maths question and I have to know the answer or is it more of a realistic just how would I do it?

If it was the latter, then that was one thing, and his position was like Mick's or David's:

> I'd chuck in what I've got. Whoever has got the money will pay and just work it out as normal ... it's not like oh you owe me now, it's just, you know, next time, you know, that they're around you shout them pizza or whatever.

For a maths question, he pointed out, you do it differently:

> [You] have to work it out properly and you cut the piece off perfect. Yeah. No, it just doesn't really fuss me, but if it was like - if I had to - if I got a pizza in front of me and I had to work it out, you know, and they go oh this is a test, then you know, of course I'd be cutting at the right angle and seeing who chucks in, you know. Working out evens and — No, it's like no one really cares, I think. Unless you're selfish, but I don't think many people are.

It was this 'maths question' element that to some extent engaged Charmaine, Jonathon and Matt. Matt got tangled up in the calculations and resisted the idea of thirds. However in spite of the confusion of his spoken explanation, the amount he comes out with is a reasonable estimate:

Matt	I'd put in a quarter of that, which would only be about $7.90 roughly.
Interviewer	Why are you paying a quarter of the bill?
Matt	Because there's three people.
Matt	I'd put in a quarter of that, which would only be about $7.90 roughly.
Interviewer	So there's three people and you're paying a quarter and a quarter of $16.90 is ...
Matt	I said $7, but more likely its just over $4....I divided it in half - $16.90 would be $8. You take the 10 and split that into five and you take the six and take away three, which leaves $8, so that's $8 for two, so you halve it again and double the amount and halve it and you get $4.
Interviewer	Have a go at three into $16.90 because there's only three of you. Do it out loud.
Matt	It would be roughly about $4.80 each, approximately.
Interviewer	With a few friends would you argue about that or would you each of you go, oh well here's the five dollars?
Matt	Well you'd actually pay the $16.90, we wouldn't go over that. You're not going to pay $18 for a $16.90 pizza are you? It would come out even for two people and odd for one anyway.

This 'two people would pay the same amount and the other a little more or less' seems to be the generally accepted solution to the situation. The difference between the answers seemed then to depend on how much more or less was acceptable. Charmaine made a first approximation:

> Well, um I'd go $5 each and then that would make $15 ...and then there's $1.90 to pay so, make that ..Yeah, 50 cents each. And that leaves 40 cents.... Two people could put in 20 cents.

She was happy with that solution initially, but a few minutes later, came back to it, to a still more 'even' sharing:

Charmaine	Or, instead of someone chucking 20 cents each in - 15 cents, three 15 cents. I don't know, I suppose you'd chuck in yeah, about 15 cents each.
Interviewer	And you'd leave a little tip, would you?
Charmaine	Yeah. 5 cents.

It seemed she was, at least a little, challenged by the mathematical possibilities, as distinct from the other social demands of the situation. Jonathon after making an initial estimate of $6.30 tried again, using both paper and pencil and a check on the calculator:

Charmaine	I'll just work it out again....So, they got three there each, four each, five each...$5 and split a dollar into 3. 90 at 30 each, split 10 in 3. Um oh gee, that's 30 - split 10 in 3, that's 9, 3 each. Oh Jeez this is getting complicated. Um --
Interviewer	You've got it. You've got 30, split 30 plus - - -
Charmaine	1, yeah, that's it, $5.60. I was wrong. You know where it says 333, yeah it would have worked out to be about 33, like $5.6333 it would have worked out to be about that because you've got to divide those extra little - because you'd still have probably another couple of cents left over so you've got to divide those cents. So, it would probably be about 333, as far as I know.

The mathematics was clearly taking precedence over social likelihood here: the question had become Cameron's 'maths question'.

Conclusion

Vygotsky's Activity theory claims that human behaviour and thinking occur within meaningful contexts as people conduct purposeful goal directed behaviour, communicate, and learn to use the tools and practices of the culture. Chapters 4 and 5 gave us evidence of how mathematical activity is embedded in everyday practices, forming what might be called 'numeracy events', and how those practices affect what maths is used. In this chapter we have seen, with the fractions, how meaning can be lost with increasing abstraction, in the trade off between preservation of more everyday meanings and the potential for generalisation. We have seen that measurement is not only a cognitive, but also a social, process of development. With the pizza question we have been able to see, as the literature suggests in Chapter 2, that practices relating to the same concept will vary with the purpose of activity, with the power relations between those involved, and with their values. All these situations point us in the direction of the importance, for teachers, of scaffolding a move from everyday numeracy practices to the mathematical world of abstractions. This chapter gives some ideas of how to look back to the everyday world to tease out how mathematical concepts are generated there and how they develop into abstractions.

Chapter 7 Investigating Numeracy Practices: Teacher Research

Introduction

In this Chapter we are going to draw out some implications for teacher researchers who might want to deepen their understanding of numeracy practices by undertaking a small scale research project. This might be "research for its own sake", as part of a higher education course, or as part of a curriculum development cycle (researching numeracy practices in a particular context as an input to developing adult numeracy curriculum for a particular group). In doing so, we will be drawing on the experiences of our research group in researching numeracy practices for this project and illustrating the presentation where relevant with examples from this study.

We will be considering the following approaches to research:

- researching your own numeracy practices
- researching other people's numeracy practices
  - interviewing
  - participant observation
- tape recording and discourse analysis
- structured elicitation of data

We will conclude by discussing some issues involved in designing a small scale research project.

Researching Your Own Numeracy Practices: Making the familiar strange

In the early stages of the project, in order to deepen our understanding of what we meant by numeracy practices we decided to keep a reflective journal of instances in our everyday life where numeracy had an impact. Here is an example from the records we made taken from one of our journals (Mike's):

I go down to BBC Hardware to buy a Father's Day present for my 6 year old daughter to bring in to school for a Father's Day Present Stall that is being organized. (My wife has suggested a box of chocolates I wanted to get a bottle of wine but the bottle shop is closed.) BBC Hardware is open so I go in, browse for a while, feeling rather awkward as I am not really a DIY person, and choose a torch and batteries priced at $5.90. which I think of as a suitable Father's Day present. When I take it to the counter it comes up on the screen as $6.25. I point this out to the man behind the counter and he says I have to take it to another counter where the item can be rung up manually. At the other counter the first man I speak to says "It's nothing to do with me, I handle the plumbing sales, I'll get Greg to see to it". I go and double check the pricing to make sure I'm not wrong. When I get back, Greg is there.
"This torch is priced at 5.90, but it comes up as $6.25 on the screen", I repeat.

"It doesn't worry me" says Greg and goes to ring up $5.90 manually.

I'm left feeling that I've made a lot of fuss about something that is basically trivial. I tough it out however and the transaction ends amicably.

Q: Why does Greg's "It doesn't worry me" make me feel awkward?

Q: When I was writing this vignette, I found it very difficult to find the words to describe what the shop assistant does to establish the price of the item. I want to write "When he rang up the price" yet this is clearly not what he did. Why is this a difficulty for me?

One of the issues that I reflected on was that of the gendering of numeracy practices. I felt as if my complaint about the pricing was somehow trivial or fussy. Greg seemed to be saying to me "blokes don't worry about a few cents here or there." Was I being paranoid? As it turns out in the interviews, we identify a "no worries" attitude to money as being a specifically masculine response to daily budgeting.

The other issue raised questions of changes in work practices and associated language. My language development had stuck at the era of the old fashioned cash register with the ringing bell. I literally didn't have the language to talk about the operation performed to ring/key in/enter a figure in the till.

Recording and reflecting on this little episode raised interesting issues about the relationship of my daily numeracy activities with 'big' social issues like gender and technological change (the structuring contexts as we call them in our analysis).

Important aspects of this reflective process were:

- noting that numeracy had been a factor of the interaction
- if possible, talking about it with others (not everyone I talked to agreed with my masculinity challenged interpretation of the incident above)
- working out what actually happened (often much harder than it sounds)and

- how to record it (also not always easy)

So what was the value of this approach? What this activity enabled us to do was to enrich our understanding of the interrelationship between numeracy activity and other everyday activities, first by reflecting on our own uses of numeracy and those that we observed around us. This is important as a process of "making the invisible visible". By this we mean that day to day numeracy activities are largely invisible to us, they are so tightly woven into the texture of everyday life. If you ask someone directly "How much use did you make of numeracy knowledge and skills today?" the answer might well be "not much". This is because we need to learn to look, learn to notice phenomena which might otherwise pass unnoticed in everyday life. So documenting your own numeracy practices is a way of learning to look and learning to notice.

This approach was described by Shirley Brice-Heath in her book on Literacy Practices *Ways With Words* (Heath 1983) in which she describes how she works with her graduate students, teachers and other professionals, getting them to document their own literacy practices as part of a process of enriching their understanding of the roles of literacy in everyday life and the range of skills associated with the different practices.

