National Research and Development Centre
for adult literacy and numeracy

Adult numeracy

A review of research

Research report comissioned by BBC Learning and conducted by NRDC

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Foreword

BBC Learning is committed to helping adults improve their literacy and numeracy skills, with a particular focus on adults failed by school education.

While it is well known that good literacy skills improve life chances, fewer people are aware of the importance of good numeracy. However, research by NRDC and other organisations has shown that good numeracy skills are strongly correlated with a range of positive outcomes, both at work and in realms such as health and wellbeing.

To understand better our audience's needs for numeracy resources, the BBC commissioned NRDC to provide this review of key research on adult numeracy, paying particular attention to the reasons why some adults struggle with their numeracy skills, and the impacts of poor numeracy on people's lives. But we did not just want to know the potential causes and effects of poor numeracy skills; we also wanted a better understanding of how to improve those skills. Therefore, this report also provides a review of research evidence on how adults can improve their numeracy, both through traditional classroom instruction and through the use of ICT and mobile technologies.

Millions of adults in the United Kingdom would benefit from improved numeracy skills. The BBC Skillswise website and Learning campaigns are there to support them, and we are pleased to have commissioned this report to inform our development of new resources.

Lisa Percy
Executive for Adult Skills
BBC Learning

Introduction

i. About this review

This report provides an overview of existing research on adult numeracy, with a strong focus on the United Kingdom but also including other countries. The emphasis is on poor numeracy: its antecedents and effects, teaching and learning to overcome it, and the potential use of ICT and mobile technologies in that pursuit.

In general, adult numeracy is under-researched and under-theorised (Coben, 2003). Much of the research on numeracy is schools-based, the bulk on teaching the individual elements and operations of numeracy. Adult numeracy is a relatively new concern for governments and other potential funders of research, with much of the growing interest in the field attributable to concerns, both in the UK and elsewhere, about a numeracy 'skills deficit' which limits individuals' life chances while also impacting negatively on national productivity.

Our understanding of adult numeracy issues is markedly greater in some areas than in others. In demographics, for example, the last decade has seen a great deal of robust research shedding light on the antecedents and effects of poor numeracy. Somewhat less is known about how to tackle the numeracy skills deficit. Engagement and motivation are particularly challenging: only a small minority of adults who appear to have numeracy difficulties feel they have a problem or express a desire to improve. For those who do seek to improve, there are still many questions for researchers to address regarding teaching and learning. To list only a few: What are the most effective teaching practices? Do they differ depending on learners? What role can ICT and mobile technologies play? Research in these and other important areas is as yet limited.

Where sufficient and sufficiently reliable research is available – e.g. with regard to the antecedents and effects of poor numeracy – this report summarises that research at length. The aim in doing so is to provide as robust a picture as possible of the lives led by individuals with poor numeracy skills. The research in this area is largely statistical: it gathers data from large samples of the population in order to provide an aggregate picture of the lives of individuals who suffer from poor numeracy in adulthood. However, this report also includes case study-based research, so that we can provide more personal snapshots of some of the individuals who make up the aggregate picture.

Where less research is available – e.g. in the areas of teaching and ICT – summaries are by necessity less extensive. There is still a great deal of research to be done in these and other areas.

ii. The scope of this report

This review draws on English-language adult numeracy research from various countries, but with a very strong emphasis on the United Kingdom. Sources include:

- academic literature
- practitioner-focused publications
- government reports
- large-scale representative surveys

- case studies.

For an earlier, highly comprehensive review of the field, we strongly recommend Diana Coben's *Adult Numeracy: review of research and related literature* (2003).

iii. What is numeracy?

The word numeracy is a portmanteau (that is, a new word formed by joining two others and combining their meanings) of ‘numerical literacy.’ It appears to have been coined in the 1959 Crowther Report.

Numeracy is also known – particularly in the United States – as ‘quantitative literacy’. In that country's 1992 National Adult Literacy Survey (NALS), quantitative literacy was defined as ‘the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials, such as figuring out a tip, completing an order form, or determining the amount of interest on a loan from an advertisement’ (Hector-Mason, et al, 2006).

However, there is no consensus on a definition of either ‘quantitative literacy’ or ‘numeracy’. Numeracy is a ‘deeply contested, notoriously slippery concept, the subject of lively debate by commentators concerned with the education of adults’ Coben (2003). Numeracy is often understood as referring to elementary mathematics, and is often directly linked to functionality at work and in society in general (DES/WO, 1982; NRDC/ LSC, 2006). The link between numeracy and economic functionality is strongly influenced by the current policy focus in adult education, which emphasises the economic role of basic skills (Swain, et al, 2005).

Many researchers feel that such an approach, while partially useful, is too narrow. Coben (2000), for example, says that to be numerate and means: ‘to be competent, confident and comfortable with one's judgements on whether to use mathematics in a particular situation and if so, what mathematics to use, how to do it, what degree of accuracy is appropriate, and what the answer means in relation to the context.’

In addition to being ‘confident and comfortable’ with particular mathematical operations, Brown (2002) argues that an individual needs to have an ‘inclination to use number concepts and skills’. It is not enough to possess the skills; one must also be comfortable enough to deploy them. This suggests that the lower an individual's confidence in their numeracy, the less likely they are to be inclined to use it in a range of situations.

One researcher (Gal, 2000, cited in Coben, 2003) has delineated three different types of ‘numeracy situations’ – ‘generative’, ‘interpretive’ and ‘decision’ – all three of which require language and/or logic skills. Genera to situations call on people to count, compute, manipulate or quantify numbers or items. Interpretive situations require people to comprehend verbal or text based messages that may be based on quantitative data. Decision situations require people to balance and consider multiple pieces of information in order to choose a course of action.

Many NRDC projects have incorporated the definition of numeracy adopted by Skills for Life, the Government’s adult literacy, language and numeracy strategy (DfES, 2001). This posits that numeracy covers:

> the ability to understand, use, calculate, manipulate, interpret results and communicate mathematical information.

This definition is far removed from earlier government definitions of numeracy. In the late 1950s numeracy signified ‘a relatively sophisticated level of what might nowadays be called scientific literacy’ (Coben, 2003). In 1982 the Cockroft Committee, whose focus was ‘the mathematics required in further and higher education, employment and adult life generally’ opted for a definition closer to current conceptions, stating that being numerate enabled ‘an individual to cope with the practical mathematical demands ‘ of everyday life, and that a numerate individual would have ‘some appreciation of information which is presented in mathematical terms, for instance in graphs, charts or tables or by reference to percentage increase or decrease’ (DES/WO, 1982: paragraph 39, page 11, cited in Coben, 2003).

But what actual skills were considered essential? The Cockroft Committee produced a list including: number, money, percentages, using a calculator, graphs and pictorial representation, spatial concepts, ratio and proportion, and statistical idea (Coben, 2003). This list would eventually form the basis for the National Curriculum for Mathematics in schools and the Adult Numeracy Core Curriculum Skills for Life. Thus ‘numeracy has come to refer to the mathematics at the lower end of the mathematics national curriculum’ (Coben, 2003).

While this positioning is challenged by many researchers, many learners may be happy with it. In NRDC research, numerous learners drew clear distinctions between what they saw as numeracy and what they saw as mathematics. They tended to express a narrow interpretation of numeracy, seeing it as being a subset of mathematics, and referred to numeracy as ‘the basics’ (Swain et al, 2005). For many learners, policymakers and others, the term ‘numeracy’ refers to basic number computation only: the four rules of addition, subtraction, multiplication and division (Coben, 2003).

There is also a tendency for individuals to categorise the mathematics they can do as ‘common sense’, reserving the term ‘mathematics’ for that which they cannot do (Coben, 2003). This may be related to a lack of confidence in numeracy: if people believe that they ‘can't do maths’, then the maths that they can do must not be maths at all.

iv. Research headlines: a brief summary of the evidence

This section provides a brief overview of key research findings about the impacts and antecedents of poor numeracy in adulthood. A fuller review of this research can be found in Part 1 of this report.

Numeracy levels

The Skills for Life survey (DfES, 2003) measured the numeracy levels of the working age (16–65) population of England, finding that:

- 5% of the population (1.7 million adults) had very poor numeracy skills (‘Entry level 1 or below’)
- A further 16% of the population (just over 5 million) had poor numeracy (‘Entry level 2’)
- 25% of the population (just over 8 million) had numeracy skills that could be classified as fair or functional (‘Entry 3’)
- 53% (just under 17 million) had good numeracy (‘Level 1’ or above).

While men and women have similar literacy levels, women are more likely than men to have poor numeracy. Younger and older adults tend to have slightly poorer skills.

Family lives and educational backgrounds of adults with poor numeracy
Comparing the lives of 34-year-olds who have poor numeracy with those who have good numeracy, those with poor numeracy were:

- twice as likely to receive free school meals at age 10
- twice as likely to have had parents or carers who received unemployment or income support benefits
- much more likely to have parents with no qualifications
- half as likely to have parents who were very interested in their education
- half as likely to have parents who wanted them to stay in school past the age of 16
- twice as likely to leave school by age 16
- five times more likely to achieve no qualifications by age 34
- 1/6 as likely to have a degree or its equivalent by age 34.

Compared to women with good numeracy at age 34, those with poor numeracy or more than twice as likely to have had their first child while still in their teens. They were nearly twice as likely to have three children by age 34, and were three times as likely to have four more children by that age.

Employment and earnings
Numeracy skills have a strong impact on employment and earnings. Among adults born in 1970, compared to those with good numeracy:

- Men and women with poor numeracy were more than twice as likely to be unemployed
- Men and women with poor numeracy were far less likely to receive work-related training, get a promotion or receive a raise.

Health
- Adults with poor numeracy are 2.5 times more likely to report having a long-standing illness or disability.
- Among 34-year-olds, men and women with poor numeracy are roughly twice as likely to report having several symptoms of depression.

Self-perception of numeracy difficulties
- Only 8% of the working age population rate themselves as below average in numeracy.
- More than a quarter (28%) of adults with poor numeracy rate their skills as ‘very good’. Only 5% of this group rate their skills as poor.

Among 34-year-olds who reported having a problem with numeracy:

- more than one-third of men and nearly half of women said they wanted to improve
- fewer than one in 25 had been on an adult numeracy course.

The digital divide
Compared to 34-year-old men and women with good numeracy skills, those with poor skills have been found to be:

- twice as likely to lack Internet access
- twice as likely to not have a computer at home
- more than twice as likely not to use a computer even when there is one in the home.

Part 1: What we know about adult numeracy skills

1.1: Overview

i. Why are we interested in numeracy skills?

In the field of adult education, literacy has consistently taken prominence over numeracy. In the last decade, however, this has become less true, at least in England, where the national Skills for Life adult literacy, language and numeracy strategy has placed globally unprecedented emphasis on the importance of improving the nation's adult numeracy skills. That emphasis has grown even greater since the Government published in 2006 an independent inquiry into skills entitled *Prosperity for All in the Global Economy – World Class Skills* (Leitch, 2006). More commonly known as the Leitch Review of Skills or the Leitch Report, this publication argued that in order for the United Kingdom to remain an economically competitive nation, it would have to greatly improve its literacy and numeracy skills – and that it would have to improve the latter more than the former. The recommendations of the Leitch report were accepted by the Government, which then laid out its adult literacy and numeracy strategy for England in a document entitled *World Class Skills* (DIUS, 2007). In this strategy, it was argued that while England was making good progress in improving the literacy and numeracy skills of the population, it would need to greatly increase progress in numeracy in particular in order to avoid losing economic ground to other nations.

Much of the impetus for this new focus on numeracy comes from recent research detailing the close links between poor numeracy skills and negative life outcomes (e.g. Bynner and Parsons, 2006 and Parsons and Bynner, 2007). These outcomes include the economic – for example, individuals with poor numeracy earn less and are much more likely to be unemployed than those with good numeracy – and the non-economic: adults with poor numeracy tend to have worse health and are less likely to be socially engaged than those with good numeracy. These issues will be discussed in great detail later in this report.

ii. Assessing and ranking adult numeracy skills: introduction

How do we assess the levels of numeracy skills that adults have? As can be seen from the findings below, researchers have devised various assessment exercises and an array of systems for classifying the skills levels that individuals have. These assessments and skills groupings are not always directly comparable.

One particular complicating factor in the assessment of numeracy skills is the difficulty of transposing a task from context-rich everyday life to two-dimensional test situations (Coben 2003). Relationships between context and formal knowledge are often vexed. For example, a well-known Brazilian study (Carraher, Carraher and Schliemann, 1985, cited in Coben, 2003) found that children who made their living selling watermelons and sweets in the streets could calculate quickly and accurately in that context but could not perform similar mathematical problems when they were presented in a school-like context.

What is true for street sellers also appears to be true for shoppers. When Capon and Kuhn (1979, cited in Coben, 2003) asked shoppers outside a supermarket to perform best buy calculations using paper and pencil, fewer than half got their calculations correct. Lave

(1988) argues that this is because these were not real life problems to be solved, but instead were school maths questions dressed up as if they were everyday mathematics. Participants in the study, she asserts, treated the questions as exactly what they were: school maths.

Swain et al (2008) posit five difficulties associated with numeracy research. First, it is difficult to measure numeracy skills in isolation, as success in maths is undoubtedly tied to literacy and reading skills. Individuals who have more talent in maths than in literacy may not be able to demonstrate that talent on standardised assessments because of those assessments' literacy demands, for example in word problems.

Also important is the context in which one views maths. Individuals may not recognise maths in activities outside of the classroom. Third, circumstances may alter skills – there is good evidence that for many adults, numeracy skills improve or decline in adulthood (Bynner and Parsons, 2006). Fourth, it can be difficult to accurately assess the skills of people who feel afraid of maths and/or formal assessment processes, as their fear is likely to affect their performance on the assessment. Fifth, making an assessment an accurate representation of real world math skills is extremely challenging. In addition to these challenges, it can be particularly problematic to measure the numeracy skills of adults with lower abilities, including those with special educational needs and dyscalculia, and those with possible language / reading difficulties. (Coben, 2003)

As Coben (2003) points out, 'while the survey evidence reveals a serious and persistent problem of adult innumeracy, there is no consensus about what the surveys should be measuring, how best to measure it, and whether the results are valid, reliable and therefore truly comparable. Rashid and Brooks (forthcoming 2010) concur. Assessments, they point out, 'are based on the assumption that experts in the field know what other people should be able to do. Little research has been done to establish what people actually need to be able to do.'

iii. Terminology: what do adult literacy, language and numeracy levels mean in terms of numeracy skills?

In England, the Adult Literacy, Language and Numeracy (LLN) sector utilises a five-level system to categorise skill levels. Starting at the bottom, these levels are: Entry Level 1, Entry Level 2, Entry Level 3, Level 1 and Level 2. Figure 1.1 below offers a comparison between adult literacy and numeracy levels, vocational levels and the academic levels associated with compulsory schooling, college or university.

Figure 1.1: Comparison of selected qualification levels in England

<table>
<tr><th></th><th>National qualifications framework</th><th>Compulsory schooling, A-levels and university</th></tr>
<tr><td></td><td>National Qualifications Framework Level 5</td><td>Honours degrees</td></tr>
<tr><td></td><td>National Qualifications Framework Level 4</td><td>Foundation degrees, etc.</td></tr>
<tr><td></td><td>National Qualifications Framework Level 3</td><td>A Levels, IB, etc.</td></tr>
<tr><td>National standards for adult literacy and numeracy</td><td></td><td></td></tr>
<tr><td>Level 2</td><td>National Qualifications Framework Level 2</td><td>GCSE A*–C</td></tr>
<tr><td>Level 1</td><td>National Qualifications Framework Level 1</td><td>GCSE D–G</td></tr>
<tr><td>Entry level 3</td><td rowspan="3">National Qualifications Framework Entry Level</td><td>The standard expected of 9- to 11-year-olds</td></tr>
<tr><td>Entry level 2</td><td>The standard expected of 7- to 9-year-olds</td></tr>
<tr><td>Entry level 1</td><td>The standard expected of 5- to 7-year-olds</td></tr>
<tr><td>Pre-entry level</td><td>National Qualifications Framework Pre-entry level</td><td></td></tr>
</table>

Entry levels 1, 2 and 3 are also commonly referred to as ‘Entry 1’, ‘Entry 2’ and ‘Entry 3’, in order to more clearly distinguish them from levels 1 and 2.

It should be emphasised that the levels in figure 1.1 may be *nominally* equivalent, but are not *directly* equivalent. Comparing the skills levels of children and adults is an extremely complex undertaking, and one that should be embarked upon cautiously, if at all. For example, research (DfES, 2003) has found that 22 % of 45- to 54-year-olds in England have numeracy skills at Entry Level 1 or 2. This is nominally equivalent to the levels expected of 5- to 9-year-olds. However, when we consider that the vast majority of these adults are employed and have been so for many years, own or rent their own homes, pay their bills, do the shopping and otherwise run their households, it would be inaccurate and indeed unfair to argue that their competency with numbers was that of a young child.

The skills expected at each level of the national standards for adult literacy and numeracy are detailed immediately below, along with the proportion of the working age (16–65) population in England assessed as being At that skill level (DfES, 2003).

- Entry Level 1: Understands information given by numbers and symbols in simple graphical, numerical and written material.
- For example, recognising and selecting coins, or ordering and comparing numbers up to 10
- 5% of 16- to 65-year-olds (1.7 million)
- Entry Level 2: Understands information given by numbers, symbols, simple diagrams and charts in graphical, numerical and written material
    - For example, calculating costs and change, or adding and subtracting two-digit whole numbers
    - 16% of 16- to 65-year-olds (5.1 million)
- Entry Level 3: Understands information given by numbers, symbols, diagrams and charts for different purposes and in different ways graphical, numerical written material
    - For example, dividing two digits by one digit and interpreting remainders, or comparing weights using standard units
    - 25% of 16- to 65-year-olds (8.1 million)
- Level 1: Understands straightforward mathematical information used for different purposes and can independently select relevant information from given graphical, numerical and written material
    - For example, doing simple percentages, or converting units of measure
    - 28% of 16- to 65-year-olds (8.8 million)
- Level 2: Understands mathematical information used for different purposes and can independently select and compare relevant information from a variety of graphical, numerical and written material
    - For example, calculating ratios and proportions, or determining median, mean and mode.
    - 25% of 16- to 65-year-olds (8.1 million).

While the audience for this report will certainly include adult numeracy professionals, academics, policymakers and others who are all too familiar with adult education jargon, the report has been commissioned for and is meant to appeal to a broader audience. Bearing that in mind, the report will at times refer to numeracy skills as either poor (Entry 2 and below), fair (Entry 3) or good (Level 1 or above). This classification system, while less precise than speaking in terms of specific levels, has a basis in both policy and research. In terms of the former, the government's numeracy strategy to 2011 (DIUS, 2007) has established Entry 3 as the level of numeracy required to be fully functional in the modern British economy, and has focused its policy targets on helping adults to achieve this level. In terms of research, Parsons and Bynner (2007) have studied the relationship between adult numeracy skills and individual outcomes in numerous areas of life, including employment and health, and have found that the gap between individuals with Entry 2 and Entry 3 skills is often greater than that between individuals with Entry 3 skills and those with Level 1 skills. That is to say, the difference in skills between Entry 2 and Entry 3 often has a particularly strong impact on individuals' life chances.

iv. Data sources

Introduction

There are a variety of quantitative data sources which have, over the years, helped researchers to build a reliable picture of the level of numeracy skills in the UK. The first national survey of adult basic skills in Britain was the literacy survey carried out in 1972 (Brooks, 2005). The sample was taken from the first lifetime cohort study carried out in Britain, the National Survey of Health and Development. The cohort members were all aged 26 at the time of the survey, and had also been tested at the age of 15. The 1972 results, writes Brooks (2005): 'were interpreted as showing 'an illiteracy rate [sic] of less than 1 per cent' (the criterion being a score of less than 11 out of 35).... However, the test was already both ageing and out of tune with current concepts of reading, and the quantitative approach taken was probably out of line with prevailing opinion.'

In 1981, two national surveys were carried out. The first asked members of the National Child Development Study (a cohort study of people all born in one week of April 1958) to complete self-report questionnaires; this was the first survey to test respondents on their abilities in numeracy. The second survey was a Gallup Poll of a nationally representative sample of adults, and measured numeracy attainment. Although the test was flawed, 21% of the sample scored less than 6 out of 11 (Brooks, 2005).

The 1990s saw a dramatic increase in basic skills assessment. In the period 1991–96 in Britain there was one national survey of adult literacy alone, one of adult numeracy alone, and six which covered both. Though self-report questionnaires featured in several, none used purely qualitative methods. All used summative, quantitative attainment tests (Brooks, 2005).

The first major international comparative survey of adult literacy and numeracy was the International Adult Literacy Survey (IALS). The IALS was first conducted by the Organisation for Economic Co-operation and Development (OECD) in 1994; however, only nine countries took part that year and the UK was not among them. Two years later the 1996 IALS surveyed 20 countries, including the UK. The unexpectedly poor results for the UK, both in relative and absolute terms, prompted a succession of internal assessments of the nation's literacy and numeracy skills.

Prompted by the UK's poor performance on the IALS, the Moser Report was published in 1999. Entitled *A Fresh Start*, the report painted a stark picture of the nation's basic skills deficit. Following the launch of the Skills for Life strategy in 2001, the Skills for Life survey of need (2003) assessed the literacy and numeracy skills of England's working age (16–65) population. Since this survey, the National Research and Development Centre for adult literacy and numeracy (NRDC) has utilised the British Cohort Study 1970 (BCS70) to provide an in-depth analysis of the literacy and numeracy skills of a large, representative sample of individuals born in England and Wales in 1970.

IALS

The International Adult Literacy Survey (IALS), conducted by the Organisation for Economic Co-operation and Development (OECD) three times in the mid-to late 1990s (1994, 1996 and 1998), investigated the literacy and 'quantitative literacy' (that is, numeracy) skills of representative samples of adults aged 16 to 65 in industrialised countries. The UK did not take part in 1994, but in 1996, out of 20 nations, the UK came 18th in quantitative literacy, ahead of only Ireland and Poland. 23% of the working age UK population performed at the lowest level on the IALS (Level 1) and 28% performed at Level 2 (OECD 1997, Coben 2003). From this performance, it was estimated that more than half the UK population aged

16–65 lacked the minimum numeracy skills required for coping with the demands of life and work in a ‘knowledge society’ (Houtkoop and Jones, 1996).

Basic Skills Agency (BSA) surveys

On behalf of the Basic Skills Agency, Bynner and Parsons (1997) used the National Child Development Study (NCDS) to assess numeracy skills. The National Child Development Study (NCDS) is a longitudinal study of nearly 10,000 individuals born in Great Britain in one week in 1958. Members of the NCDS cohort have been visited periodically throughout their lives in order to collect representative data about their lives, including education, employment, health, civic participation and family life. Looking at the numeracy skills of this sample when cohort members were 37 years old (1995), the researchers found that:

- Just under a quarter of respondents had very low numeracy skills that would make everyday tasks difficult to complete successfully
- Around four times as many respondents had very low numeracy skills compared to very low literacy skills.

The Moser Report

In 1999, Sir Claus Moser was asked by the government to assess the available evidence on adult literacy and numeracy in England and to deliver a set of recommendations for reducing the number of adults with low basic skills. His report, entitled *A Fresh Start – Improving Literacy and Numeracy* (1999), but more commonly known as the Moser Report, reported that roughly one-fifth of England's 35 million adults had ‘very low’ numeracy and that a further one-fifth had ‘low’ numeracy. One in three adults, the report argued, could not calculate the area of a 21 x 14 foot room, even with a calculator, and one in four adults could not calculate the change they should receive from a simple purchase.

The 2002/03 Skills for Life survey

One of the recommendations of the Moser Report was that the then Department for Education and Skills should carry out a national survey of literacy and numeracy need. The resultant Skills for Life survey (DfES, 2003), also known as the ‘Needs Survey’, assessed the literacy and numeracy skills of 8,730 randomly selected adults aged between 16 and 65, and provides the most up-to-date national survey of the skill levels of working age adults in England.

Figure 1.2 (DfES, 2003) shows numeracy levels for working age adults in the England as of 2002/03, as assessed by the Skills for Life survey.

Figure 1.2: Numeracy levels of the working age (16–65) population of England, 2003

	% of 16- to 65-year-olds	Number of 16- to 65-year-olds
Level 2 or above	25%	8.1m
Level 1	28%	8.8m
Entry 3	25%	8.1m
Entry 2	16%	5.1m
Entry 1 or below	5%	1.7m

The Skills for Life survey found that nearly seven million adults (6.8 million) had numeracy skills below Entry level 3, which is currently considered the minimum level of numeracy required to function fully in work and society (DIUS, 2007).

The nation's literacy levels are higher than its numeracy levels, the survey found, 53% of respondents achieved a lower level in numeracy than in literacy, while only 10% had a higher numeracy level than literacy level.

Relative success on questions about fractions, proportions and percentages, charts and tables, and dimensions appeared to distinguish those respondents performing at the higher levels from those at the lower levels.

Comparison of qualification levels with numeracy skills revealed that it was possible to have gained a good GCSE pass in maths and not to score highly on the numeracy assessment. Individuals with lower maths grades at GCSE or equivalent only tended to perform at a slightly higher level than those with no such qualification.

Gender was a factor, with men scoring higher than women. One in three men achieved Level 2 or above in the numeracy assessment, compared to one in five women. At the other end of the scale, more than half of all women (53%) scored at Entry 3 or below, compared to 40% of men.

Age was a factor as well, although only slightly. The youngest (16–24) and the oldest (55–65) respondents tended to perform at a slightly lower level in the numeracy assessments. For the oldest respondents, this slightly poorer performance is more likely to be a cohort effect rather than a characteristic of age. A cohort is a generational group (that is, a group of people born around the same time), and the term ‘cohort effect’ refers to a generation's shared experiences which are likely to produce similar outcomes. For example, individuals born between 1938 and 1948 (ie those who would have been aged 55–65 in 2003) grew up in an era in which compulsory schooling ended at an earlier age than it now does, and in which fewer individuals took part in post-compulsory education. Both of these factors are likely to lead to lower numeracy levels for this cohort.

With regard to the slightly poorer performance of younger individuals, there is evidence that numeracy skills continue to develop after the end of full-time education, especially if work demands it. Thus many 16- to 24-year-olds could be expected to improve their numeracy. There is also evidence that both literacy and numeracy skills exhibit a lifecourse trend (Rashid and Brooks, forthcoming 2010), in which there tends to be improvement of skills into early middle age, followed by a plateau in middle age and eventual decline, albeit not necessarily by age 65.

While gender and to a lesser degree age had some predictive capacity as far as the level of an individual's numeracy skills, ethnic origins did not. There were no significant differences in the numeracy skills of ethnic groups in England. However, respondents whose first language was not English performed less well in both the numeracy and the literacy assessments.

British Cohort Study 1970

The British Cohort Study 1970 (BCS70) is a longitudinal study following the lives of a large sample of individuals born in the United Kingdom in one week of 1970. After the initial data collection in 1970, cohort and members (excepting those born in Northern Ireland) have been visited six times – at ages 5, 10, 16, 26, 30 and 34 – to collect data about their education, economic circumstances, their families, health and other life experiences and outcomes. Additionally, a representative sample was followed up at age 21. At age 34, as part of a comprehensive interview, there was also a literacy and numeracy assessment based on a reduced form of the tests used in the 2003 Skills for Life survey of need. In 2004, the BCS70 sample size was 9,665, 56% of the original birth cohort and 74% of the first (age 5) follow-up sample. Just like the National Child Development Study (NCDS), the BCS70 is considered one of the research world's great resources (see, e.g., Toynbee, 2008).

v. Overview of socio-demographic characteristics and geographic patterns

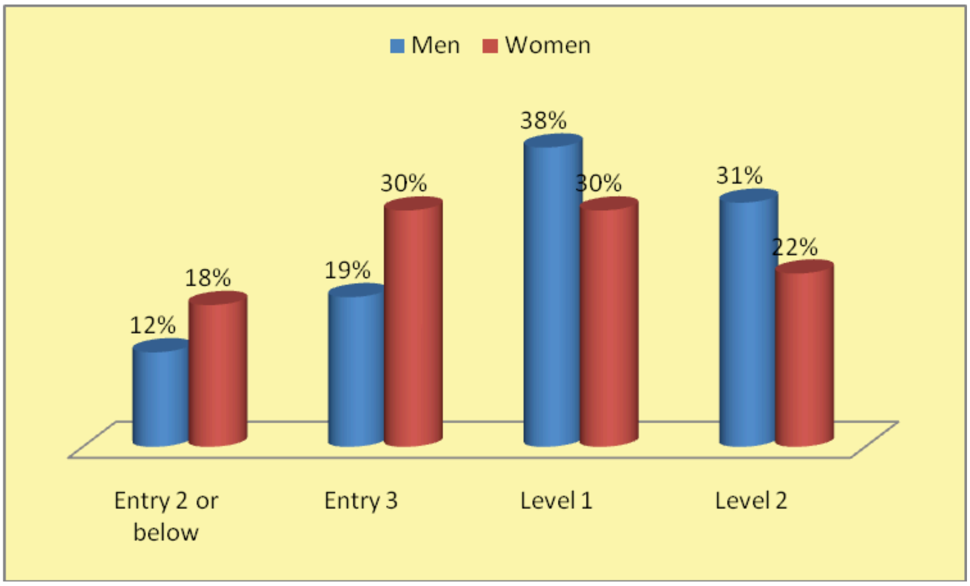
The following section utilises data from the Skills for Life survey and the British Cohort Study 1970. The most recent assessment of individuals in the BCS70 took place in 2004, when cohort members were 34 years old.

Gender

Among individuals born in England and Wales in 1970, males and females have nearly identical levels of literacy skill. There is significantly more gender variation in numeracy, in which skill levels are lower than literacy for both sexes, but especially for women (Bynner and Parsons, 2006).

The British Cohort Study 1970 (BCS70) assessed the numeracy skills of 34-year-old individuals born in England and Wales in 1970. Figure 1.3 shows a comparison of skill levels by gender. As the figure illustrates, women were 1.5 times as likely to have poor (Entry 2 or below) numeracy skills, 1.5 times as likely to have Entry 3 numeracy skills, and significantly less likely to have good (Level 1 or above) numeracy.