> Activity
>
> Obtain a notebook and keep a diary for a fixed period, say one or two weeks in which you record the occasions in which numeracy (and literacy) play a part in your daily life and the lives of those around you.
>
> When you have finished your observation period, write a two page summary of the uses of numeracy which you have recorded.
>
> This process ought to heighten your awareness of the place of numeracy in everyday life

Researching other people's numeracy practices

Having established our own numeracy practices as a strategic site for investigating the nature of everyday numeracy practices what happens when we move on to ask how other people do it? This immediately raises questions of difference and otherness which are basic in research that engages with other people's experiences, knowledge, beliefs and actions. How can we step outside our own particular space, with its familiar cluster of experiences, knowledge, beliefs and regular activities, constructions of what counts as normal and everyday and into a space that may be constructed quite differently. In a way we have already raised this issue in the earlier section in which we suggested that estranging the familiarity of your own everyday life, by looking at it through a different lens, the numeracy lens, unsettled and destabilised the familiar taken for granted world, what Bourdieu (1979) calls 'habitus'.

Difference and otherness may be a product of culture, gender, race, class, age differences, (dis)ability, access to resources. All of these impinged in different ways and to differing degrees in our research project. In researching sites where difference is foregrounded, we are necessarily talking across boundaries, gender boundaries, cultural boundaries, class boundaries. In the case of our research, one of the crucial issues of difference arose in terms of access to resources: how can the waged understand the social world(s) of the unwaged? One of the limits to freedom of the people we spoke to was the amount of money they had and their ability to get the money they needed. How about people who had fallen outside some of the social safety nets, such as homeless young people? How does the researcher/outsider who is located in a home and a social position or set of positions get inside their world(s)?

These are basic questions for a whole range of social research in which the researcher is an outsider constructing understandings of the social world(s) of other people. As a numerate teacher/researcher (if that is what you are) you may be interested in understanding the ways that your students engage with numeracy in their everyday lives. You may be interested in the role that numeracy plays in a particular work environment, or in the context of technological change. In this case, the challenge is not that of making the familiar strange, but of seeing beyond your familiar constructions of how things are, your taken for granted 'habitus' and trying to work out the different patterns and principles around which someone else's 'habitus' is organized

So how do you work/think your way into someone else's social world(s)? One obvious way is through talk. In the next section we will look at interviewing as a structured way of talking yourself into other peoples' social world(s).

Interviewing: Talking your way into other people's numeracy practices

There are a range of types of research interviews which are surveyed in books on research methodologies (Cohen & Manion 1989, Gilbert (ed.) 1992). Highly structured interviews, like questionnaires will seek to produce data that can be counted in some way(quantitative data). The type of interview we are interested in is relatively open ended and aims to produce qualitative data. It is useful to think of it as a structured and purposeful conversation designed to produce information to answer or illuminate questions that the interviewer would like to answer.

The types of questions you choose will relate to the kind of information you want.

- Closed questions will aim for a yes/no answer which will enable you to quantify responses:

e.g. Do you use a calculator when you go shopping?

- Open questions will aim for a more extended response:

  e.g. How do you work out your budget?

- Question sequences that aim to elicit stories:

  e.g. Has anyone ever tried to cheat you or short change you? If so, what happened?

- Hypotheticals:

  e.g. What would you do if you thought that you had been short changed at a supermarket checkout?

In the Numeracy Practices project we were interested in how unemployed young people made use of numeracy in their everyday lives, so the questions we asked in our interviews were designed to produce information on that topic. Here are some of the questions we asked:

> Have you or any of your friends been ripped off because they couldn't understand the maths they needed in a particular situation?
>
> How useful is the maths you learnt at school to situations in your everyday life?
>
> A lot of us need to ask for help with things like DSS forms, timetables, tax forms, working out our pay, map reading and so on. Who do you ask for help? (eg. parents, friends, government bodies, advocates etc)

What follows are a selection of answers to one of the questions we asked:

Interviewer	Yeah, okay a lot of us need help with things like DSS forms, timetables, tax form, working out our pay, map reading and so on. Do you have people you can ask for help when you need that?
Respondent	Yes, I do.
Interviewer	Who would you ask?
Respondent	I normally find it hard, but I've got my dad to help me and he, like he knows like a fair bit about that. So, it works out good.
Interviewer	Oh that's good. What does he do?
Respondent	He's actually um electrical engineer, but he's not - he doesn't do it like he's the department - like above - well, sort of in the office, sort of like.
Interviewer	So, he's pretty cluey?
Respondent	Yeah, like he'll be signing the papers, not going out and doing the work.
Interviewer	Yeah, so what sort of things like that do you particularly need help with?
Respondent	Well, like tax - well actually yeah I had about ten forms the other day, that was from pizza hut and just um joining the union and you know, i got that, I didn't really - you know, like some of it I understood, but most of it I just didn't really have a clue at all. So, I just took it to my dad and like he read through it and helped me out and my tax file number. We had to like go and find that again. So, it worked well.
Interviewer	Well a lot of us need to ask with help with things from time to time like help with ...... You know working out our pay or working back or something like that. Do you find in a situations where you ask anyone for help in working out these things?
Respondent	Um well, when I was working at McDonalds I didn't understand the pay sheets and I had to have someone help or organise how much percent was for tax and so ---
Interviewer	And who did you ask for help with that?

Respondent	Um my boyfriend or my mother.
Interviewer	You were asking family and friends?
Respondent	Yeah.
Interviewer	You didn't ask people at McDonalds?
Respondent	No, no way. I never discuss - like to me it's my pay rate is my business, you know,

Activity

Design a set of questions to elicit information about uses of numeracy over a 24 hour period.

Make sure that some of the questions are closed/open ended

Try the questions out on a friend or colleague.

How are you going to record their answers? (By tape-recording or taking notes during the interview?)

Summarize the responses in no more than a page

Participant observation or shadowing

One of the drawbacks of interviewing, although it is a very widely used research methodology, is that it yields accounts of activity, not the activity itself. If you want to find out what people actually do rather than obtain accounts of what they do, you need to undertake participant observation or shadowing. One example of this is if you wanted to find out about the numeracy practices in a particular workplace, you would need to observe the ways that workers in the workplace went about regular work tasks and try to establish what the typical routines and patterns are.

Example from shopping here

Participant observation activity

Take a context that is very familiar to you, It could be a workplace context, such as the lodging of pay claims in an office, or an everyday context like a shop or the Post Office. Over a number of occasions, observe the routines that take place, for example in buying stamps at the Post Office.

Make notes immediately after your observation of the regular routines or patterns you have observed.

In researching the Maths of everyday activities Lave (see Chapter 1) shadowed participants throughout the whole day recording as she observed. Actively shadowing participants in research may prove too difficult, costly or intrusive for small scale research.

Tape-recording and discourse analysis

If you were interested in investigating the role of language in everyday numeracy activity, it probably wouldn't be enough to rely on observation and notes of what people do as in the participation/observation activity suggested above. You would also want to have a record of exactly how an encounter developed, the actual words that were used not just an observer's summary of them. This has been possible for several decades now, with the popularity and availability of tape-recorders and more recently video recorders. Jean Searle for example has carried out an ethnographic study of supermarket checkout service encounters (Searle 1991) . This study was made possible because the researcher could tape record, transcribe and analyse instances of actual service encounters. Suppose we wanted to explore the ways that workers at supermarket checkouts deal with the mathematical aspects of their work, we could arrange to tape record instances of customer service and examine the ways that the worker dealt with the encounter. In some cases, the encounters would be quite routine, in others, when perhaps a customer asks for change in particular denominations, for the parking meter for example, this may be more challenging.

Tape recorded instances of actual encounters would provide the data for understanding, from a linguistic perspective, how everyday numeracy activities are achieved.

Clearly there are practical and ethical issues involved in recording conversations. Permission has to be given beforehand, since clandestine recording is unethical. How do we know whether and how the presence of the tape recorder has affected the interactions between the people being tape recorded?

Structured elicitation of data

One of the problems with the 'naturalistic' participant observation approach to research is that it may not provide you with rich enough data or sufficient examples of a phenomenon you want to analyse. To take an example from research on narrative: if you are researching narratives from a naturalistic perspective, you let the tape -recorder run in some everyday setting, a mealtime conversation, a pub or a group of friends chatting on the veranda. You as researcher have little control over what happens, whether stories are told or not and if so how many or about what.

One way researchers have approached this problem in research on narrative is to elicit narratives, using for example a cartoon film clip as a prompt and asking people to retell the story. This data is elicited by the researcher in a structured way. The researcher is therefore able to exert control over the data which is by definition not possible in everyday settings. (Although of course the presence of a researcher in an everyday context is likely to have some influence on what goes on!). Eliciting re-tellings of a film clip is therefore an instance of structured elicitation of data.

In this section we are going to talk about a range of ways of enriching the data about numeracy practices, for example through asking people to undertake a range of simple numeracy activities. This approach raises some problems in that it creates a somewhat artificial situation in which the person providing the data is being asked to undertake tasks and activities out of their usual context. In this study there were two ways that we elicited data in this more structured, non naturalistic way. The first was through what we called the numeracy kit, a grab bag of real life prompts which we used to elicit responses about particular aspects of everyday numeracy activity. (We discuss the Numeracy Kit in more detail below.)The second was via what we called "the pizza question", in which we asked each person we interviewed how they would approach a simple task of dividing up a pizza between friends. (We discussed the results of "the pizza question in Chapter Six.)