Figure 1.3: Numeracy levels by gender, 34-year-old individuals born in England and Wales in 1970 (BCS70)



Ethnicity

There is limited information available about the relationships between the adult numeracy levels of various ethnic groups. Even with a sample as large as that in the Skills for Life survey (8,040 respondents), it is difficult to gather statistically sound conclusions about the skills levels of ethnic groups other than those who classified themselves as 'White British', a group constituting 86% of the sample (DfES, 2003). This is because the number of respondents in the non-White British ethnic categories tends to be too low for statistical reliability. With that caveat in mind, figure 1.4 presents numeracy levels by ethnic group, as measured in the Skills for Life survey (2003).

Figure 1.4: Numeracy levels by ethnic group, adults aged 16–65 in England (Skills for Life survey, 2003)

	All	White British	Asian Indian	Asian Pakistani	Black Caribbean	Black African
	8040 respondents	7160 respondents	130 respondents	70 respondents	86 respondents	78 respondents
Level 2	25%	27%	16%	8%	11%	5%
Level 1	28%	28%	23%	21%	8%	17%
Entry 3	25%	25%	26%	27%	26%	38%
Entry 2	16%	15%	20%	13%	44%	24%
Entry 1 or below	5%	4%	15%	31%	10%	15%

Young people
A review of research on young people's numeracy skills in England over the last several decades has found evidence of some, albeit limited, improvement (Rashid and Brooks, forthcoming 2009). Noting that there is very little evidence from before 1978, the researchers find that among 13-year-olds, there appears to have been a slight decline in skills between 1964 and 1988, especially in arithmetic, and that there appears to have been no significant change between 1988 and 1995.

Among 14-year-olds, international surveys show no significant change in performance between 1995 and 2003, but national test data show a slow improvement between 1995 and 2005.

Among 15-year-olds, Rashid and Brooks (forthcoming 2009) found evidence of a small improvement between 1978 and 1982, followed by a significant improvement through 1987, and a steady increase in the GCSE maths pass rate between 1989 and 2005.

The data for individuals aged 16 and over are less encouraging. Four surveys conducted between 1987 and 2003 found that consistently substantial proportions of young adults – around 22% – had poor numeracy skills.

Geography
Both the Skills for Life survey (2003) and the BCS70 have shown strong relationships between where people live and how good their numeracy skills are.
In the Skills for Life survey, respondents in the South East and the East of England significantly outperformed all other English regions. Respondents living in rural areas were slightly more likely to be at Level 2 or above than respondents in urban areas (DfES, 2003).

Research by Bynner and Parsons (2007) utilising the BCS70 has also found strong geographic differences in numeracy performance across Great Britain, with particularly poor performances in Wales. Men in Wales had the highest likelihood of having poor, i.e. Entry 2 or below, numeracy (19%). Men in the South East were half as likely as those in Wales to have poor numeracy skills. Other regions were clustered in between these two extremes.

Men in Wales were only slightly more likely to have Level 2 or above numeracy skills (22%) than to have Entry 2 or below. In contrast, 34-year-old men in the South East were roughly four times as likely to have Level 2 or above skills than to be at Entry 2 or below. In several other regions, such as East Anglia and the East Midlands, the ratio of strong numeracy skills (Level 2 or above) to poor numeracy skills and (Entry 2 or below) was roughly 2 to 1. Women exhibited fewer geographical differences, both at the bottom end of the scale and at the top end. East Anglia had the lowest percentage of women with poor (Entry 2 or below) numeracy (14%), while the East Midlands and the North had the highest percentage (22%). Women in East Anglia and the South East (25%) were the most likely to have strong (Level 2 or above) skills, followed closely by those in Scotland and the South West. Women in the East Midlands (14%), the North (16%) and Wales (18%) were the least likely to have Level 2 skills.

Figures 1.5 and 1.6 illustrate the numeracy performance of men and women in Great Britain.

Figure 1.5: Numeracy performance of men in BCS70, by region, 2004

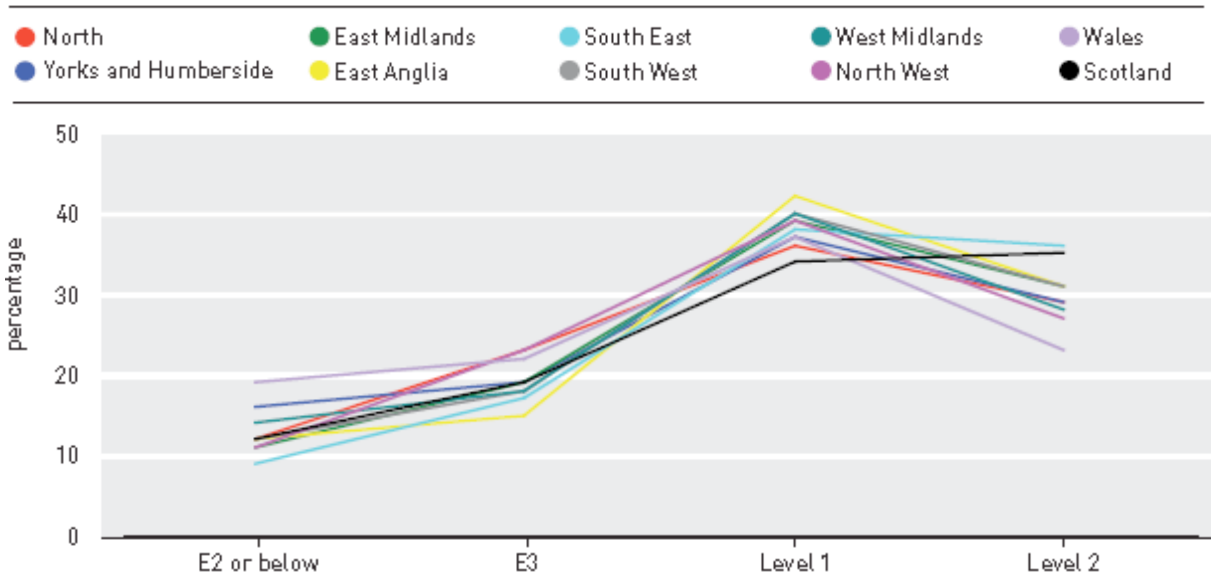
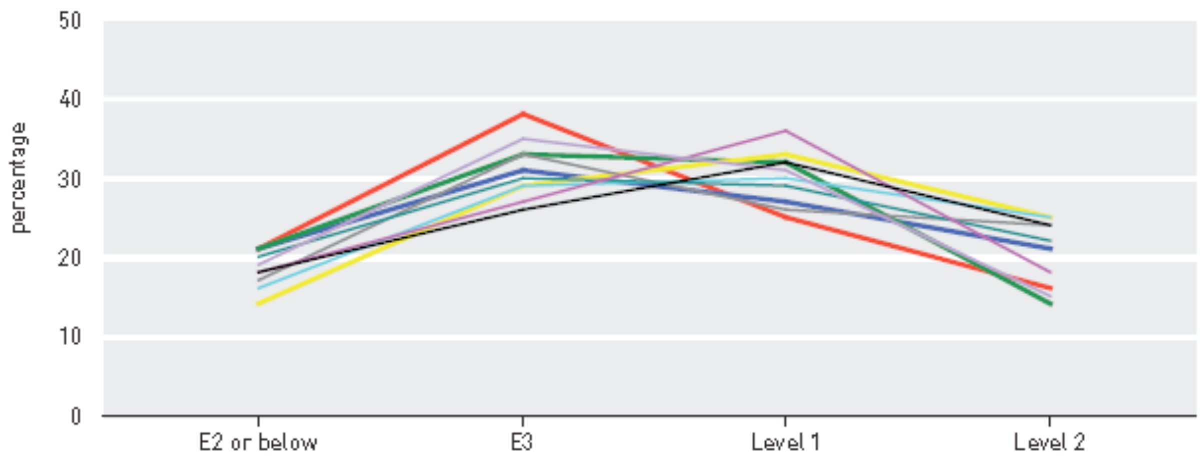


Figure 1.6: Numeracy performance of women in BCS70, by region, 2004



It is not only numeracy performance that varies by geographic region: Skills for Life research on numeracy courses offered as part of the Skills for Life initiative found that participation and achievement rates also vary. Achievements in numeracy range from a high of 12% of people with skills below Level 2 in the North West and North East to a low of 7% in London (NAO, 2008).

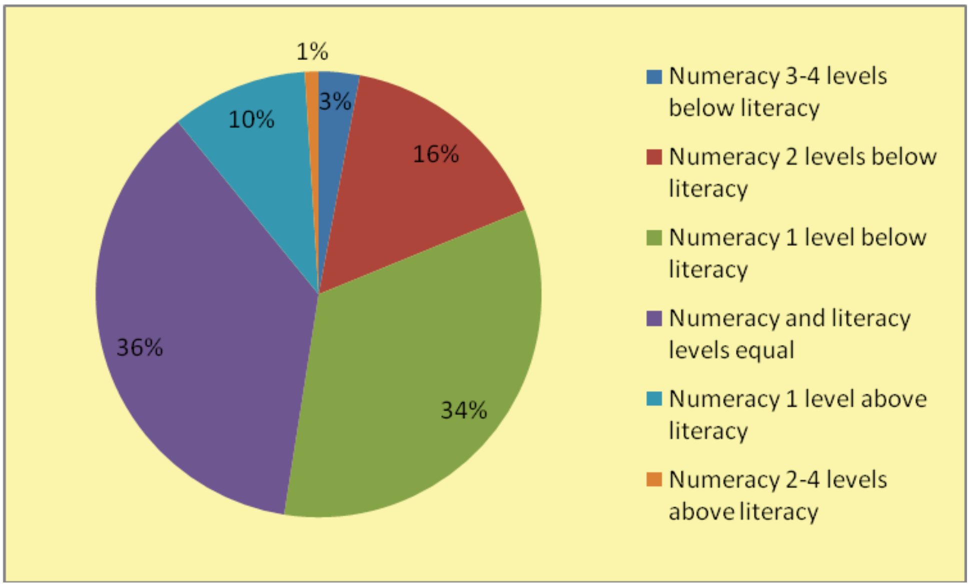
vi. Relationship between numeracy skills and literacy skills

In the Skills for Life survey (DfES, 2003) of the working age (16–65) population in England, literacy and numeracy skills were closely correlated – i.e. individuals' literacy and numeracy skills tended to be similar. Some of this effect is likely due to the nature of the assessment (Coben, et al, 2007): the numeracy test was written in English and respondents had to be able to read in order to carry out each numeracy task. This presents some individuals with a double difficulty, and would be likely to penalise respondents with strong numeracy but poor reading skills.

In the Skills for Life survey, only one in 10 adults scored higher on the numeracy test than on the literacy test (DfES, 2003), as illustrated in figure 1.7. More than half (53%) scored lower in numeracy than in literacy. A significant majority of individuals (71%) had either numeracy and literacy levels that were equal (37%) or had numeracy skills one level below their literacy skills (34%). The bullets below show the relationship between numeracy levels and literacy levels.

- Numeracy 3–4 levels below literacy (e.g. Level 2 in literacy but only Entry 1 or 2 in numeracy): 3% of respondents
- Numeracy two levels below literacy: 16% of respondents
- Numeracy one level below literacy: 34% of respondents
- Numeracy and literacy levels equal: 37% of respondents
- Numeracy one level above literacy: 10% of respondents
- Numeracy 2–4 levels above literacy: 1% of respondents

Figure 1.7: Relationship between numeracy and literacy levels in England's working age population, Skills for Life survey (DfES, 2003)



In the Skills for Life survey, more than nine out of 10 adults (91%) with entry level literacy also had entry level numeracy. Figure 1.7 provides a full breakdown of numeracy levels in relation to literacy levels.

Figure 1.7: Numeracy level by literacy level, adults aged 16–65, Skills for Life survey 2003

	All respondents	Entry 3 literacy or below	Level 1 literacy	Level 2 or above literacy
Numeracy level				
Level 2	26%	2%	18%	41%
Level 1	28%	7%	29%	35%
Entry 3	25%	25%	33%	19%
Entry 2	15%	41%	16%	5%
Entry 1 or below	5%	25%	3%	–

vii. Relationship between numeracy skills and language background

In the Skills for Life survey of the working age population in England, 7% of respondents stated that English was not their first language (DfES, 2003). Nearly half of that group (47%) lived in London, and those for whom English was not their first language made up more than one-fifth (21%) of London respondents. The South East accounted for a further 15% of those reporting that English was not their first language.

Adults who reported that English was not their first language tended to perform worse on both the literacy and numeracy assessments of the Skills for Life survey. Figure 1.8 shows a comparison of numeracy levels by first language spoken. It is notable that the largest difference is the high percentage of Entry 1 or below numeracy scores for those whose first language was not English. It is possible that some and perhaps much of this effect was due to individuals with poor English having trouble reading the text required to understand and perform numeracy tasks.

Figure 1.8: Numeracy level by first language spoken, adults aged 16–65, Skills for Life survey 2003

	First language English	First language not English
Level 2 or above	26%	11%
Level 1	25%	28%
Entry 3	16%	19%
Entry 2	28%	20%
Entry 1 or below	4%	22%

1.2: The lives of people with poor numeracy skills

i. Family background

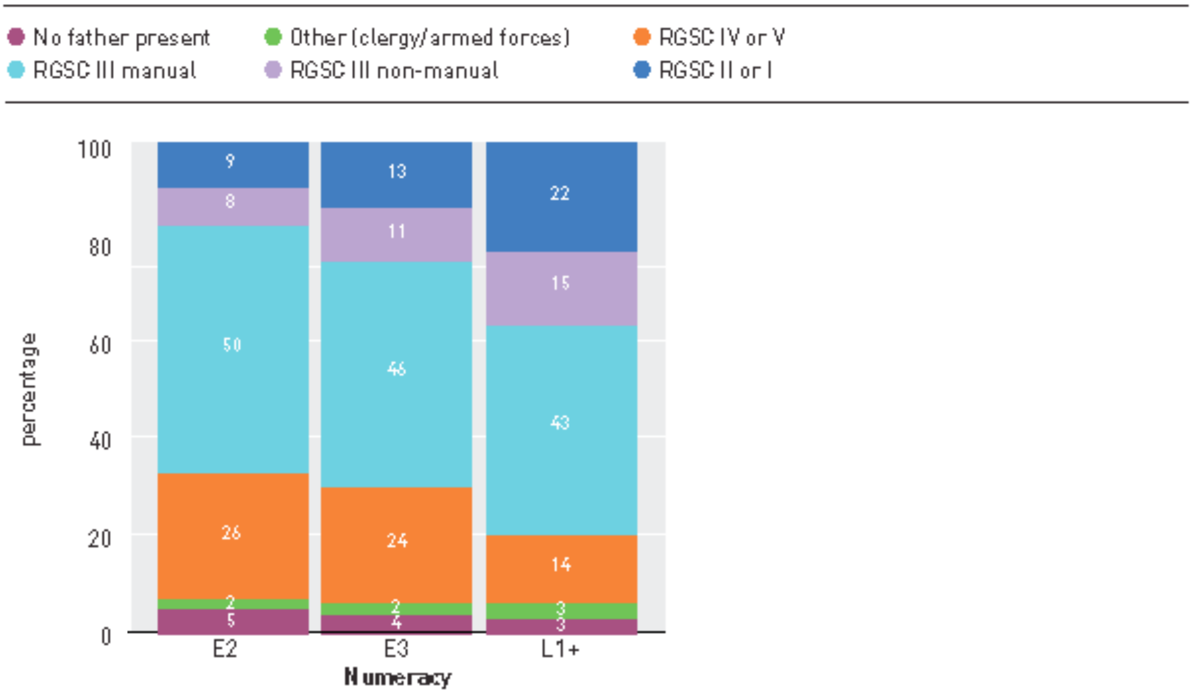
Social class
As discussed above, the British Cohort Study 1970 (BCS70) has followed the lives of thousands of individuals born in England and Wales in one week of 1970. Because this study revisits these individuals roughly every five to seven years, researchers have been

able, over time, to develop a good picture of the life experiences that contribute to and/or are associated with disadvantage, including poor literacy and numeracy skills. Using this information, Parsons and Bynner (2007) have been able to develop a statistical picture of the earlier life experiences of individuals who would go on to have poor numeracy skills at age 34.

Those who had poor numeracy skills at the age of 34 were more likely to be born into large families — i.e. families of three or more children**.** They were also more likely to be the child of a teenage mother. Nearly one quarter (24%) of cohort members who would go on to have poor (Entry 2 or below) numeracy were born to a teenage mother, compared to 14% of those whose numeracy skills as adults were good (Level 1 or above).

Figure 1.9 shows the social classes of cohort members in 1970. Coming from a higher social class greatly increased an individual's chances of having good numeracy as an adult. Only 9% of individuals who would go on to have poor numeracy skills were born into families in which the father's job was classified as 'professional/managerial', compared to 22% of those who would go on to have good skills.

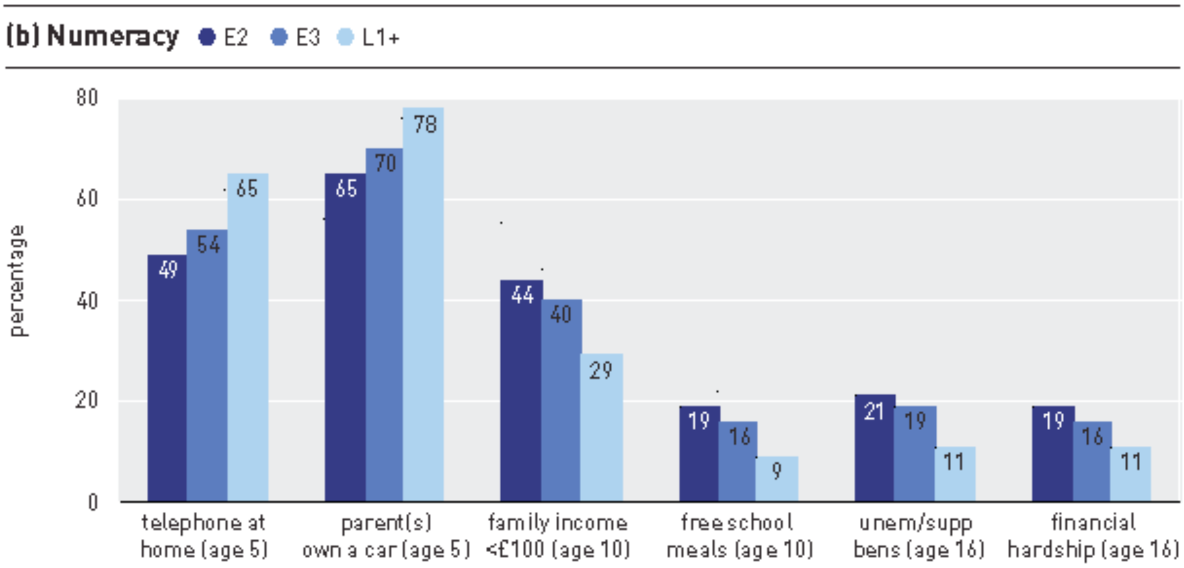
Figure 1.9: Social class of family in 1970 by cohort members' numeracy skills at age 34



* Registrar Generals Social Class (RGSC): Professional/Managerial (I or II), Skilled non-manual (III non-manual), Skilled manual (III manual), Partly or Unskilled (IV or V).

As Figure 1.10 illustrates, those who would go on to have poor numeracy as adults were more than twice as likely as those who would go on to have good skills to have received free school meals at age 10 and to have had parents or carers who received unemployment benefits.

Figure 1.10: Measures of economic disadvantage in childhood, by BCS70 cohort members' numeracy skills at age 34



Parents' education levels

Individuals who would go on to have poor numeracy skills as adults were 1.5 times more likely to have been the child of a mother with no post-compulsory education, compared to individuals whose skills at the age of 34 were assessed at Level 1 or above (Parsons and Bynner, 2007). The first group's parents were also far more likely than the latter group's parents to have had no qualifications: 69% compared to 44% for mothers, 61% compared to 37% for fathers.

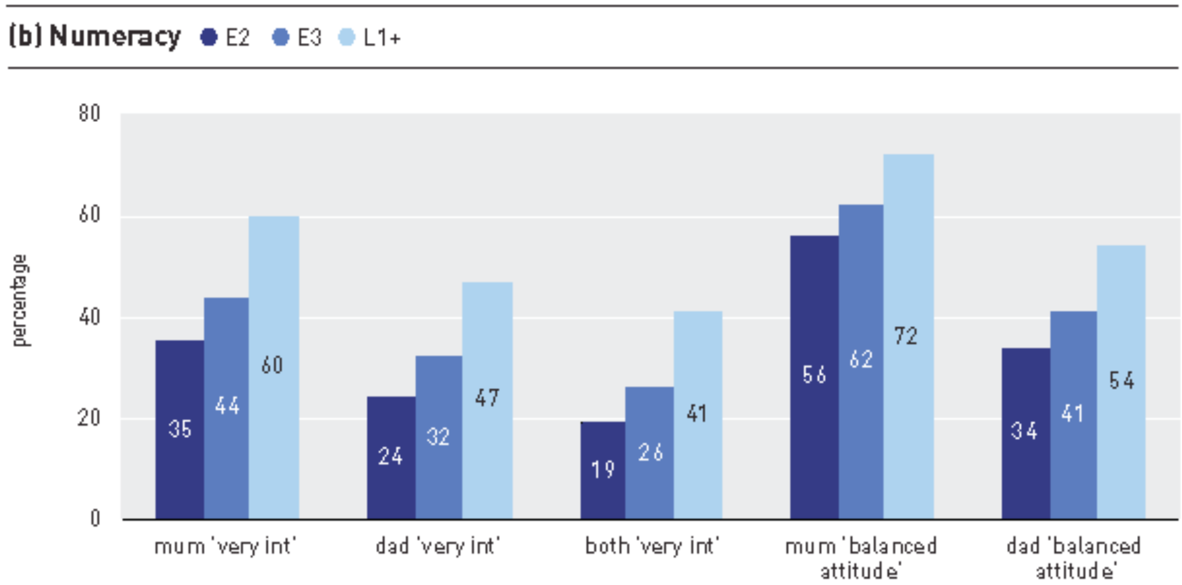
Parental attitudes to their children's education

When cohort members were 10 years old (ie in 1980) their teachers were asked to rate the level of interest their parents showed in their education, and what attitude they held towards their child's schooling. To determine the parents' attitude, teachers were asked 'Can the parents' attitude towards the child be described in any of these terms?' and told to choose from one of the following six options:

- balanced view of child's potential
- over-concerned about progress
- hostile
- dismissive
- cannot say
- no parents

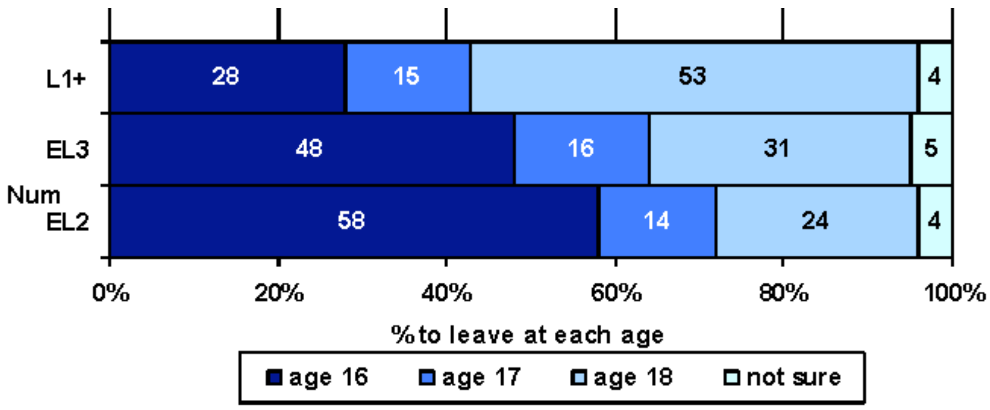
Comparing this data with numeracy skills at age 34, Parsons and Bynner (2007) found a strong association between parental interest and attitude when the child was 10 years old and future numeracy skills. Both mothers' and fathers' interest and attitude were correlated with better numeracy in the future, as illustrated in Figure 1.11.

Figure 1.11: Parents' interest in and attitude to their child's education when they were age 10, by child's eventual numeracy skills at age 34



In 1980, when cohort members were 10 years old, their parents were asked if they wanted their child to remain in education beyond the age of 16. Figure 1.12 shows that parents' ambitions for their 10-year-old children's future education was strongly associated with the level of numeracy skills those children would go on to have as adults. For example, compared to individuals who would go on to have good (Level 1 or above) numeracy skills at age 34, those who would go on to have poor (Entry 2 or below) numeracy were more than twice as likely (58% compared to 28%) to have parents who wanted them to leave school at the earliest legal opportunity.

Figure 1.12: Parents' ambitions for their 10-year-old children's future education, in terms of the age at which parents wanted their child to leave education, BCS70



ii. Educational background

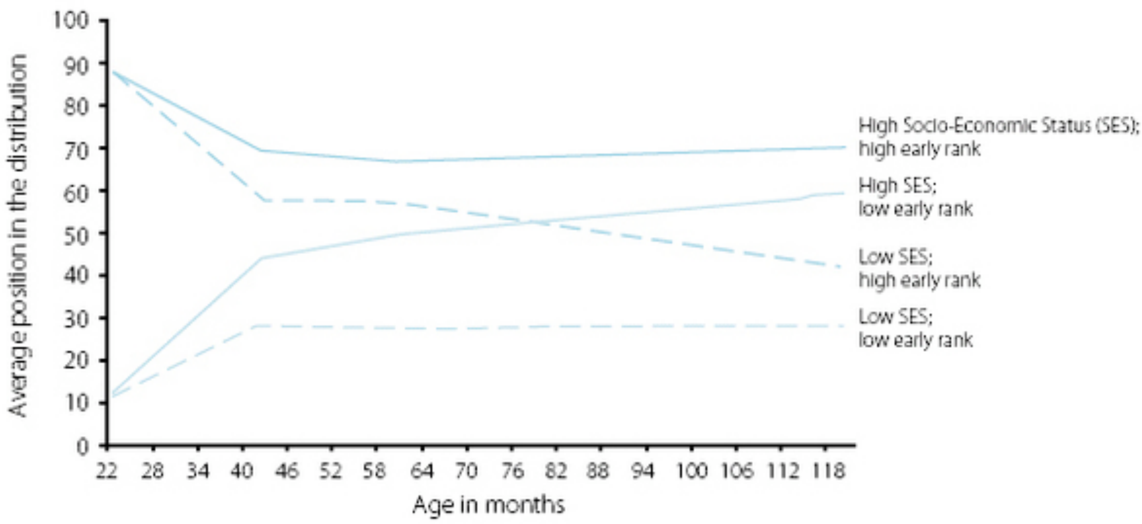
Early cognitive skills

At age 5, members of the BCS70 cohort underwent an assessment to gauge their cognitive development. Comparing the results of this assessment with numeracy skills at age 34, Parsons and Bynner (2007) found that, on average, adults who would go on to have poor numeracy skills were more likely to have performed poorly on their cognitive development assessment at age 5.

However, assessments even at this young age should not be taken as fully indicative of innate ability. As Feinstein (2003) has demonstrated, external factors such as socioeconomic status (SES) appear to have a powerful influence on children's cognitive assessments from a very young age. As illustrated in figure 1.13, Feinstein found that low socioeconomic status children who performed very well in cognitive assessments at age 2 saw their performance decrease markedly over the following years, while high SES children who also performed very well at age 2 continued performing well. Low socioeconomic status greatly increased the likelihood that high-skilled children would produce progressively poorer cognitive performances.

The opposite was also true: among children who performed very poorly in cognitive assessments at age 2, those from low socioeconomic status families continued performing poorly over the following years, while those from high socioeconomic status families steadily improved their results. The effect was so strong that low socioeconomic status children who scored in the 90th percentile at age 2 had fallen to the 50th percentile at age 6, while high SES children who scored in the 10th percentile at age 2 had risen to that same level. By age 10, high socioeconomic status children who had originally scored in the 10th percentile were performing far better on cognitive assessments than were low socioeconomic status children who had originally scored in the 90th percentile. This is clear evidence of the powerful impact of socioeconomic status on innate ability.

Figure 1.13: Relationship between socioeconomic status and cognitive test scores (Feinstein, 2003)



Experiences of compulsory education

Whatever the relationship between early cognitive scores and later numeracy skills, Parsons and Bynner (2007) found that very few (11%) of the adults who would go on to have poor numeracy at age 34 received remedial help in maths at age 10. When cohort members were 10, their teachers were asked to rate their ability in numeracy. Among those who would go on to have poor numeracy at age 34, only half were identified by their teachers as having ‘below average’ or ‘very limited’ maths skills at age 10. However, compared to individuals who would go on to have good numeracy, those who would go on to have poor skills were four times more likely to be identified as having problems as 10-year-olds.

When cohort members were aged 10, their parents were also asked if the children had problems with mathematics. For those individuals who would go on to have poor numeracy at age 34, parents' opinions were similar to teachers: 50% of these parents said they felt that their child had some difficulty with maths, while 9% felt their child had great difficulty with the subject. This means that among individuals who would go on to have poor numeracy as adults, two out of five were not identified by their parents as having difficulties at age 10. Some of these individuals genuinely may not have had difficulties at an age, but it is likely that many if not most did.

There is some evidence for this in the children's own assessments of their abilities. At the age of 10, cohort members were asked about their own maths skills. Children who would go on to have poor numeracy skills at age 34 were almost twice as likely (65%) to report maths problems at age 10, compared to children who would go one to have good (Level 1 or better) skills (34%). Just over half (55%) of 10-year-olds who would go on to have Entry 3 skills reported having problems with maths.

Early school leaving

The Skills for Life survey (DfES, 2003) found that respondents who had left school at an earlier age were far more likely to lack good numeracy skills than those who stayed on in education. Parental education also had an impact on numeracy, with respondents whose parents remained longer in education scoring at higher levels.