Multi-method research

In the sections above we have sketched out a number of approaches to researching numeracy practices but of course these approaches are not mutually exclusive. Projects are often enriched and made more significant by drawing on a number of research methods, using for example interviews, participant observation and the tape recording and linguistic analysis of key interactions.

Designing a Project

The best way to get your thinking straight about a research idea or project you are interested in is to get it down on paper. What follows is some guidance on embarking on this process. (Though clearly such guidance is no substitute for undertaking research in a structured way, either as part of formal study or through working with a research mentor.) We have illustrated this with examples of the way we went about designing the Numeracy in Practice project.

The early stages of this process would involve identifying an issue or problem and then brainstorming an idea in note form and trying to develop it into a coherent and researchable idea. For us the practical problem was to explore the pedagogical implications of the shift in the kinds of student attending ABE courses, due to the emphasis on courses to promote job seeking. We were also interested from a theoretical perspective in the relationship between everyday numeracy use and the development of mathematical knowledge. Through brainstorming the idea we came up with a concept of what we wanted to research

Here is an extract from our proposal, outlining the concept on which we based this research project:

> Young unemployed people form an increasing proportion of the membership of numeracy classes. Teachers who are skilled in teaching the more traditional students of Adult Basic Education have few resources to draw on in their interactions with this new and demanding population. There is often a disjunction between the culture of the classroom and the culture of the student and there has been little relevant documentation that can inform teacher's pedagogy.

Activity

On your own, or with a colleague, try and identify some researchable issues in relation to your work role. Jot them down in note form, first try and see how they make sense for you, then try an explain them to someone else. You should go through a process of clarifying an issue that puzzles or intrigues you.

Next you might ask has anyone else worked in this area? What are the theoretical ideas underpinning the research idea that need to be made explicit? For us in this report a key theoretical idea was that of numeracy practice. Another important component of the research arose out of considering what we meant by young unemployed. As we continued our research, this concept began to appear a lot more complex than the simple and straightforward idea that is bandied about in the media and government statistics. You can read about the research that we thought was relevant to the concept of numeracy practice in Chapter 1 and young unemployed in Chapter 2.

Having determined the focus of your research, the next step is to identify some researchable research questions. Remember that research questions are not, initially at any rate, the questions you ask other people, but rather the questions you ask yourself, they are the research idea re-cast in question form. Here are some of the research questions we asked ourselves as part of this project.

> What are the nature and purposes of everyday numeracy practices in the lives of young unemployed people?
>
> What implications do these everyday numeracy practices have for numeracy curriculum development for the young unemployed?

Having identified your research questions, the next step is to clarify your theoretical perspective and identify the methodology you are going to use to gather data in order to answer or try to answer your research questions. We clarify our theoretical perspective in chapters one and two of this report. In Chapter 3 we discuss the methodology we used to research our topic.

Next you need to plan exactly how you are going to carry out the study. How many people are you going to interview, how many classrooms are you going to visit?

Planning also involves designing how you are going to gather the data. If you are using interviews, what questions will you ask? Designing an interview involves patient processes of drafting, trialling and re-drafting. Try out what you are going to use first and incorporate feedback in the final version. In this project our two main sources of data were open-ended interviewing and elicitation using the Numeracy Kit described in Chapter 3. We have discussed the questions we used in this project in that Chapter but, here is the list of materials we included in the Numeracy Kit:

Bus/train/ferry timetables
recipes
ATM receipts
shopping docket/lay-by docket
street directory
digital and/or analogue watch
calculator (simple)
medicine glass
lotto forms
phone cards
tape measure
pack of cards
tax form
DSS or CSA form
dressmaking, knitting, woodwork patterns
calendar

Designing a research project and carrying it out is not unsimilar to planning a lesson or sequence of lessons and teaching them. If you are a novice teacher you need to walk yourself through the plan to get really familiar with what you will teach. It's the same with research interviews. As for participant observation, being in a classroom as a teacher is a very different matter to being in a classroom with a researcher's notebook or tape recorder. You need to rehearse and plan till you feel comfortable in the role you are taking up, because if you don't feel comfortable as an interviewer/classroom observer, others are unlikely to either.

Build in a recognition of the ethical issues involved in carrying out your research. Does the information you are gathering have the potential to harm or prejudice the lives of the people you are researching in any way? Is the information you gather to be stored in such a way that anonymity is protected? Do research participants have the right to withdraw from the research if they wish? Do they have some pathway of redress, if they feel unhappy with the way the research is going? Does your organization have guidelines for the ethical conduct of research? The letter we used to gain permission from those we talked to to use their conversations in our research is included in Appendix 3.

Once you have gathered your data, you need to decide how to analyse it. Data analysis in a well designed study should arise fairly logically from the research questions you have asked and the theoretical perspectives you have taken. Suppose you are interested in researching the ways that supermarket checkout operators deal with encounters where routine breaks down in some way, for example when a customer feels that he or she has been overcharged or short changed. If you have been able to gather data of such encounters, you might use a linguistic analysis. A critical incident approach would rely on check out operators accounts of such incidents and how they dealt with them. Our question "Have you ever been short changed?" led to this kind of critical incident:

Interviewer	For that time, yeah and then you come back on it. Have you ever been ripped off in a situation because they didn't understand the maths, you know say buying something?
Aidan	(laughing that) Funny you should say, this lady tried to rip me off 50 bucks yesterday.
Interviewer	Who's that? What happened?
Aidan	Oh, like a give her $50 to get a packet of cigarettes, a fifty dollar note and then I said, 'cos I wanted some change, then I thought nah don't worry about it and I give her a 20 dollar note, and I said 'Oh, I've got a 20 here' and she said 'Oh, OK' and she took the 20 off me and she's there mucking around and she give me the change back for the 20 and then sort of, as if that was it and I said 'Oh, I've gotta grab that fifty' to her and she 'Oh, oh that's right' and she never had it in the till. She had it sort of as if behind thinking 'if he forgets, I'll keep it but if he remembers' Oh, oh..." (laughing). Ah, yeah there has been times when um, a bit of change has been missing and that, so I usually check it out and....

The final stage of the research process, once you have analysed your data is that of writing up your findings. Again you can look at the structure of this research report as a model of how this was done (see Contents page for Chapter headings).

Needless to say, the above is a brief skim through the considerable complexity of designing and carrying out research. We could have expanded more on almost every area, not least on the issue of how you develop a research mindset, how you start to see everyday life and your professional practice in terms of researchable issues and questions. We have included the following introductory referees on the subject of teachers as researchers: Burns, A. Hood, S. (ed) 1995; Allen 1994. However the guidance in this chapter is no substitute for undertaking research in a structured way, either as part of a taught course, or through establishing a research mentor who can guide you and talk you through the issues, problems, pitfalls (and pleasures) of undertaking research.

Chapter 8 Understanding Numeracy Practices: Pedagogical Implications

In this chapter we try to bring together some of the threads of the project to spell out their implications for numeracy teachers, particularly those teachers involved with young unemployed people. The chapter is divided into three sections, all concerned with the learning situation but from different perspectives. The first section concentrates on how we can understand students and their practices: by examining numeracy as a social practice; by understanding who our students are; by teasing out strategies for developing an awareness of everyday numeracy in the lives of both ourselves and our students; by considering questions of motivation. The second section suggests ways in which numeracy teachers can extract starting points for teaching from data such as that gathered in this project. In the final section we focus on teachers and their curriculum and suggest how a framework for understanding numeracy as making meaning in mathematics can be used to analyse practice and plan learning opportunities for students.

Students and their Practices

Understanding numeracy as social practice

Mathematics is often seen as an immutable, decontextualised and supposedly universally accepted body of knowledge and procedures: a model sometimes referred to as the autonomous model of mathematics. The understanding we adopt in this project challenges this view and argues that the mathematical content and techniques that people employ varies according to the situation, and that people dealing with what is apparently the same situation generate different mathematical realisations depending on the purpose and context in which the maths activity takes place. This alternative understanding of the generation of mathematical problems, skills or procedures as in some way determined by other contextual factors is variously known as cultural, ideological, contextualized mathematics or mathematics as a social practice. Examining 'context' in this account of practice involves not simply examining what people do, and where, but how the doing is shaped by broader social structures. As we say in the Introduction, such a position presupposes both the person as agent, and the formative role of structure - gender, work, class, power, location - in shaping and constraining possible agency. 'People make their own lives, but not in circumstances of their own choosing', is how Marx put it a century ago. Practice in this sense is specific, historical and constrained by structure.

Knowing your students

A vivid impression that emerged from the interviews was that of a pervading uncertainty, of lives that were complex and continually changing, where housing and financial arrangements might change every few weeks. This resonates with our own lives which are increasingly affected by some of the same uncertainties; the rapidly shifting boundaries between tenured work, contract work and no work were critical issues for teachers and researchers involved with this project. As teachers however we are on the margins of our students' lives and are often unaware of the extent of their changing needs and urgencies. The data of this project challenges the stereotype of the singular 'young unemployed person', and establishes the complex and fluctuating nature of the existences of these young people as they seesaw between work and unemployment, between paid work and unpaid work, between living with family and living away from home, between having money and having none, between being dependent, independent or responsible for others.