In the BCS70 cohort (Parsons and Bynner, 2007), 50% of men and 42% of women left full-time education by the age of 16. Those most likely to stay in education were females who would go on to have Level 1 or higher numeracy at age 34: only 30% left at age 16. At age 16, males and females who would have good (Level 1 or higher) numeracy as adults were more positive and ambitious than any other group of students, including those who would go on to have good literacy as adults. Among females who would go on to have poor (Entry 2 or below) numeracy, more than 60% had left school by age 16. More than half of those who would go on to have Entry 3 skills had also left by age 16.

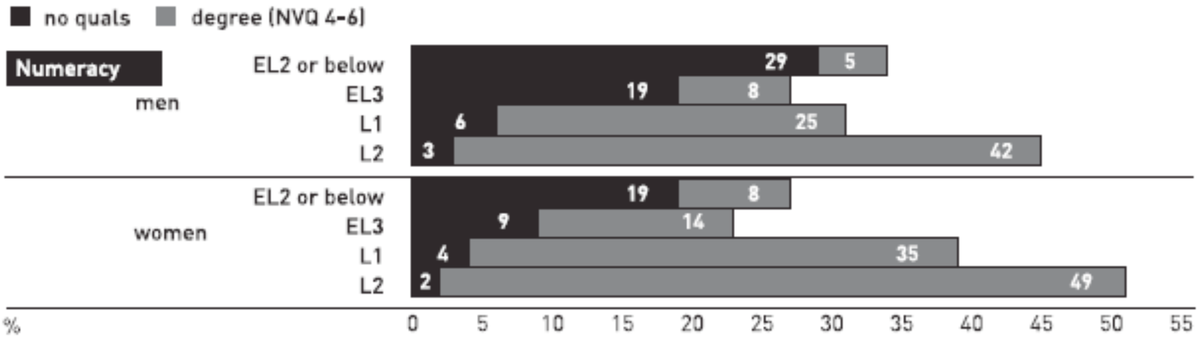
In general, men are more likely to leave school early, and this was reflected in Parsons and Bynner's findings. Even taking this into account, though, males with poor numeracy skills were 1.75 times as likely to leave school at 16. Roughly 70% of men who would go on to have poor or fair (Entry 2 or Entry 3) numeracy skills left at age 16, compared to only 40% of men who would go on to have good skills.

Men and women who had lacked good (Level 1 or above) numeracy at the age of 34 were five to six times less likely to want to do A-levels when asked about this when they were 16 (6% of men and 10% of women with poor (Entry 2) skills and 5% of men and 16% of women at Entry level 3 compared to 37% of men and 50% of women with good skills at age 34).

Qualifications attained

As with literacy, numeracy skills are closely associated with qualifications, and men and women with poor numeracy are much less likely to have qualifications. As figure 1.14 illustrates, 29% of the male members of the 1970 cohort with poor (Entry 2 or below) numeracy skills did not have any qualifications by the age of 34, while 5% had a degree or its National Vocational Qualification (NVQ) equivalent (Bynner and Parsons, 2006). Men with very poor numeracy were 10 times more likely than those with Level 2 or above numeracy to have no qualifications, and had only 1/8 the likelihood of having a degree or its equivalent. While women with very poor numeracy skills were more likely than men to have a qualification or even a degree at age 34, the ratios between skill levels were similar across genders. Women with Entry 2 or below skills were approximately 10 times more likely than those with Level 2 or above skills to have no qualifications at age 34, and were only 1/6 as likely to have a degree or its equivalent.

Figure 1.14: Qualifications achieved by level of numeracy, BCS70 cohort members at age 34



When qualifications were attained

Just over 40% of men with Entry level numeracy skills at age 34 gained all their qualifications while still in their teens (Parsons and Bynner, 2007). This is indicative of lack of involvement in post-compulsory education and limited education and training during working years. However, a sizeable minority (more than 20%) gained all the qualifications they had while in their 20s and 30s, suggesting a pattern of dissatisfaction with compulsory education, leaving school with no qualifications, but then gaining initial and further qualifications later on. This highlights the critical importance of 'second chance' adult education and training, both in the workplace and in other settings.

Women at all skill levels were less likely to attain their qualifications in their 20s and 30s only.

iii. Moving into adulthood

Leaving the family home

Men with poor basic skills have a higher likelihood of continuing to live in the family home (i.e. with their parents or other carers) well into adulthood (Parsons and Bynner 2007). Analysis of the BCS70 data showed that, at the age of 25, more than 40% of men with poor (Entry 2) or fair (Entry 3) numeracy skills were still living in the family home, compared to roughly 30% of men with good (Level 1 or above) numeracy skills. At the age of 30, almost 25% of men with poor numeracy skills still lived in the family home. This was roughly twice the rate for men with good skills (12%). At age 34, roughly 22% of men with poor numeracy continued to live at home, as did 19% of those with fair numeracy and 10% of those with good skills.

There were some skills-related differences in the age at which women left the family home, but those differences were much smaller, varying by only a few percentage points from the ages of 25 to 34. On the whole, women in this cohort moved out of the family home at an earlier average age than did men. This was particularly true for low skilled women. For example by age 25, roughly 80% of women with entry level numeracy had left the family home, compared to 60% of men with the same skills.

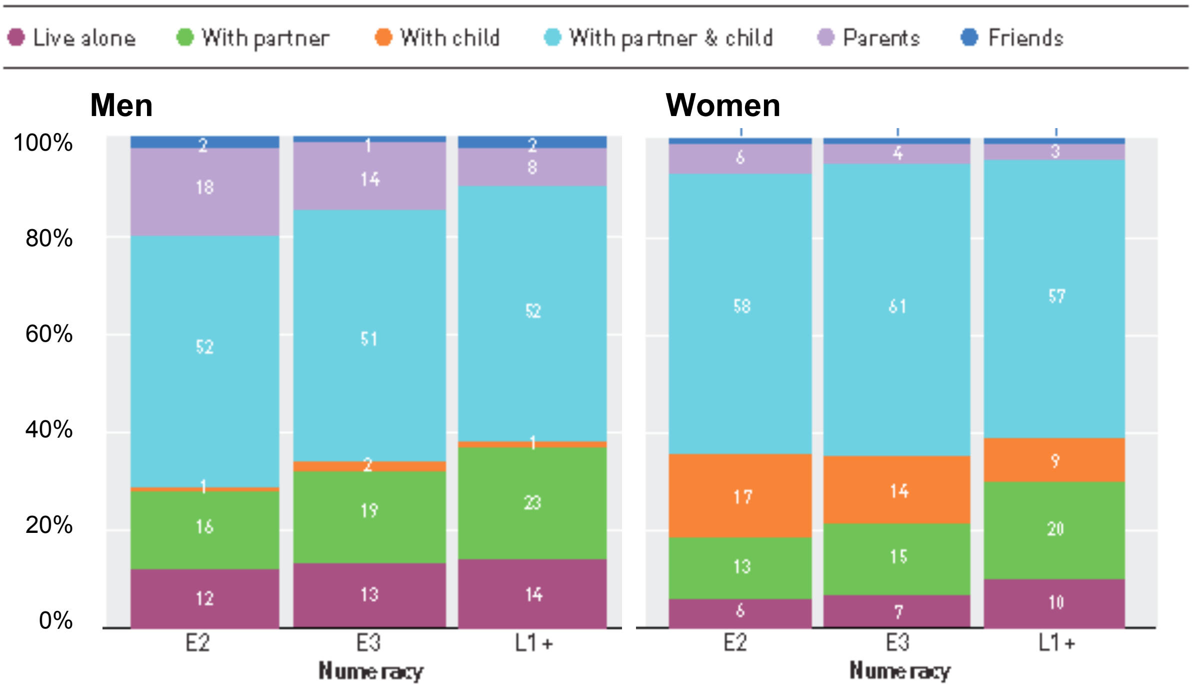
Living arrangements

Between the ages 16 and 34, men and women in the BCS70 cohort lived in an average of five different homes (Parsons and Bynner, 2007). Men and women with Entry level skills were more likely to live in disadvantaged housing conditions and rented and/or overcrowded accommodation. They were also less likely to have moved house for reasons to do with work. By the age of 34, 33% of men and women with good (Level 1 or above) numeracy skills had moved home for work-related reasons, compared to 20% of men and 16% of women with poor (Entry 2) numeracy and 22% of men and 21% of women with fair (Entry 3) numeracy.

Overall, 6% of men and 5% of women in the BCS70 cohort reported having experienced at least one spell of homelessness by the age of 34. Having poor numeracy doubled the likelihood of a woman in this cohort experiencing homelessness, with one out of 10 women with poor numeracy suffering this fate.

At 34, women with poor numeracy were about twice as likely as those with good numeracy to have a child but not in live-in partner (17% compared to 9%). Figure 1.15 shows living arrangements at age 34 by BCS70 cohort members' numeracy skills at that age.

Figure 1.15: Living arrangements at age 34 by BCS70 cohort members' numeracy skills at that age, percentages



Becoming a parent

By age 34, 55% of men in the BCS70 cohort had become a father (Parsons and Bynner, 2007). Only 2% reported doing so while still a teenager. Teenage fatherhood was highest (5%) among men with poor (Entry 2) numeracy skills.

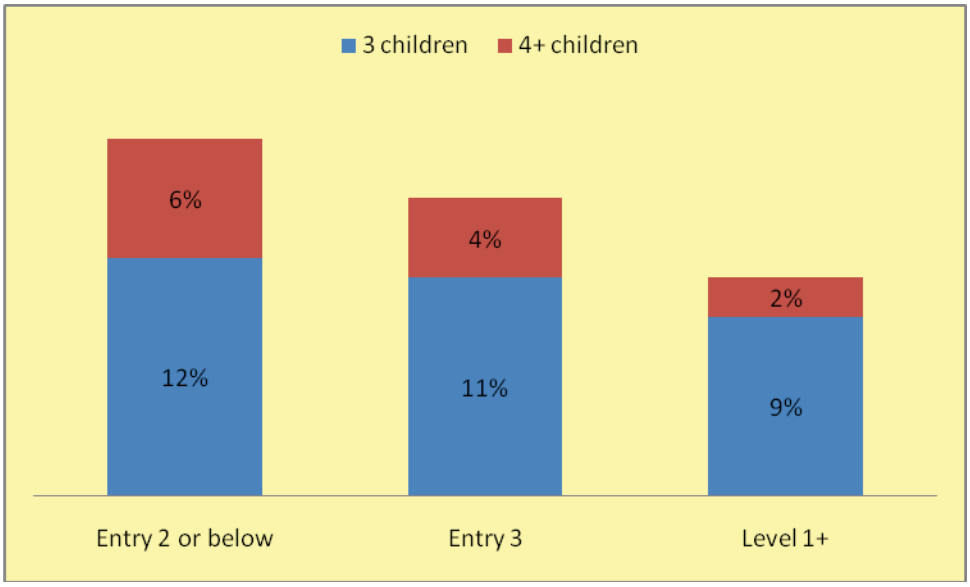
Among women, more than three-quarters (77%) of those with poor numeracy had a child by age 34, compared to 68% of those with good (Level 1 or above) skills.

Looking at patterns of parenthood, there were strong indications of a cyclical intergenerational transfer of disadvantage. Just as individuals who would go on to have poor skills at 34 were the most likely to be born into large families and of young mothers in 1970, women with Entry level skills were much more likely to have children early and to have more children.

Compared to women with good numeracy skills, women with poor or fair numeracy at 34 were more than twice as likely to have had their first child while still in their teens: whereas only 5% of females with Level 1 or above numeracy had become a mother while still a teenager, 12% of those at Entry 3 and 13% of those at Entry 2 had done so.

Women with poor numeracy not only had children earlier, they had more: women at Entry 2 or below were three times as likely as those with good (Level 1 or above) numeracy to have four or more children by age 34 (6% versus 2%), and were much more likely to have at least three children (18% compared to 11%). As figure 1.16 illustrates, there is a clear skills-related gradient, with women at Entry 3 numeracy falling almost exactly in the middle of women with better and worse skills.

Figure 1.16: Percentage of women with 3+ children aged 34, by grasp of numeracy



This suggests that when the government or other organisations seek to draw more women into education and training, they must take family commitments into account. The women most in need of improved skills are much more likely to have a relatively large number of children and to be raising them on their own, so time available to them for learning is more likely to be limited.

Parenting practices and helping children learn

The Skills for Life survey (DfES, 2003) found that the vast majority of parents of school-age children (87%) helped their children with maths.

Analysis of the BCS70 (Parsons and Bynner, 2007) found that among cohort members with children under the age of six, there were no skills-related differences in the amount of support that parents offered to help children learn basic numbers and the alphabet, or to recognize colours, shapes and sizes. Twelve per cent of parents did not report helping with any of these activities, a figure that was consistent across skills levels.

However, cohort members' skills were closely associated with the number of books that children possessed. While only 18% of individuals with good (Level 1 or above) numeracy reported that their children (up to the age of 16) had fewer than 20 books, 25% of parents with fair (Entry 3) numeracy reported this to be the case, as did 33% of parents with poor (Entry 2) numeracy.

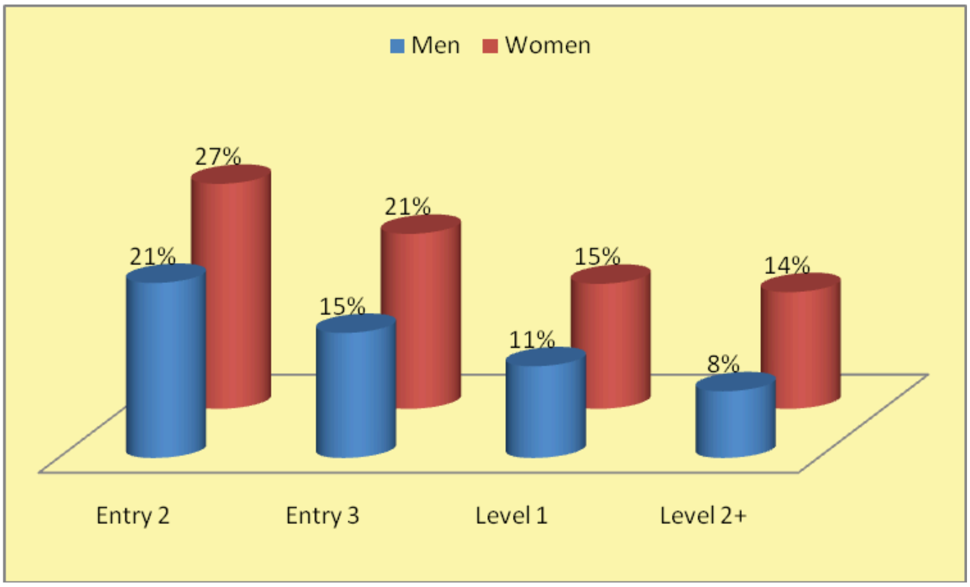
Mental and physical health

The Skills for Life Survey (DfES, 2003) found links between respondents' reported health and numeracy levels. Individuals with entry level numeracy were far more likely than those with better numeracy to report having a long-standing illness or disability (56% of individuals with entry level numeracy, compared to 22% of those with better numeracy). In addition to this question, respondents were also asked to rate their health, saying whether it was: poor or very poor, fair, good, or very good. Though individuals with entry level numeracy made up less than half of the Skills for Life survey sample (47%), they accounted for 70% of self-reported cases of poor or very poor health. They were also statistically less likely to report being in very good health. Some of this effect can be explained by the fact that poor health was more common among older respondents, and this group was also more likely to have poor numeracy skills. However, the impact of age only explains part of the skills-health link.