If we see human action as involving free invention within structural constraints (see Introduction), then the project allows us to see the wide range of possible practices as constrained by different circumstances. For instance, it became clear that those young people who did not live with their parents were usually much more at home with social security finances, and budgeting in general. Those who lived at home were far less familiar with money issues. The younger people, the 14 and 15 year olds, were of course more likely to be in this category, but they were not the only ones: some of the older ones lived at home, but shopped and budgeted for themselves separately. Disability and education also combined to shape numeracy practices: we have discussed how David's deafness was leading him into work on hydraulics, and how Sam's dyslexia was one of the factors in her determination to understand and control her use of money. In these situations, as in others, when the skill and knowledge was needed it was developed. Income and housing, education and dyslexia, constrained and enabled particular numeracy practices.

Working from passions and interests as well as need

As teachers we make assumptions about what students need. We assume for instance that it is important for our students to be able to read maps and timetables. The evidence in Chapter 5 however shows that many are able to get around perfectly well without recourse to written texts. They have a variety of strategies for doing so which we would do well to pay attention to: they ask other people, they organise lifts, they wait around for the appropriate bus, they use trial and error. Efficiency may not be a core concern: if you have a lot of time, perhaps you don't mind waiting around so much.

Again, one response to having a limited or fluctuating income might be to try to take control by budgeting carefully, and it is not surprising if teachers assume that this skill would be useful for their students. We have seen how determined Sam, Angie and Matt were to retain control in this area, and have examined some of their strategies for doing so. However the evidence of the project points clearly to the fact that careful attention to regular budgeting is not the only response of young people in this situation. Some are living with parents, where they can choose to be distanced from the decision making. Others, like Tom, Aidan and David, are vague about how much money they get from their allowances, and seem to spend it until it runs out, at which point they borrow from mates. For different reasons, all these young people have chosen not to be engaged in this particular mathematical activity. If we are not careful we will interpret this choice as lack of knowledge, or even as moral inadequacy. Such assumptions are the implicit framework around which lessons on the importance of budgeting are often constructed. In a class where some are too young to have more than pocket money, most are unemployed, several live with their parents, one mother of two is already very competent and committed to budgeting, is it surprising if few of the students gain very much from such a lesson?

However, if we extend the notion of budgeting, then we find that many of the young people are deeply involved in some aspect of managing money - placing bets, making pots, selling drugs, avoiding being ripped off - accumulating a wealth of skills and knowledge in very specific contexts. We have seen in Chapters 4 and 5 how Jonathon, Terry and Liam amongst others all find mathematics more engaging when the purpose for doing it becomes clear. We have gone on to argue, in Chapter 5, that precise knowledge and the ability to operationalize it, seems to be in part a product of passion and interest, as well as of the constraints of survival. If we are to ground ourselves pedagogically, then we need to search for and work from these specific passions and interests, and from the considerable knowledge that they often generate.

Exploring numeracy practices: some strategies

If we are to use the notion of numeracy practice to inform our teaching, it will help if we spend a little time noting and analysing *our own practices*. Some ideas on how we can do this are outlined in the previous chapter under the heading: *Researching your own numeracy practices.* As we note, analyse and record we become more aware of the pervasiveness of mathematically related activities, the socially-embedded nature of our responses and the complexities of recording them.

A second step in using numeracy practices to inform teaching is to increase awareness of how mathematics impinges on our students' lives, both for ourselves as teachers and for the students themselves. Again, Chapter 7 provides guidelines that can be adapted to establish this knowledge. Some form of *initial interview* is usually used in placing a student in an appropriate class: these interviews, or an extension of them, could be the basis for the beginning of a portfolio documenting the numeracy practices of the group being taught.

Checklists can continue this process. Checklists can be drawn up by the teacher and/or the group and will usually include mathematical skills and concepts (for example, multiplication and percentages), with space to record the situation where these arose. The lists can also work in reverse, starting from situations where the need for numerical and spatial skills might be expected to emerge (for example, playing darts and travelling around the town) and leaving space to record what skills or concepts had been used.

Journals may be not much more than checklists with a simple noting of the presence of mathematical activity, but can also give an opportunity for describing and recording the mathematics involved. After keeping a journal of their own practices, teachers will be aware that such recording can be a challenge.

Class discussion of a specific, perhaps hypothetical, situation (for example, the pizza question in our project - see Chapter 6), sometimes referred to as *a critical incident*, can allow a sharing of different approaches, challenge the entrenched idea of 'one right answer' and foster an understanding of the factors - both social and mathematical - that make some responses more appropriate than others. Social factors may include structural elements such as work or gender relations; they may include personal values, or the power relations embedded in social interactions. Mathematical factors may include the degree of precision needed, the power of the chosen strategy and the range of mathematical options available. Most of these factors were evident in the pizza question.

Starting Points for Teachers

Building Bridges between Mathematics and Social Practice

We have demonstrated that the mathematical procedures used in response to a particular situation varies (see Chapter 6). We are accustomed to the idea that the response will vary according to the participant's 'ability' or mathematical knowledge. We are also aware that the participant's attitude to mathematics will be influential. What we are not so accustomed to in teaching mathematics is the idea that the response will vary according to such factors as the purpose of the activity and the relationships and beliefs of the participants: that different meaning will be accorded to what are apparently the same processes. The above discussion about transport and budgeting brings out some of these differences.

In this section we will give a few examples of how the data could be used as starting points by teachers of the young people in question to build their numeracy knowledge. We will follow the pattern of the analysis of the three data chapters (Chapters 4, 5 & 6), by examining, firstly, how everyday practices can be a rich teaching resource for the excavation and development of mathematical concepts and processes. Secondly, we will work from the mathematical concepts themselves and try to construct ways of tracing these back into everyday practices.

Starting points I: Working from the social to the mathematical

We follow several of the young people into aspects of their lives, and thence into some ideas of how we as numeracy teachers might respond.

Sam

> Sam (19) has worked in a variety of jobs and is now at TAFE on Austudy, travelling confidently around the city to do so. She was diagnosed as dyslexic at school and enjoyed working with Roman numerals because there were fewer symbols to remember. She budgets for her household of three (her partner, her sister and herself), has taken out loans in order to buy a car and have her teeth attended to, does a lot of craft work, is learning to drive, but doesn't understand how tax works. (see data chapters, esp Chapters 4 and 6, for more detail)

There are many possible starting points:

- the financial area, with its budgeting, pensions, loans and tax
- the travel area, with its use of maps and timetables, and the issue of driving a car
- the craft area, with its need for measurement
- the cultural area with its reference to Roman numerals

Bearing in mind the cautions expressed above about *not* teaching what people don't want to know, we would probably avoid teaching about budgeting and map reading. Three starting points that might allow a development of Sam's expressed interests would be:

Thinking about tax:
What is it? who pays it? how is it worked out? This might involve teaching about percentages, it could incorporate work on computers, drawing graphs and compiling tables, filling out forms. It might be a place for using fractions. It would certainly be a good place to investigate Sam's concern that she has been categorised in the wrong tax bracket for a number of years, and if this is so, to claim some of that money back.

Driving a car:

Sam has never really grasped how the metric system works, and doesn't think she ever learnt about it at school. She does not know how tall she is. She has taught herself about centimetres and millimetres in relation to her craft work, but she has never had to use metres 'or anything long like that'. That is, until now that she is starting to learn to drive. Now she needs to judge distances, estimate how far 50 metres is. These needs and interests could be a springboard for bringing together the unconnected fragments of Sam's picture of the metric system, to extend the practices she has already 'invented' to a broader understanding of length, and eventually of the wider metric system.

Playing with numbers:

Sam's pleasure in the patterns of Roman numerals could be extended by looking at how other number systems work - Babylonian, Aboriginal, Mayan, for instance. It is often through a comparison of our own system with other systems that we understand the power of our own and its possible advantages and disadvantages. Another direction to take might be to emphasise the interest and beauty of other patterns in our own number system: the patterns in the 100-square (when the numbers are written from 1 to 100 in rows of 10) or the addition square; the patterns in the nine times table and the less obvious ones in the eight times table and the seven times table, and so on; the relationship between consecutive square numbers; the Fibonacci sequence; the way you can quickly add the numbers from 1 to 100 (or any other number) in your head. Such playing with numbers confirms a sense of how numbers work, and creates a valuable 'at-homeness'.

Jonathon

Jonathon (16) lives with his family near a small town outside a larger country town, and is the eldest of eight (soon to be nine) children. He has many outdoor tasks on the farm, and has been home schooled for some years. He has a passionate interest in the weather about which he is well informed. He is also interested in geology and knows where to find different rock formations near his home. He has been helping his uncle with panel-beating and is interested in taking up metal work. He is on the Newstart allowance, and gets casual work from time to time.