It is not clear from the data whether poor numeracy skills contributed to poor health or whether poor health led to poor numeracy skills, or if the relationship was more complex, with causation running in both directions – or whether a third factor was producing both outcomes.

Numeracy skills also appear to be linked to mental health. In the BCS70 cohort, a far higher proportion of men and women with poor (Entry 2) numeracy skills reported four or more symptoms of depression of a possible nine (Bynner and Parsons, 2006). As figure 1.17 illustrates, the presence of (four or more) depressive symptoms follows a skills gradient, with each lower level of numeracy associated with a higher likelihood of depressive symptoms.

Figure 1.17: Relationship between numeracy and symptoms of depression, BCS70, aged 34



iv. Employment

At a national level, numeracy skills are reported to have a profound effect on the average productivity of the workforce and to explain a significant proportion of the difference in economic performance between nations (DfEE, 1999). The International Adult Literacy Survey (IALS) data showed that those with poor basic skills earn less, and this difference is greater for those with poor numeracy skills (OECD, 1997). Research by Bynner and Parsons for the Basic Skills Agency found that individuals with poor numeracy skills experienced the lowest levels of full-time labour market participation – that is, numeracy skills had more impact on employment than literacy skills (Bynner and Parsons, 1997).

In this research, which used data from the National Child Development Study (NCDS), a longitudinal study following the lives of a large number of individuals born in the UK in 1958, Bynner and Parsons found that men with poor numeracy were the most prone to unemployment. Of women who were not in full-time work, those with poor numeracy tended to be in part-time jobs and those with poor literacy in home care.

In addition to employability, numeracy affected occupation. People with poor numeracy skills were more likely to be employed in manual occupations. No men with poor numeracy skills had professional occupations but 11% of men and 8% of women with poor numeracy skills had management jobs. Outside of professional and managerial occupations, jobs in selling and clerical / secretarial jobs – where women comprise the majority of the workforce – were those most likely to require numeracy skills, yet women are generally less proficient at numeracy than men.

The Skills for Life survey also concluded that lower levels of numeracy skills were associated with socio-economic deprivation and lower socio-economic status (DfES, 2003). We now More than 6 in 10 of those in routine or semi-routine jobs had Entry 3 or lower level numeracy skills. Respondents in full-time employment scored at higher levels than all other groups, and the gap between those employed part-time and those not employed was smaller than that observed in the literacy assessments.

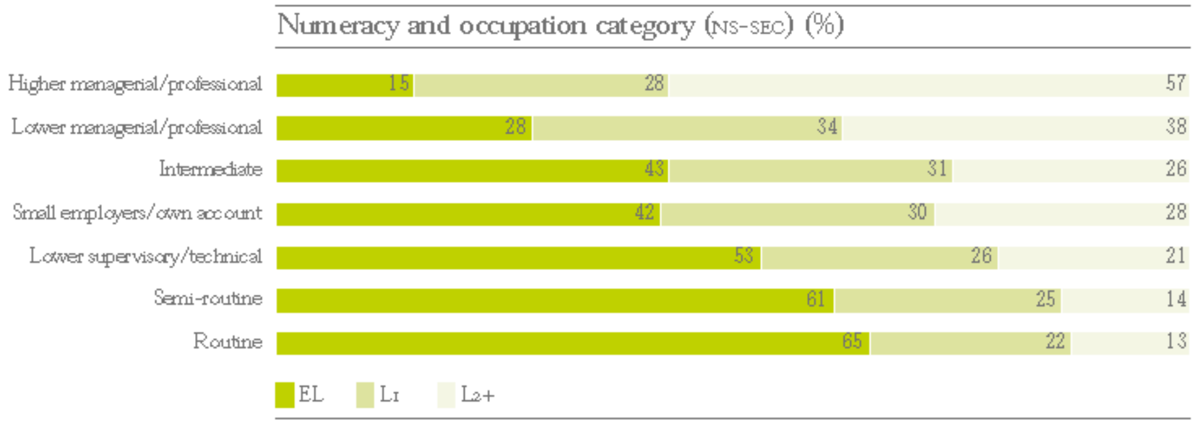
Data also suggested that people are more likely to 'lose' their numeracy skills if they are employed in jobs that do not require their use (DfES, 2003). The report speculates that young men with very low numeracy do not improve these skills as they get older but those with medium-low or medium numeracy do improve with age. This is probably associated with available occupations: individuals with even medium-low numeracy may have much broader work options than those with very low numeracy (DfES, 2003). Data on gender and employment also suggests both that poor numeracy skills were a major barrier to labour market entry and that employed people make more use of their numeracy skills and keep them fresher.

Lower level numeracy skills were associated with lower wages: on average, individuals with fair or poor (Entry 3 or lower) skills earned roughly £8,000 less than those with Level 2 numeracy or above (DfES, 2003). Furthermore, individuals with Entry 3 numeracy were less than half as likely as those with Level 2 or above to earn more than £20,000 a year before tax. However, compared to lower skill levels, having a fair level of numeracy (Entry level 3) has been shown to attract up to 13% higher earnings. Workers with good (Level 1) numeracy earn at least 6% more per hour than those at Entry levels and below (Grinyer, 2006). The connection between earnings and numeracy skills was stronger than that between earnings and literacy.
More recent research shows that men with higher levels of numeracy have significantly higher employment rates: numeracy seems to be important in determining the likelihood of being in full-time employment. (Vignoles, et al, 2008). On an individual level, as the work of Bynner and Parsons reminds us, it is individuals with poor numeracy skills who are likely to suffer most as the economy contracts (Bynner and Parsons, 1997).

Employment history and earnings
The Skills for Life survey found strong correlations between numeracy skills and occupation, particularly among individuals classified as 'managerial/professional' (DfES, 2003). As figure

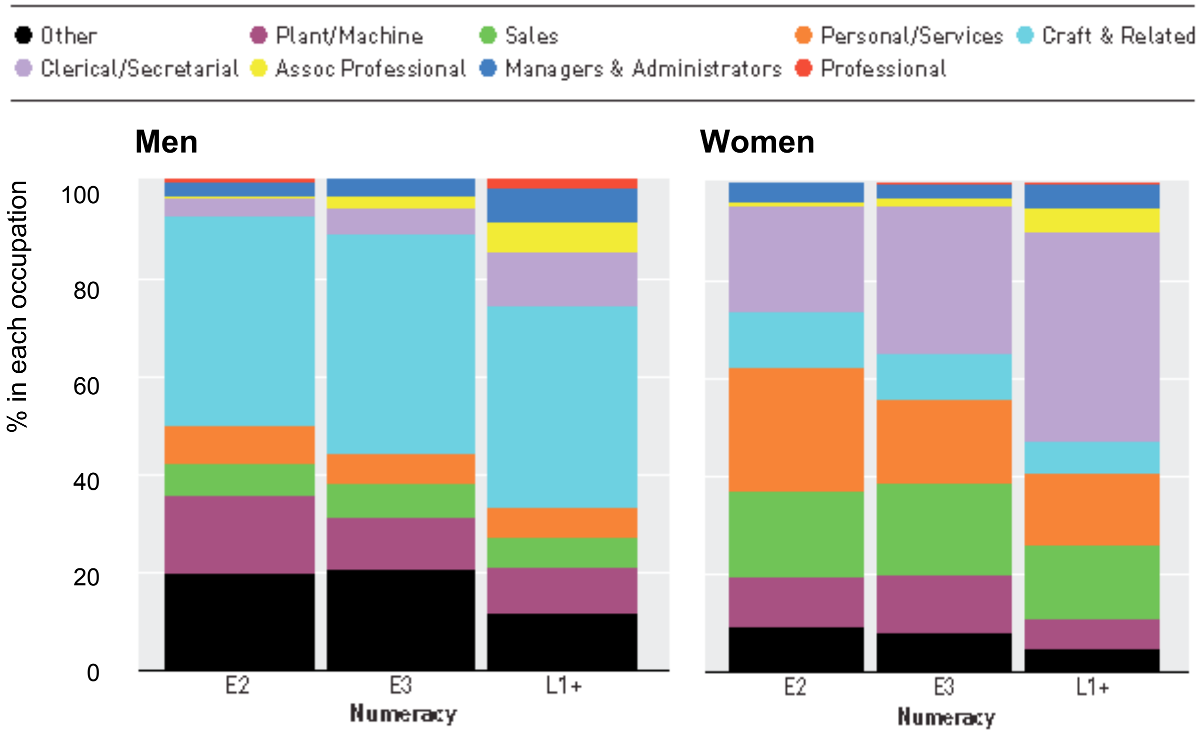
1.18 illustrates, the majority (57%) of individuals in the 'higher managerial and professional' roles had numeracy skills at Level 2 or above, compared to only 38% of those in lower managerial and professional occupations. The literacy skills gap between these two occupation levels was markedly smaller. More than 60% of individuals employed in routine or semi-routine positions had fair or poor (Entry 3 or below) numeracy skills.

***Figure 1.18*: Relationship between numeracy skills and occupation, Skills for Life survey (DfES, 2003)**



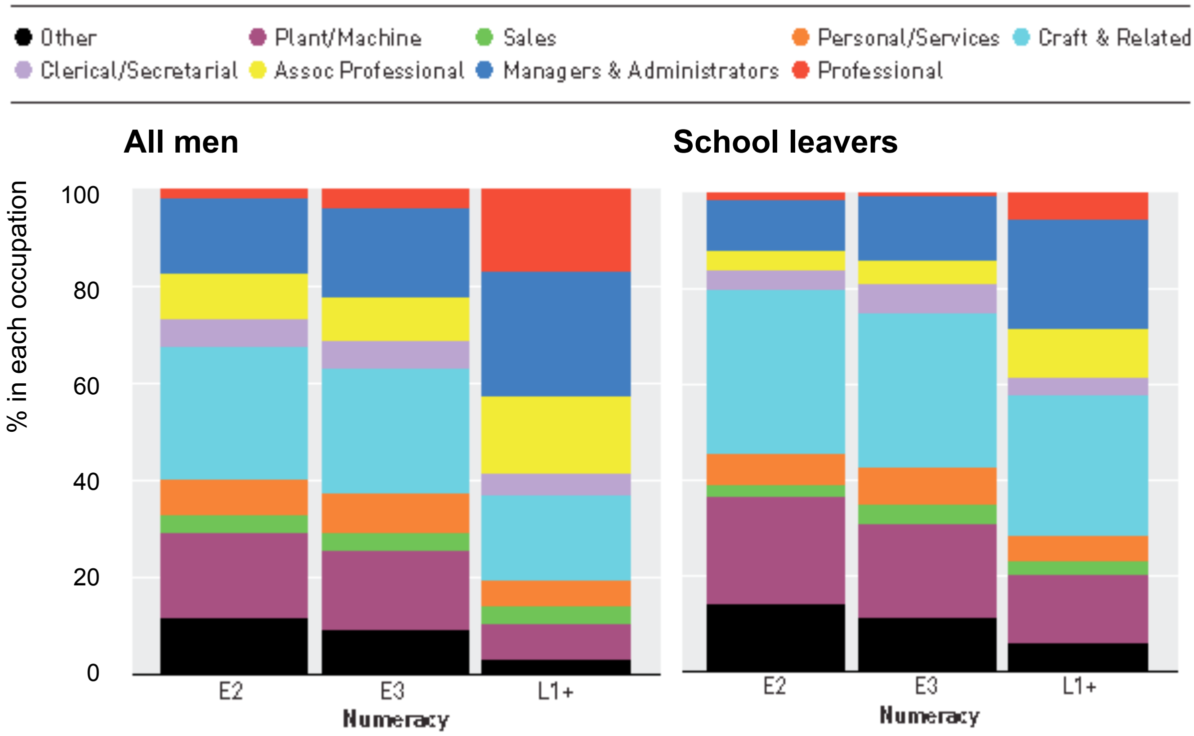
In the BCS70, men and women with poor numeracy skills tended to enter the workforce earlier than those with good (Level 1 or above) numeracy. 67% of men and 70% of women who had poor (Entry 2) numeracy skills at age 34 had entered the workforce by age 17, compared to only 51% of men and 44% of women who had good skills. Patterns of workforce entry for those who had Entry 3 skills were similar to those of individuals whose skills were at Entry 2 or below. Figure 1.19 shows the type of job that cohort members who entered the workforce at age 16 had at that age.

Figure 1.19: First job on entrance to the workforce at age 16, by BCS70 cohort members' numeracy skills at age 34



The BCS70 also contains data allowing an analysis of the relationship between numeracy skills and occupation. Figures 1.20 shows occupations at age 34 for men in this cohort, based on their numeracy skills. Men with better numeracy skills are less likely to do work classified as 'planet/machine' and are much more likely to have employment classified as 'professional' (Parsons and Bynner, 2007). This is true for those who left school at 16 as well as those who stayed on longer.

Figure 1.20: Current occupation at age 34, men in BCS70



Employment status

For males born in 1970 (the BCS70 cohort), the better their numeracy skills, the more likely they were to be in full-time employment. For example, at age 34, 95% of males with Level 2 or better numeracy skills were in full-time employment, compared to 92% of males at Level 1, 88% at Entry 3 and 85% of those with poor (Entry 2 or below) skills (Bynner and Parsons, 2006).

The relationship between numeracy skills and likelihood of being in full-time work holds for women as well – with one exception. Women with the poorest numeracy skills were the least likely to be in full-time work: in the BCS70, 34% of those with poor (Entry 2 or below) numeracy were in full-time employment at age 34, compared to 39% of women at Entry 3 numeracy and 51% of women with good (Level 1) numeracy. However, women with Level 2 or above numeracy skills were slightly less likely (48%) than those with Level 1 to be in full-time employment. The reason for this is unclear.

There is strong evidence that the gap between poor and fair numeracy (that is, the gap between entry levels 2 and 3) is particularly significant, both for economic wellbeing and social inclusion. At the age of 30 in the BCS70 cohort, men and women with poor numeracy were more than twice as likely to be unemployed as those with fair numeracy; and men with poor numeracy had the lowest hourly rates of pay (Bynner and Parsons, 2006).

Between the ages of 16 and 34, men in the BCS70 who had poor numeracy skills were twice as likely as those with good (Level 1 or above) and numeracy to experience three or more spells of unemployment (Parsons and Bynner, 2007). During the same years, men with poor (Entry 2) numeracy spent an average of 13 months unemployed, compared to only four months for those with good skills. These ratios hold even when only comparing school leavers, indicating that it is not just education level that matters but basic skills. Between ages 16 and 34, women with poor numeracy experienced three times as much unemployment as those with good numeracy (6 months versus 2 months).

Figures 1.21 and 1.22 show employment rates for men and women in the BCS70, based on their numeracy skills at age 34.