Jonathon's life offered a multitude of starting points, largely to do with measurement:

- the weather area, with its measurement of rainfall and understanding of storms

- the financial area, with the pension and earning money at the local Show
- the metalwork area, with its need for careful measurement and an awareness of shape
- the geological area, and its dimensions of time and altitude

Most of these areas could be used to extend Jonathon's knowledge and skills in a way which he would welcome. They could give rise to work with the metric system, and to the understanding of length, area, volume and the relations between them; the relation between large and small units, as you measure small pieces of metal, or high mountains; the use of graphs and tables; an extension of his embryonic understanding of average, discussed earlier.

But his fascination with science, his curiosity about how the weather works, how and where precious or semi-precious stones might be found, open up areas that may well be beyond the scope of a mere numeracy teacher. They do however offer more opportunities for extending ideas of measurement to include other units - of speed, of acceleration, of mass, of density, of electricity. The challenge of a student like Jonathon is not how to find starting points - they are everywhere - but how to help him look at, revise and connect fragmented pieces of knowledge to give more powerful tools. He offers one such starting point himself:

> Me and me dad and me mum, like we were working out if we had 100 inches like which places would get flooded and which wouldn't. We reckon if we did get 100 inches Broadfields would be covered right up here, near the Barracks. The railway - you wouldn't be able to come on the railway because it would be flooded right out to - until the ground starts going up into the mountains. You know where Eversleigh is?... That would be gone. Rowntree would be cut off in several different places and Milson, there'd be only a little bit of Milson on top of the hill because it would be ...an island. And Benton would be completely under water.

How could you model something like this with students? What would they learn?

Mick

> Mick (20) lives by himself in a country town, and is on the disability pension because of a brain malformation which has left him subject to frequent seizures and a tendency to forget - appointments, medication. The seizures interfered with his learning at school, and he has difficulty with reading but still enjoys maths. He has lived in the area most of his life, helps his father break in horses, likes to build and weld things, to play around with an old computer of his mother's and is good at playing darts.

Mick drew a map, of how to get from the college to his home. He talked his way through the drawing, and turned the paper around as he showed the interviewer how to get to his flat:

> Well, there's two ways. Say this is this building. Here's your front door, you walk - you can either walk out here via the road straight down, you come to the end of the road, you got a bridge what goes across the railway line, you go across there, walk up back past the public toilets what are situated here. There's a small garden here. There's a pedestrian crossing here, you walk across the road. [the main street]. Then you keep walking further back this way, you come to a vacant shop with a broken window, then you got a laneway, a small foot laneway, you can't drive through it, another - you got a hardware shop. Get roughly half way up the laneway and there's a little door that goes in there, you go up the stairs and I'm the first one on - I'm the only one on the right. ... Or you leave here and go this way [*points in the other direction*]. Across this bridge just here, walk down to the - across Main Street, that's either side of Main Street. You can either go across here or just walk down here until you see the laneway and you cross over and walk up the laneway.

Such talk allows a chance for the teacher to scaffold a move from a very contextualised personal language to a more decontextualised language. Difficulties with both maps and timetables can in part be understood as a lack of familiarity with the appropriate genre, rather than as a lack of mathematical skills per se. It is often schemas that need to be built up, either schemas to do with generic structure (eg to what extent scale is important) , or to do with the background knowledge (eg whether Rydalmere is a suburb of Sydney or a country town).

Clearly in the business of getting around, there is much scope for mathematical learning - about, for instance, different kinds of maps and their different uses. In what ways, for instance, are railway maps different from street maps? Street maps, with their emphasis on scale, angle, distance - that is, measurement - are geometrical. A realisation that scale and even direction are not as crucial in a suburban rail map as order and junction (of stations) can develop into further work on other such topological diagrams (eg circuit diagrams). Topology (literally, the study of shape) thus differs in focus from geometry (literally, the measurement of the earth).

Starting points II: Tracing the mathematical back to the social

We have been considering how we might develop everyday events in a student's life into mathematical skills and understanding. In this section we would like to work the other way: to start with a mathematical concept or skill that might be useful for students - in this case, the times tables, naming fractions, and measurement - and try to find occasions when we can weave it back into students' lives.

Learning the times tables

If our aim was to help students learn their tables, we might do worse than look at how Tom and Mick have become very familiar with doubled numbers, their two-times table, as they play their various games of darts. Why could we not adapt the games so that instead of ending a game on a double our students had to end it on a triple, or a quadruple or even a multiple of seven? Not all young people are enthusiastic about darts, but there will be some who are.

Scaffolding a move from halves to other fractions

Fractions are a good example of how everyday experience can quickly, and often mystifyingly, be generalised into abstracted mathematical concepts. There is no doubt that a foundational understanding of fractions was shared by most of the young people in the study: halves and quarters had everyday meaning, things could be 'chopped' into halves quite easily. An extended 'formal' system of fractions can be generated from this everyday 'spontaneous' knowledge, but for most of the young people meaning had been completely lost in the rapid and distancing process of abstraction into the formal system. The challenge for the numeracy teacher is a double one: firstly, to ascertain whether, why, and to what extent, it is important to her students that they understand fractions, remembering that it may not be important at all; secondly, if it is important, to postpone the trade-off of meaning for abstraction, to build up the system more carefully and slowly, to scaffold the formal by linking it more firmly to the everyday, to generate the strength of abstraction from the strength of experience.

The following is an outline of a possible discussion between teacher and students, where the teacher is trying to elicit knowledge about fractions from the students, trying to get them to name it and represent it.

Discussion		Comment
Teacher: Students	So how do you get half a pizza? Chop it in half, in two bits.	*The teacher is starting from knowledge about a half, because most people understand something about halves.*
Teacher Student	How many different ways can we write a half? A half, one half, $\frac{1}{2}$ (perhaps 0.5, 50%)	*Being a special, simple, everyday fraction however, the associated everyday language and irregular written form are hard to generalise from. Consistent language would call a half 'one twoth'. So, the teacher goes on to use an example that is a little less common*
Teacher Students: Teacher Students Teacher: Students Teacher:	So how do you get a quarter of a pizza? Chop it in four bits, in quarters. And if you had one of those that would be...? ... a quarter. And three of those would be ...? ... three quarters. How many different ways can we write three quarters?	*Halves and quarters are easy to use because they have common everyday meanings, but the language associated with 'a quarter' is still too irregular to generalise from. 'Three quarters' is getting closer to the pattern of less everyday fractions: its associated written form gives more information and so is more easily generalised from, but its associated language still does not fit the*

Discussion		Comment
Students	Three quarters, 3 quarters, $\frac{3}{4}$. Some people call it 3 fourths.	*pattern of the more formally mathematatised system - until we introduce the '3 fourths' variation. The next question allows this generalisation to be made:*
Teacher:	So if $\frac{3}{4}$ is 'three fourths', how might we read this? [$\frac{7}{9}$ *is written on the board*]	*And this...and this....Lots of examples can follow. But although the students can read them, can match words with symbols, they may not be able to match meanings.*
Student	Seven ninths, 7 ninths.	
Teacher	And this? [$\frac{5}{12}$ *is written on the board*]	
Students	Five twelfths, 5 twelfths	
Teacher:	What might seven ninths mean? Don't know? OK, well what does '7 boxes' mean?	
Students	It means you've got seven boxes of course.	*After all, 7 apples (or people) means there are apples (or people) and you are talking about 7 of them. Similarly, 7 ninths.... But what are ninths?*
Teacher:	Ok, so seven ninths means...?	
Students	There are these things called ninths and you've got 7 of them.	
Teacher	So what's a ninth then? Don't know? Remember what a quarter, a fourth, is?	
Student	What you get when you chop a pizza into four bits.	
Teacher	So, a ninth...?	
Student	What you get when you cut something into nine bits all the same size. One of them is called a ninth.	
Teacher:	So what's 7 ninths of a bar of chocolate?	
Students	It's what you get when you cut the chocolate into 9 equal bits and take 7 of them.	
Teacher:	Yes, so $\frac{7}{9}$ is like a command: the bottom part tells you how many equal pieces to cut the thing into, and the top part tells you how many to take.	*The way we write a fraction is fairly arbitrary: we could have written $\frac{7}{9}$ as 7(9), or 7:9 (and in some circumstances we do), or 9*7 or 7*9 - so long as we all agreed on which part meant what.*
Teacher	So what's $\frac{93}{100}$ of the population?	
Student	It's what you get when you cut up the population into 100 equal bits and take 93 of them.	
Teacher:	So what's the fraction $\frac{1}{4}$ mean then[*writing it on the board*], using this 'command'?	

Discussion		Comment
Student	It's what you get when you cut something into four bits the same size and take one of them.	*Bigger, non-everyday numbers help to generalise, by not being special cases.*
Teacher:	And $\frac{1}{2}$? [*writing it on the board*]	*And we can take the working definition -the 'command' - back and see if it works with the everyday fractions:*
Student	As if we didn't know! Cut it in two and take one.	
Teacher:	All right! So what about $\frac{1}{3}$? $\frac{17}{83}$?.......	*And so on ....*

Measurement as a social construction

We have shown that different needs elicit different responses. Thus not all measurement activities require the same tools. Some tools and procedures are more appropriate than others in particular situations, as illustrated in the idea of the 'measurement continuum' along which particular practices could be arranged, in such a way that we can see that certain features of practice change in predictable ways, as the contexts become increasingly context-reduced. (This corresponds to the mode continuum of functional linguistics (Martin, 1984 cited in Gibbons 1995.)) We give an example to tease out this notion:

Increasing distance, increasing need for communication......

Will the table fit under the window?

1 Look at the table, look at the window. Will it fit?
What if I can't tell by looking?
2 You could shift the table over to the window.
What if I can't move it?
3 You could measure it in handspans.
What if I need to tell the people in the furniture shop how long the window is and I haven't got a tape?
4 You could measure it in book lengths and take the book with you.
What if I have to tell my sister in South Australia?
5 You could use metres - standard units.

In the context embedded measurement produced in the face to face context of a particular experience (situations 1 & 2 above), the visual/sensory context allows physical reference to objects, with no need to communicate precise measurement beyond the immediate context. The measurement need not but may be shared with others, but only with those others who are physically present.

As the objects that the measurer wants to compare are distanced in time or space (situations 3 and 4), the measurer is forced to use an intermediary object - perhaps informal body units - to compare the original objects. With the use of the measurer's own body unit (situation 3), the same person is the measurer throughout; the unit can be transported by the measurer, but not by others, across limited time and space. The result of the measurement again need not be shared, but if it is (situation 4), communication is limited to a small group who share the same informal unit of measuring - perhaps, as here, a book .

As the need grows to communicate beyond the immediate face-to-face context of particular experiences, so the measurer is forced towards using standardised units.

The features that change along the continuum include:

- portability: whether you want to transport the unit from one location to another
- communicability: whether you want to tell someone else the result of your measurement
- precision: what degree of precision you want in the measurement
- meaningfulness: how meaningful the measurement is - whether it is useful, conceptually interesting, critically relevant, valid, reliable

Two interweaving dynamics - the logical and the social - are informing this progression. The logical dynamic grows out of the process of solving the question 'how can I measure those objects?' (look at them; put them next to each other; use units of some sort to measure them). The social dynamic grows out of the question 'how can I tell you my result?' (look!; use my handspans; use metres).

If our students are to be able to measure appropriately then we need to make explicit the way in which these dynamics relate, and develop. We need to construct situations which provoke an understanding of both the logical and social dynamic, scaffolding the possibility of a move from the everyday world to a more abstract one, from the personal to the more public, when appropriate. The earlier example about the table could be used as the basis for such a lesson, as could the question of height. In the following scenario the teacher asks questions about measuring height, in an effort to provoke the question of whether and when standard units might be called for.

Teacher	Comment
Compare your heights. Stand in order of height. Who is the tallest? shortest?	*At first, no tapes, rulers etc are made available. Encourage guesses, followed by direct comparison standing side by side.*
What is the difference between the tallest and the shortest? How can we express it?	*Encourage use of informal units -handspans, books, string. Don't supply rulers etc yet.*
Would we be able to tell a friend/ parent who isn't here?	*Elicit a realisation that we would need to take the string etc with us.*
So if we can't take the string with us, what will we do?	*Elicit the need for a more standardised unit... try metres, (or even feet); use rulers/ tapes.*
So, when do we need to use metres?	*Discuss the idea that formal measurement is not always necessary, though some situations will need it. Try to identify situations of both kinds, share experiences of how people do both, what kind of informal measuring they use.*

In this progression of increasingly distanced statements we can see that 'quantification is well suited for communication that goes beyond the boundaries of locality and community'. Angie and her little daughter are a poignant illustration: Angie, staying within her own community uses the outmoded feet and inches when she measures her own height; when she talks about her daughter, it is clear that she is pulled beyond the familiar boundaries of home, and uses the more widespread and public metric system. Note that a lesson of this form could be usefully extended into a parallel one on mass, volume or area and that these lessons on measurement would benefit from connections made with historical and cultural traditions relating to measurement.

We have argued that students get lost in the trade off between preservation of meaning and the potential for generalisation in mathematics (see Nunes 1993, discussed here in Chapter 1). Veel (forthcoming) also points to the hierarchical ordering of mathematical concepts and the speed with which they become distanced from meaningful everyday links. We must appreciate both the power of what abstraction can do and the strength of experience in giving meaning. To retain meaning we must build more slowly and firmly the bridges between experience and abstract thinking.

Teachers and Their Curriculum

Making meaning in maths: fostering numeracy

In the previous section we modelled ways that social or mathematical concepts could form the basis for curriculum development. Here we examine ways to relate the notion of numeracy practice to an already existing teaching/learning framework. In an effort to scaffold a shift from the autonomous to the cultural ideological model of mathematics, Johnston (1995) proposes five 'strands' of meaning that can be used as a framework by teachers to plan activities that foster a multi-faceted understanding of mathematics, or in other words, numeracy. The model owes much to Freebody & Luke's (1990) discussion in the parallel literacy context of what they argue are the four necessary reader roles (decoder, participant, user and analyst). The five strands that Johnston proposes can be summarised thus:

- meaning through rote
  where meaning is acquired through rote-learning of atomised content
- meaning through conceptual engagement
  where mathematical meaning is constructed through problem-solving, process and provocation
- meaning through use
  where meaning is developed through use in everyday contexts
- meaning through historical and cultural understanding
  where meaning is enhanced by an understanding of the genesis and cultural use of specific mathematics
- meaning through critical engagement
  where meaning is generated by asking "in whose interest" type questions and also questions about the appropriateness and limits of the maths model in the real situation.

Each strand can be seen as one way of weaving meaning into a particular mathematical activity; the more strands that are woven together through that activity, the richer the grasp of the relevant concepts and skills.

Working from our accumulated data, we can mine it in two quite different ways, one to locate student weaknesses, the other to identify their strengths, or to put it in a different way, one to locate learning opportunities for students, the other to identify learning opportunities for teachers. The first exploration searches for the mathematical gaps and misunderstandings in students' everyday practices that provide learning opportunities that teachers can exploit. The second exploration searches for valid alternative approaches already 'invented' by students in their everyday practices that teachers can adapt and share with other students. We give some examples of each using the framework of the five strands of meaning.

Gaps and misunderstandings: locating learning opportunities for students

Gaps and misunderstandings in student knowledge are often seen only as deficits. We would like to frame them also as situations where the challenge is to tease out how the student is constructing meaning and to use that understanding to scaffold new and deeper meaning.

We will use each of the five strands of meaning to identify one or more examples of such a gap and misunderstanding related to that strand, and we will try to indicate the points at which bridges could be built.

Meaning through rote:

When Angie worked out a sharing of the pizza money, her procedure was correct, but her knowledge of her three times table let her down:

Interviewer — How much would it be, in fact then?
Angie — I'm not sure, um 16 - how much was it? 16?
Interviewer — 16.90?
Angie — 90, I don't know that one. I'd sort of probably have to sit down with a pen and paper and work it out or something..
Interviewer — Okay, there you are. it doesn't matter how you do it. just -
Angie — [*Angie works it out on paper.*

```
   4.53  and 1 over
3 ) 16.90
    15
     19
     18
      10
       9
       1
```

(*after this working out*) Oh well about $4.53 each.

Interviewer — Okay so you did it by dividing - you did a sort of long division kind of thing. Well 3 into 16, you got 4 and 1, okay 16, so you said 4 x 3 are —?
Angie — Nearly 15.
Interviewer — And 1 over and then ... 3 into 19 and 1 over.
Angie — There's still remainder 1 so someone would have to get stuck with an extra 1 cent.

The automatic knowledge of one's tables is not the only skill that should be taught in relation to multiplication; it is not even the first or most important. At some point however the lack of such rote knowledge has implications for the ease with which the skills can be used in other activities, either in everyday situations such as this one, or in building a more extensive mathematical repertoire.

Meaning through conceptual understanding:

For many, the idea of a third was a conceptual mystery. Matt, for instance, found it impossible to work out a third, reverting always to quarters (see Chapter 6 for a more detailed discussion). The notion of average for Jonathon as he discusses local annual rainfall in the following extract, included some idea of making things even, or predicting, but only from one year to the next:

Jonathon	Say that's for the year, 71 inches. Now that's quite a lot, but not - it's a fairly rough guess. .. then say for '97 you only had say 29 see now you're down behind average for that year.
Interviewer	So, what would be the average of those two years?
Jonathon	Well, see this what you base the average off for this year. If you get higher than that you're well above the average.
Interviewer	So, what is the average?
Jonathon	Oh the average for this year ... Okay say we had 12 inches last year, '96. Now, our average for this year is 12 inches, okay. So, now if we only get say 6 inches we're 6 behind the average for the year and if we get - say we get 17 inches we're above the average.
Interviewer	But how do you make it? Supposing for three years you - supposing one year you got 12, the next year you had 6 and the next year you had 12, what would the average be of those three years? Would you be able to work that out?
Jonathon	Well, see the average only goes from year to year. Like you can't do it for more than like two years in a row. So, what I've done there is, that's the average you can't go like - oh hang on I see what you mean, yeah, right.
Interviewer	You could work it out?
Jonathon	...You get what I mean? Like you base it off like every year. All right I'll draw another calendar. Sorry, okay and say we're meant to have that and we only get 6 inches. Can you see the pattern, like this year works off last year's average. Next year works off this year's average. The year after that works off next year's average. So, you kind of like - it's kind of like from year to year from year to year.