Figure 1.21: Percentage of men in BCS70 in full-time employment age 16–33, by numeracy skills at age 34

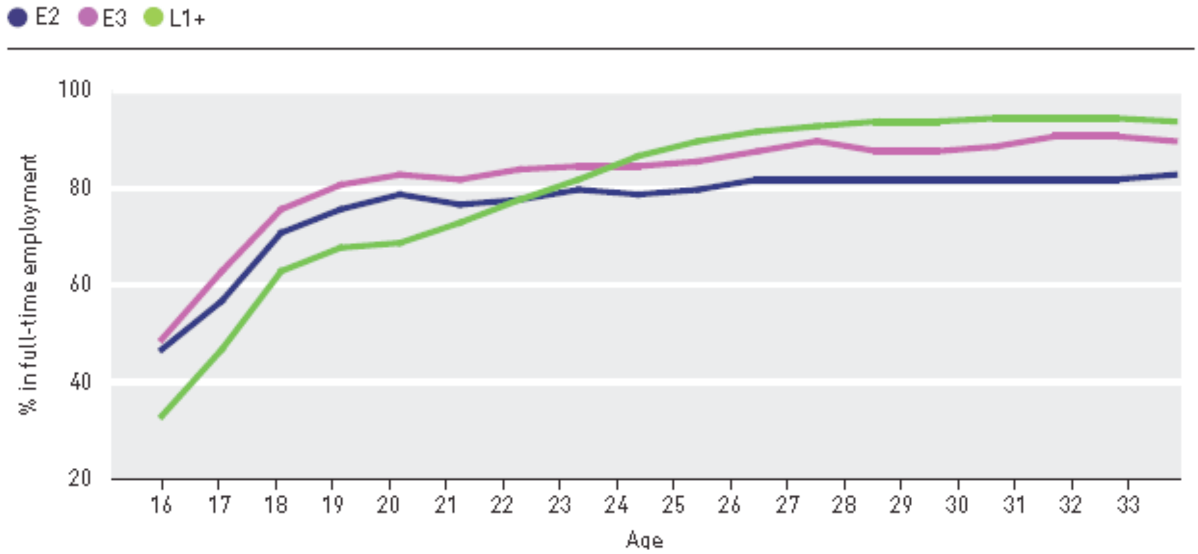
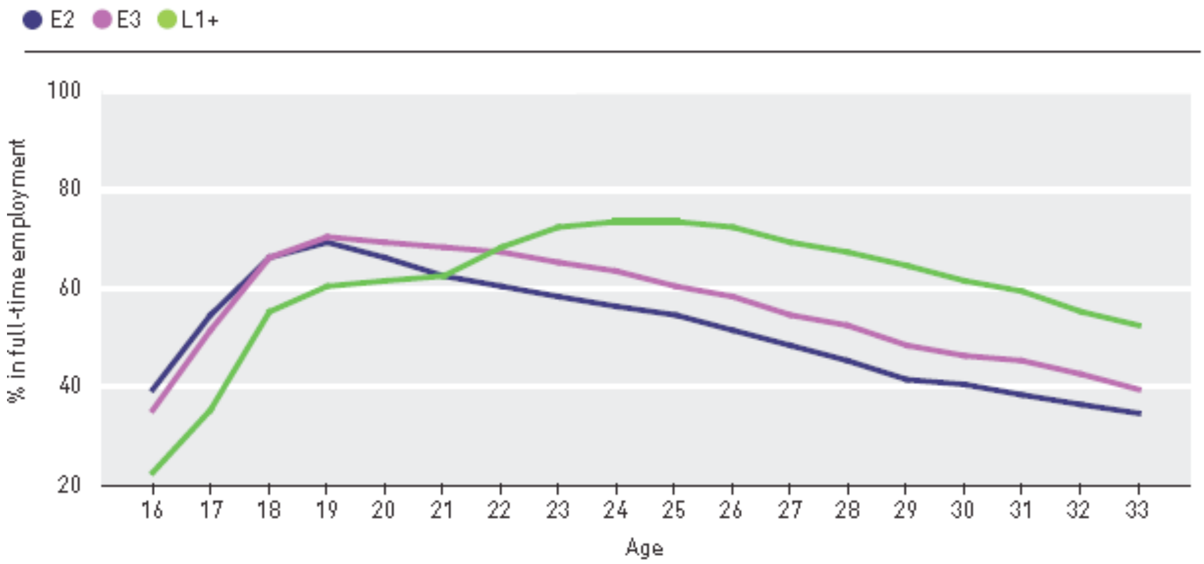
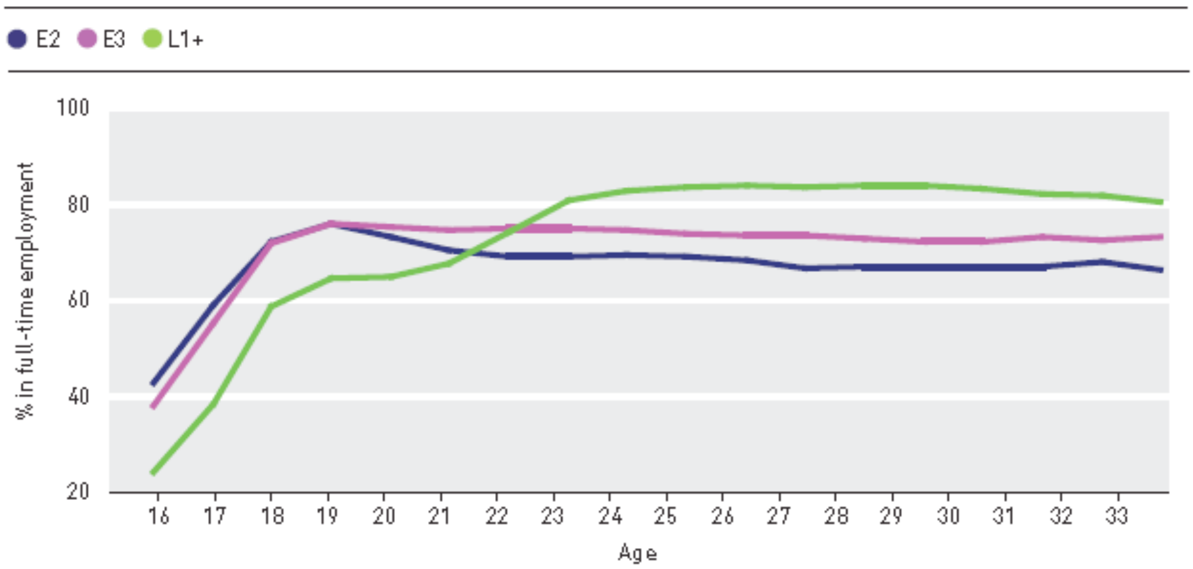


Figure 1.22: Percentage of women in BCS70 in full-time employment age 16–33, by numeracy skills at age 34



Women of childbearing age have a high likelihood of being in part-time employment (Parsons and Bynner, 2007). Figure 1.23 shows the combined rate of full-and part-time employment for women born in 1970.

Figure 1.23: Percentage of women in BCS70 in full or part-time employment age 16–33, by numeracy skills at age 34



Research shows that for both men and women, skills decline if not used in employment, which may partly account for the fact that large numbers of adults with numeracy problems were not identified as having problems while at school (Bynner and Parsons, 1998). Adults who are out of work lose their skills, and such loss tends to be more acute, and to start sooner after loss of employment, for numeracy than for literacy. This can create a vicious circle, in which poor numeracy contributes to limited employment, which leads to poorer numeracy, which makes it harder to find and keep employment. ICT use also appears to play a role in this process, as will be discussed in section 3 of this report.

Although poor numeracy appears to be central to both boys' and girls' educational difficulties, post-school it remains a distinct educational problem in getting qualifications, mainly for men.

Figures 1.24 and 1.25 show the proportion of time spent in various economic statuses between ages 16 and 34. As these illustrate, even among early school leavers, numeracy skills are strongly associated with employment. Individuals with poor (Entry 2) numeracy are much more likely to report being out of the labour market because of illness than those with somewhat better (Entry 3) skills.

Figure 1.24: Proportion of time spent in each economic status, men in BCS70, ages 16–34

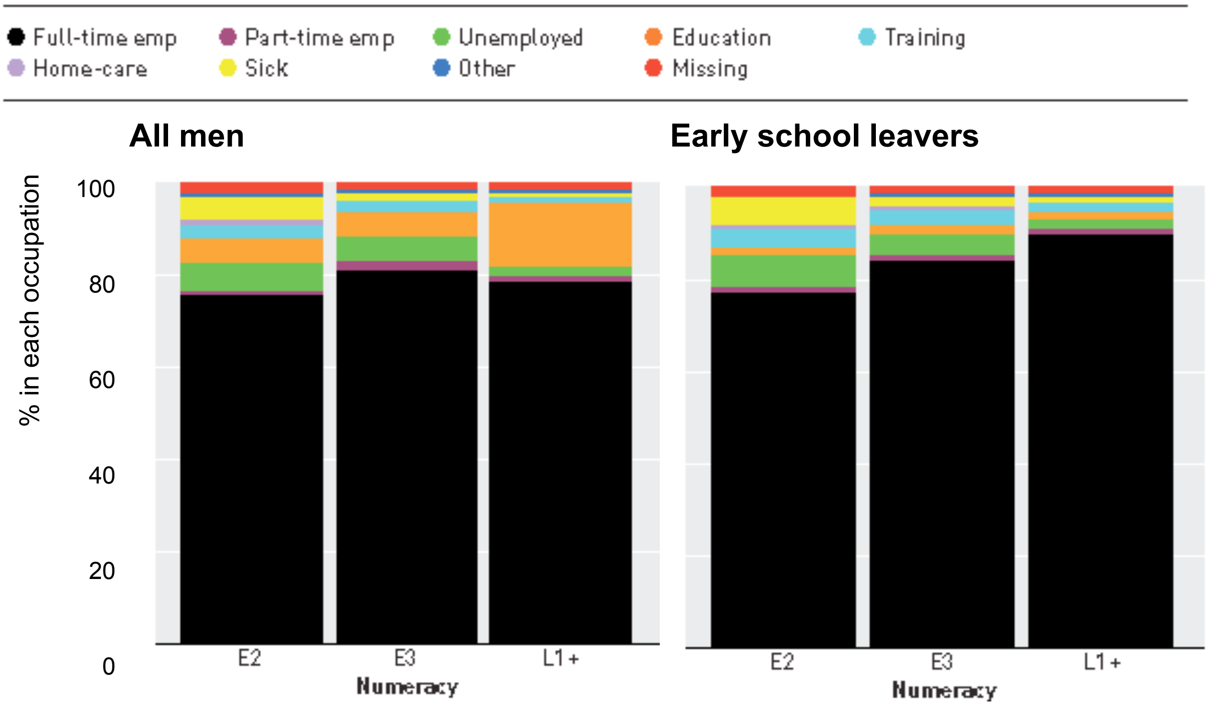
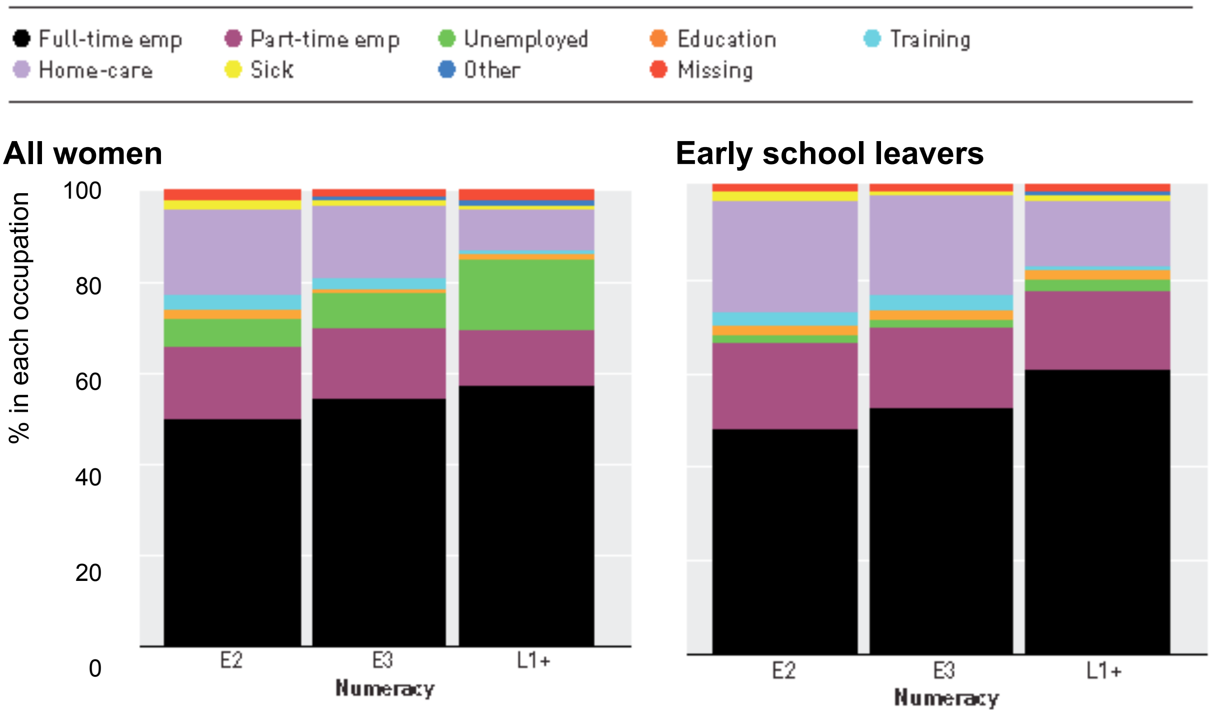


Figure 1.25: Proportion of time spent in each economic status, women in BCS70, ages 16–34



Training / promotion

Early research by Bynner and Parsons discovered that individuals with poor basic skills were less likely to receive work-place training in early employment than those who were competent at numeracy. These people were also less likely to see their earnings increase or get promotion (Bynner and Parsons, 1997).

Analysis of BCS70 cohort data (Parsons and Bynner, 2007) showed that better numeracy skills were associated with a greater likelihood of receiving work-related training. Among men born in 1970, 18% of those with poor (Entry 2 or below) numeracy received work-related training, compared to 26% of those with fair (Entry 3) skills, 31% of those with good (Level 1) numeracy and 38% of those with Level 2 or above.

Among women, the pattern was less consistent. Seventeen per cent of women with poor numeracy received work-related training, as did 16% of those with their numeracy, 22% of those with good numeracy and 26% of those at Level 2 or above.

Men with poor numeracy were also much less likely to have been promoted at any time (38% versus 58%). Only one-third of women with poor numeracy had been promoted, compared to more than half of those with good skills.

Financial capability

Research on the financial capability of the adult population in the UK has found that, while an assumption could not be made that people with literacy and numeracy needs necessarily had low financial capability, many exhibited worrying behaviours and attitudes. People with literacy and numeracy needs were more focused on the short term than average, and were therefore less likely to be able to manage if they faced a drop in income or an unexpected bill. People with literacy and numeracy needs also reported lower levels of knowledge about financial products and were thus more likely to overspend or buy unsuitable products (Atkinson, 2007). This report suggested that there was real potential to improve levels of financial capability alongside literacy and numeracy.