Both Matt and Jonathon had some conceptual knowledge (of fractions and averages, respectively), and though it was inadequate for the purposes required, it could form a strong realistic starting point for learning - a teaching opportunity.

Meaning through use:

One of the reasons explicitly put forward for why fractions were hard came from Mick, who on the whole enjoyed maths and found it stimulating:

> I love adding, subtracting, I'm not that good on fractions and the conversion of fractions to decimals. You don't use them in every day life. ... You use your times tables and stuff like that...You don't (use fractions). Unless you're cooking.

Clearly the challenge for the teacher here is to identify a situation where fractions can be seen to be useful, where use can contribute meaning to their abstract form. The teacher may have to begin with Mick's suggestion of cooking, and collect materials about other real life situations that use fractions. She should not forget also that one kind of 'use' is the use in further mathematics.

Meaning through historical and cultural understanding:

There was little evidence that any of the young people understood that maths was historically located, that, for instance, different societies developed different number systems partly in response to material needs and constraints, let alone that different circumstances within their own society could give rise to different, valid strategies. An exercise like the pizza question where a group of students were asked how they actually would solve a particular problem would allow insight into the myriad of ways that others calculated the answer, the factors that might be taken into consideration, different ways of recording the reasoning and opportunities for assessing whether particular methods were appropriate, both mathematically and socially. An exploration using a book like Lancelot Hogben's *Man [!] Must Measure* (1936) into how and what people in earlier times and other cultures have measured could provoke questions about both the process of measuring (how we do it) and the rationale (why we do it). A discussion of the history of our own money and measurement systems, why they were changed to metric systems, and how metric systems work, would give meaning and interest to what could be mere rote learning.

Meaning through critical understanding:

Unlike some of the others, Aidan's knowledge of benefits and how they worked was fairly vague:

> I think I can earn around part time, $200 a week, I think, a hundred or two hundred, I'm not real sure, but it's not much. And then once you earn so much if you go over that amount, for every dollar you earn then they start taking it off.

There is room here for the development of an understanding that would have both socially and mathematically critical dimensions. Is the way that extra money earned results in money deducted from the benefit fair? Are there poverty traps implicit in the model? One exploration of just such a question is discussed in detail in Barnes' article on poverty traps (1994).

Alternative approaches: identifying learning opportunities for teachers

A very freeing realization for a student in a maths class is the knowledge that there is more than one good way to approach most problems, and quite possibly more than one 'right' answer. Teachers too can benefit from this realization, as they learn to listen to their students as they work, eliciting as wide a range of methods as possible in any given activity. Critique will be necessary, as some methods will be inappropriate and some calculations will be wrong, but many methods invented by students will be worth following up, and some will be valid both mathematically and socially. These methods should be adopted by teachers as part of their own repertoire and shared with students.

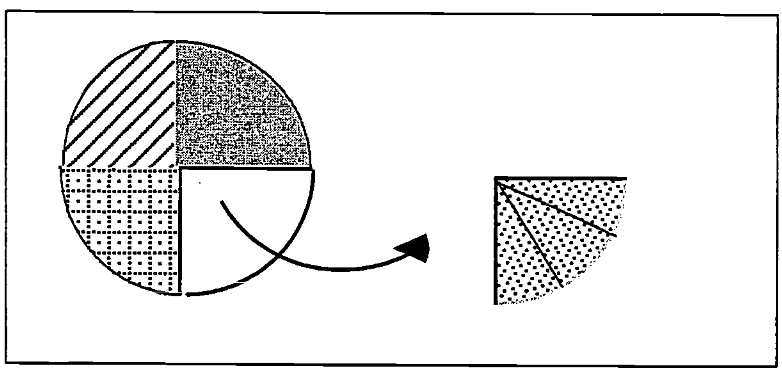
Again, we will use the five strands of meaning to trace examples of such alternative methods that occurred in our data: student knowledge that could be adopted and adapted by teachers.

Meaning through rote:

Jillian counted the number in her family by starting from five (the number of older children) and then counting on by rote 'six, seven, eight' to add the group of little ones, clearly a way that was very meaningful for her. As we argue in Chapter 6, there had been time to identify as a family of five; for seven years, that is what they had been and for Jillian these were the very formative years from the age of 3 till the age of 10. Since then, because a new child had arrived every year or so, the numbers had not stabilised. One-to-one counting, tallying, was still a necessary check, and the method of counting closely mirrored the social reality of Jillian's growing family. What she said involved a process that could be represented as 5 +1+1+1, or to be more precise, 5 + (1+1+1) +1 because 'there's another on the way'. It could be interesting to see how other people talk about and represent the size of their families.

Meaning through conceptual understanding:

Most of the young people found a third hard to conceptualise, or to construct practically. When Jonathon talked about sharing out a pizza between himself and two friends he said he would do it in the following way: 'Cut it into 4 pieces, take one each. That's three. Cut the fourth piece into 3, and take one each' ie a quarter plus a third of a quarter. This involves a practical way of illustrating the concept of a third, based on the easier concept of a quarter:



This method might usefully be generalised and shared with other students. Could we see a half as a third plus a half of a third? Could we see a quarter as a fifth plus a quarter of a fifth? Why would we want to? Fun? Developing a feel for how to play around with the concept of fractions?

Meaning through use:

Mick used paper and pencil to calculate the length of the train journey from his local town station to Central Station in Sydney, leaving at 6.54 am, and arriving at 9.57. He wrote down the calculation with the smaller number above the larger:

6.54
9.57

He said

> Yeah, three hours and three minutes.

When the interviewer asked if he always did subtraction in that form he replied:

> No. I can muddle up me things and still know what I'm subtracting.

And then he suddenly said:

> You know what I did?... I added from that to that. I said 7 plus what - no, 4 plus what equals 7.

And then, he continued, fumbling somewhat for the pattern, five plus what is five, and six plus what is nine. Reflecting on what was an almost automatic practice, he was able to make his rationale explicit. Such a method may be close to what other students use, and a thus a valuable tool in the teacher's kit.

Meaning through historical and cultural understanding:

Because Roman numerals use only three or four different symbols, they gave Sam a sense of control denied to her with standard numerals because of the dyslexia which prevented her recognising symbols easily. (This is an interesting example of how what is perceived as a disability can work in a different way to enable.) An approach that cultivates an awareness of the historical genesis of mathematical knowledge can allow alternative openings for students who have built up resistance to the many mathematical tasks that have seemed meaningless in their journey through the educational system.

Meaning through critical understanding:

A basic awareness of 'who might benefit' - the social element of this strand - was fairly well developed in most of the young people in relation to their own lives, and sometimes more broadly. Cameron, for instance, wanted to know whether the pizza question was a 'real' question so that he could adjust the 'genre' of his answer. Others combined this social critique with a more detailed, though sometimes flawed, attention to the actual mathematics involved. Sam, for instance, was determined to see for herself how her budgeting calculations worked - her partner's word was not enough. Angie was well aware that the cost of the pizza needed to be shared equally each week if she wasn't to be ripped off, a concern that expressed itself at a more complex level in the financial calculations that enabled her to track the strands that contributed to her income and make judgements about whether or not she could afford to live with her boyfriend, the father of her children.

Using the strands of meaning of this framework is one way for teachers to ensure that they are systematically and carefully embracing in their curriculum a wide range of activities from concrete experience to abstract generalisations in order to build up opportunities for students to construct meaning in whatever mathematics they use.

Conclusion

Resisting or confirming marginality

Chapter 4 vividly illustrates the socially constructed nature of numeracy practices through examining the structuring effects of gender, location, disability and culture. One aspect of this social construction is the power the teacher has to reproduce or resist the effect of these structuring categories; too often the power works to confirm the marginality of various groups, therefore limiting learning opportunities, as in this description by the young Aboriginal man, Terry:

> Just certain teachers that we used to have, you know, they'd be on your case and stuff all the time. Couldn't really get into the learning process kind of thing, you know. They'd be on your case all the time about little things....Not just me but, you know, a lot of other students and that too. And it would just, I don't know, it turned you right off school, you know....It used to make you feel, I don't know, kind of don't feel real comfortable at school, you know and being around that teacher.

Liam, classified as a 'slow learner' at school because of his deafness and dyslexia, had to work to contest the teacher's construction of himself and his classmates as stupid:

> [they] didn't know how to teach OA... we were put in a room and basically we didn't do much...we were basically doing kindergarten work. Teachers got frustrated at us. It takes time to go over and over, but if you do you can eventually learn. We're not dumb, we just take longer to learn.'

The location of these descriptions is the school system, and certainly we found that few of the young people had positive experiences of school, a fact which goes some way towards accounting for the comparative popularity of TAFE , Skillshare and community colleges as sites of learning, for the young people in our study. Teachers in these institutions nevertheless need to be aware of how the ways in which they perceive and respond to different groups can be read by their students: they need to be aware of their own power to resist or confirm the marginality of many of their students.

Teaching Mathematics: extending choice and challenging constraints

Our numeracy practices can be seen as what we do by way of response and resistance in a mathematical context, our free invention in the limiting circumstances of our everyday lives. One of the constraints on our freedom to act, limiting our power, is the depth of our mathematical knowledge and understanding. The deeper this knowledge the greater our potential range of choice in action, and this is as true for teachers of numeracy as for their students. The project gave some evidence for the position that people's actions are not simply determined by what they know; people seemed also at times to select whether or not, or to what extent, they would take on numbers in a particular context. David, for instance, though capable of studying hydraulics, chose not to use mathematics in the context of eating out or with reference to his weekly pay. If the mathematical meaning had dominated, David might have concentrated on the exactness of the calculation. In this case however, David's selections are coloured by other meanings attached to the situations: here, the social relations with his mates, and the perceived low status of manual labour in comparison with trades are foregrounded instead. The focus is the (social) 'she'll be right' rather than the (mathematical) precision. Because he could have done the calculations, this was a matter not just of choosing but of choosing not to. His agency can be seen to be greater than that of others who did not have the skills or knowledge to carry out the calculations in the first place.

The core role of the numeracy teacher is to increase the range of options for the students, by helping them deepen their mathematical knowledge and understanding, so that they can make choices in tune with their needs and desires, taking active control of their lives when they choose to. Being numerate, according to this view, involves:

> more than being able to manipulate numbers, or even being able to succeed in school or university mathematics... being numerate is being able to situate, interpret, critique, use and perhaps even create maths in context... (Yasukawa et al 1994: 33)

For teachers of numeracy it means two things. Firstly, and this is no small matter, it means that they themselves need to be truly at home with the mathematics their students need. Secondly, it means that they need to be able to understand something about both the structural constraints of society and the possibility of agency, about how students make their own mathematical lives, even though it may not be in circumstances of their own choosing.

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Appendix 1 Questionnaire for participants

Questionnaire For Use By Abe Teachers

General Background

1. How old were you when you left school?
2. What was your favourite subject? Why?
3. What was your worst subject? Why?
4. How did you feel about mathematics at school? Why?
5. Have you held any paid jobs since leaving school? Unpaid ones? What sort of jobs?
6. What year did you reach at school?
7. What age were you when you stopped studying maths?
8. What are your hobbies, interests, sports, or whatever?
9. Who do you currently live with? eg friends, parents etc
10. Is English your first language, or the first language of your parents?
11. What language do you count in?
12. Could you tell me something about your cultural background?

Numeracy Practices

- Do you recall learning times tables?

  How did the teacher teach times tables?
  Did you find it easy or hard?
  Do you still know your tables? do you use them?

- How tall are you?

  Do you use metres, centimetres etc to measure? Waht sort of things? Why?
  Do you use feet and inches? When? Why?
  Which do your parents use?

- What kind of activities do you remember doing in school maths?

  Were these always on paper, or did you figure things out using equipment?

Did you get to make up your own questions?
Did you like word problems? Why or why not?

- How useful is the maths you learnt at school to situations in your everyday life?

  Can you tell me how you've used maths since you've left school?
  Is any of the high school maths that you did any use?
  In what ways do you use tables now?

- A lot of us need to ask for help with things like DSS forms, timetables, tax forms, working out our pay, map reading, and so on. Who do you ask for help?
  eg friends, parents, government bodies, advocates etc

  What other things do you find hard to read?

- Have you seen the new digital railway indicator boards?

  What do you think of them?

- Have you seen Roman numerals?

  Do you know how they work?

- Do any of your friends do maths differently from you? eg long division, subtraction

- You can get two different types of watches: what's the difference between them?

  Which do you prefer, and why?
  How do they work?

- Have any of your friends been ripped off because they couldn't understand the maths they needed in a particular situation?
  What sort of situations is it important to have some sort of maths skills?
  eg car buying
  laybys
  holidays
  borrowing
  banking
  rent

- Why do salary/wage earners pay tax?

  Does everyone pay the same amount of tax?
  How is tax worked out?
  In your opinion, how should the taxes you or your parents pay be used?

- How do banks make money?

- Do you use the Department of Social Security?

  What are they there for?
  Is the Dole enough to meet your needs?
  What do you think about "work for the Dole"?

- Do you use the Internet?

  Does anyone make money out of the Internet?
  What do you think about "timed local calls" on the phone and Internet?

- When politicians talk about inflation, do you know what they're talking about?

  How might it affect you?

Appendix 2 Teacher Questionnaire

Questionnaire for use by researchers with ABE teachers

1. Do you have formal guidelines for assessing what the students already know on entry to numeracy classes? Describe.

2 Do you also make this assessment informally, and if so, how?

3 Are you able to use insights from either of these sources to assist the students in their learning of numeracy? If so, which ones? If not, what are the obstacles?

4 Can you think of any occasions when a student's method of dealing with a problem has taken you by surprise? especially if it was a successful method that you wouldn't have used yourself?

Appendix 3

Profile of the young people

Name	Age	Living arrangements	Income support	Location*	Gender*	Cultural Background*	Year left school
David	26	home	Newstart	c	m	A/C	10
Alicia	19	home	Newstart	c	f	A/C	11
Aidan	18	home & with friends	Newstart	c	m	Norw	10
Cameron	20	home	-	m	m	A/C	10
Kylie	19	?	-	m	f	A/C	
Charmaine	17	sometimes home	-	c	f	Koori	9
Sam	20	with partner & sister	Austudy	m	f	A/C	10
Jillian	14	home	-	c	f	A/C	
Angie/ Kelly	19	with child & sometimes with partner	sole parent	c	f	A/C	9
Rashid	17	home	-	m	m	Philip	10
Jonathon	16	home	Newstart	c	m	A/C	
Kevin	14	home	-	c	m	A/C	(9)
Lars	18	home	Newstart	c	m	A/C	12
Lynne	16	home/ mother	none	c	f	A/C	9
Tranh	19	homeless	-	m	m	Viet	7
Teresa	24	?	-	m	f	Ital	
Matt	22	home/ mother	dole/ Newstart	c	m	A/C	11
Melanie	16	home	none	c	f	A/C	9
Nerida	17	home	Newstart	c	f	A/C	9
Sharon	16	home	none	c	f	A/C	8
Liam	26	with friend	dole/ Newstart	m	m	A/C	10
Steve	21	home/ mother	Newstart	m	m	A/C	10
Tom	19	with friend	Jobsearch	c	m	A/C	9
Terry	20	extended family	Abstudy	m	m	Koori	10
Mick	20	alone	disability support pension	c	m	A/C	9

* Location: c=country; m=metropolitan

Gender: f=female; m=male

Cultural background: A/C=Anglo-Celtic; I=Italian; K=Koori; N=Norwegian; P=Philipino; V=Vietnamese

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Appendix 4 Consent Form

UTS

FACULTY OF EDUCATION

CONSENT FORM

I ______________________________ agree to take part in the research project , *Mathematics Practice in everyday life,* being conducted by Betty Johnston, School of Adult Education UTS, Ph 9514 3885. I understand that the researchers may interview me or ask me to keep a record of the mathematics I do in every day life.

I understand that the purpose of this study is to help teachers learn more about the mathematics used by young people in their everyday lives. The researchers will use the information they gather from me to help teachers plan relevant mathematics courses for young people. i also understand that this project will advise other teachers and researchers about how to conduct this kind of investigation.

I agree that the information gathered from this project may be published in a form that does not identify me in any way.

I am aware that I can conduct Betty Johnston if i have any concerns about the research. I also understand that I am free to withdraw from this research project at any time I wish and without giving a reason.

I agree that Betty Johnston has answered all my questions fully and clearly.

______________________________ ____/____/____.

Signed by

______________________________ ____/____/____.

Witnessed by

NOTE:
This study has been approved by the University of Technology, Sydney Human Ethics Research Committee. If you have any complaints or reservations about any aspects of your participation in this research you may contact the Ethics Committee through the Research Ethics Officer, Ms Susanna Davis (ph: 9514 1279). Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

Appendix 5 Logging Grid

sites of practice --->	geog location	resource access/use				personal/ physical		family	personal activities			interaction with		
structuring contexts		travel/tr ans-port	housing	income & exp	other eg compur-ers	health	disabilit y		leisure/ hobbies	informal skills acquis'n	cash generat-ive	school	other bureau cracies	further edu-cation
power														
work														
social space/time & social networks														
emotion/ affect														
mathematical activities														
number - counting														
calculating														
locating: space and shape														
measuring eg time/distance/ weight/														
representing eg use of symbols/graphs														
explaining relations														
language and literacy issues														

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