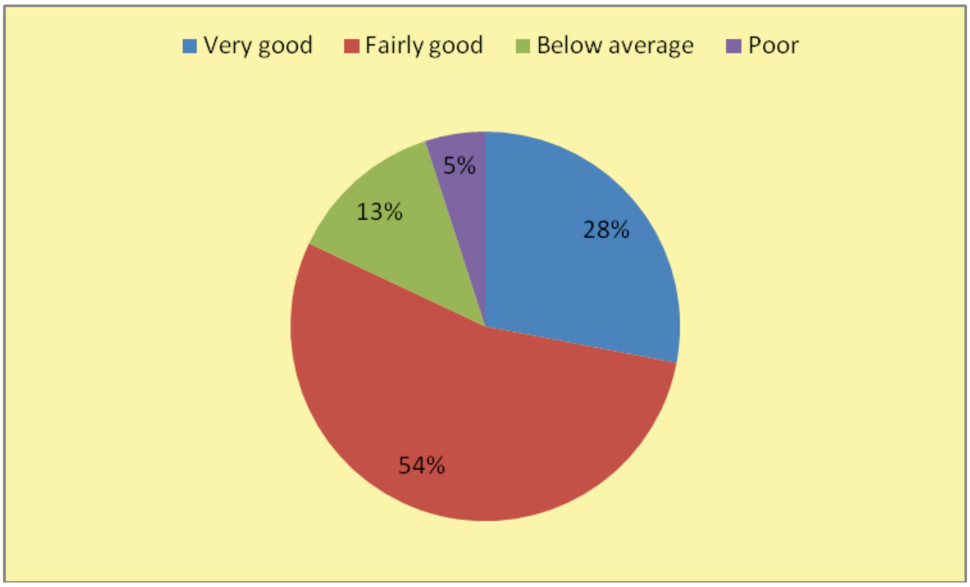
Part 2: Tackling the numeracy skills deficit

i. Identifying numeracy problems

Self-perception of numeracy difficulties

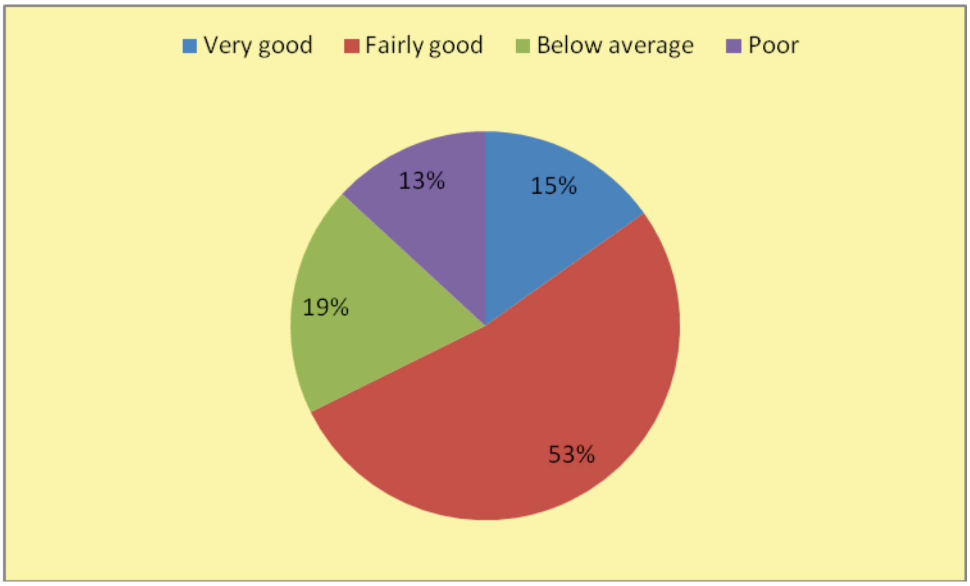
Surveys of adult numeracy skills have consistently found a gap between people's perceptions of their skill level and the level the survey assessment judged them to be at. For example, in the Skills for Life survey (DfES, 2003) only 8% of respondents rated themselves as below average in numeracy. Individuals with poor numeracy tended to rate their skills much higher than their performance indicated. 28% of individuals with poor (Entry 2) numeracy, for example, rated their numeracy as 'very good', while 54% rated it as 'fairly good'. Only 13% of adults with Entry 2 numeracy rated themselves as 'below average', with a mere 5% categorising themselves as 'poor'.

Figure 2.1: How do adults with Entry level 2 numeracy rate their numeracy skills? Data from Skills for Life survey (DfES, 2003)



Adults with very poor (Entry 1 or below) numeracy were more likely to rate themselves as very good (15%) than poor (13%). 52% of adults at this level rated themselves as fairly good at numeracy, while 19% considered themselves below average.

Figure 2.2: How do adults with Entry level 1 or below numeracy rate their numeracy skills? Data from Skills for Life survey (DfES, 2003)



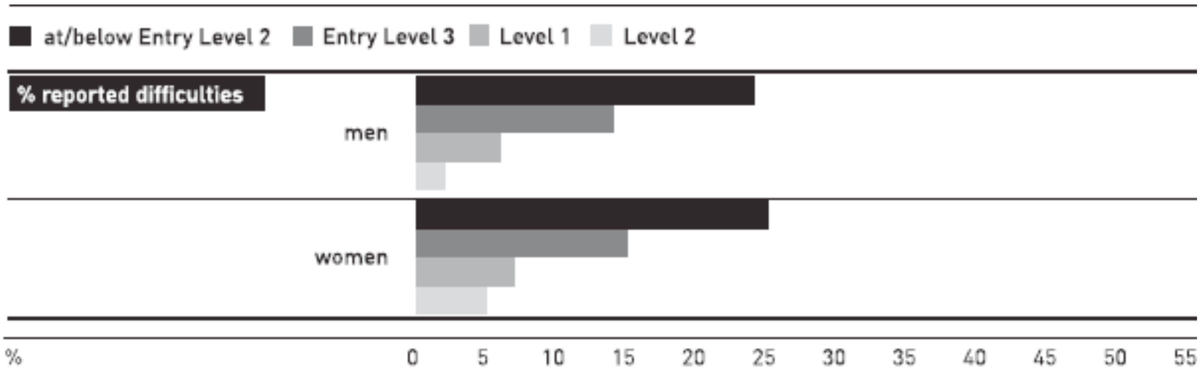
Many members of both the National Child Development Study (NCDS) and BCS70 cohorts whose test performance was very poor did not acknowledge any difficulty.

The gap between perceived and assessed skills is even larger for numeracy than for literacy (Bynner and Parsons, 2006). For example, analysis of NCDS data on individuals born in 1958 found that only 9% of respondents with poor numeracy scores recognised or acknowledged their difficulty, compared to 19% of those with poor literacy scores (Bynner and Parsons, 2006). To a much lesser extent, some people who have average or better scores on numeracy assessments report having problems with the subject. Looking at the NCDS and BCS70 between 1981 and 2000, the percentage of cohort members saying they had difficulties with number work remained consistently low, between 3% and 5% (Bynner and Parsons, 2006).

In 2004, however, the percentage of English BCS70 cohort members saying they had problems with maths rose to 11% (12% in Wales and 7% in Scotland). This change appears linked to the introduction to the survey of questions about specific mathematical operations, for instance, ‘Do you ever have difficulty with multiplication?’ and ‘Do you ever have difficulty with division?’ This would suggest that while individuals are very comfortable with their skills when they think of numeracy in abstract terms, they are somewhat less confident when they focus on specific numerical operations.

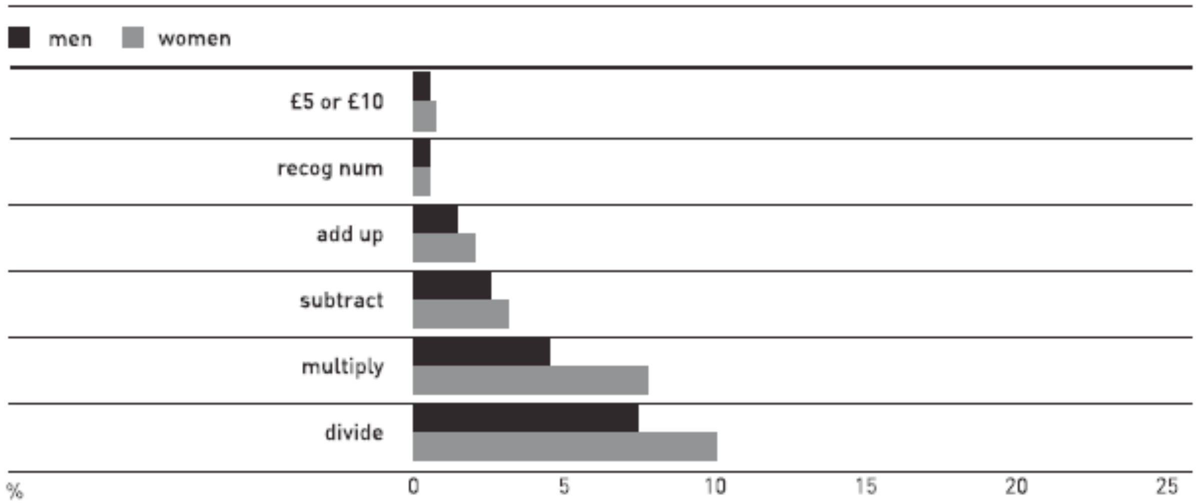
Figure 2.3 shows the proportion of the BCS70 cohort who at age 34 felt that they had problems with numeracy. Among both men and women, roughly 25% of those with poor (Entry 2 or below) are skills reported having difficulties.

Figure 2.3: Percentage of BCS70 men and women reporting numeracy difficulties at age 34, by assessed level of numeracy



Individuals in the BCS70 reported greater degrees of difficulty with particular numeracy problems. Only a very small percentage (2–3%) said that they struggled to count correct change from a £5 or £10 purchase or recognise particular numbers. Successively more people said that they sometimes had difficulties with the four main mathematical operations: addition, subtraction, multiplication and division. In all four areas, women were more likely than men to say they had problems, as illustrated in figure 2.4. For example, women were twice as likely to say they had problems with multiplication (8% of women compared to 4% of men) and nearly 1.5 times as likely to say they had a problem with division (10% of women compared to 7% of men).

Figure 2.4: Percentage of BCS70 men and women who reported specific maths difficulties at age 34



The gap between perceived and actual numeracy is more complicated than people not recognising their numeracy difficulties. Bynner and Parsons (2005) suggested that self-appraisal of one's skills has more to do with self-concept and identity than with objective evidence of performance. The key question may not be 'How good are my skills when compared to the population at large?' but, as Bynner and Parsons write, 'Do I see myself as poor against the standard that I set for myself in the context of my everyday life?' With reference to measurement, Baxter et al (2006) argue that 'the adult population of England may not be deluded in thinking that their measurement skills are adequate to their needs, if those needs are cast in terms of 'everyday' (outside education) life: it is when their numeracy is tested, or they want to help their children with school work, that their skills are inadequate.'

In part, then, self-perception of skills is connected to what people judge 'mathematics' to be. This has led researchers to talk of 'invisible maths', that is, the mathematics someone can do, but which they may not think of as maths at all, 'just common sense' (Coben, 2003). The term 'mathematics' is used to refer to the things people can't do. This is in line with Lave's observation that problems in adults' lives which involve mathematics are structured in terms of the activity and its purpose for the adult concerned, rather than in terms of mathematics (Lave, 1988, cited in Baxter et al, 2006). In a similar vein, other research by the NRDC has found that adults often do not feel that they use much maths in everyday life, and the maths they think they do is mostly related to money. Yet most report that they have functional maths and have developed survival strategies (Swain et al, 2005). These survival strategies include memorisation is, using calculators and getting other people to perform numeracy tasks for them.

This has implications for policy and for provision. Sticht (2005) argues, in the context of literacy, that efforts to improve basic skills on a major scale will founder unless policymakers and skills assessors place greater stock in adults' perceptions of their abilities to live perfectly acceptable lives with the skills they have. By 'overstating the nature' of the so-called basic skills 'crisis', Sticht argues, basic skills advocates run the risk of 'crying wolf', and being out of touch with lives as they are actually led by those with poor basic skills. It is likely, writes Sticht, that most adults do not believe that their skills are 'standing in the way of their ability to cope with most of the demands for literacy and numeracy of the new 'knowledge' or 'information' societies.' If this is the case, he continues, 'it will take a considerable effort to attract adults into programmes to improve what they do not think needs much improvement. The present relatively low rates of enrolment in adult literacy programmes in the industrialised nations seem consistent with this point of view.' For most adults, Sticht (2005, p.3) concludes, the maxim 'If it ain't broke why fix it?' continues to apply. And, as Bynner and Parsons note, low self-perception of difficulties presents major problems for policy makers and others who seek to encourage skills improvement: 'If people do not perceive a difficulty, then clearly the motivation to join classes to improve their skills is missing' (2005, p 21).

With this in mind, two key areas for future investigation are:

- Among adults assessed as having basic skills that are poor or very poor, why do some see themselves as having difficulties, and why do the majority not see themselves as having difficulties?
- What distinguishes those with poor skills who want to improve their skills from the majority who have no desire to improve?

Desire to improve

The Moser Report argued that it may be easier to get by with a lower level of competence in maths than in literacy. This is because:

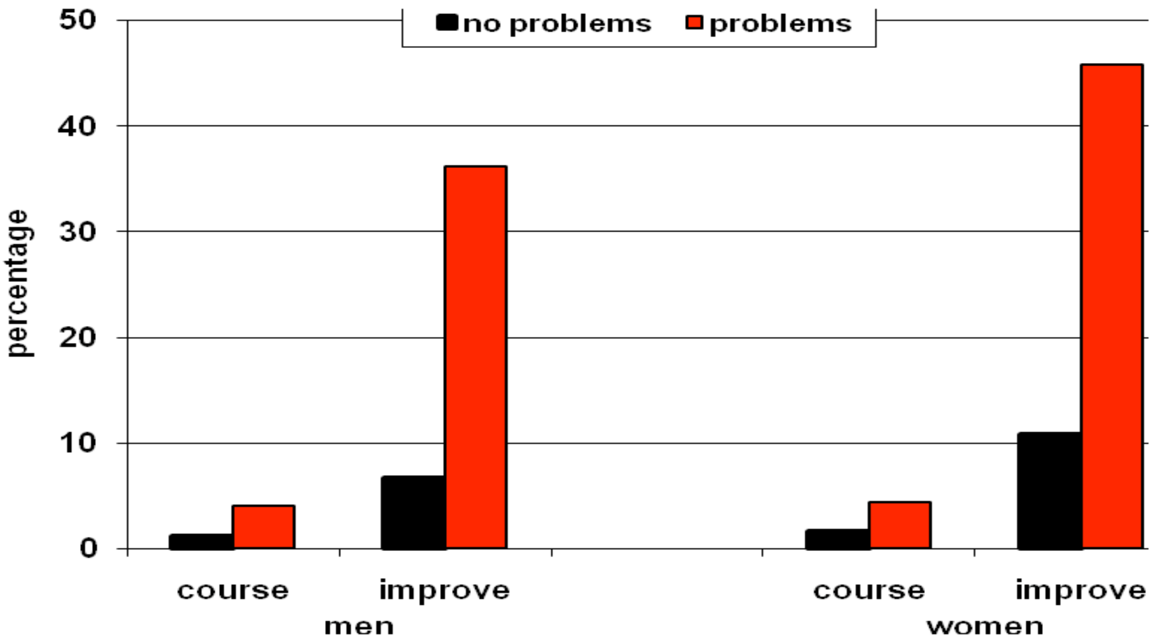
- numeracy is sometimes considered to be less essential than competency in reading and writing;
- calculators are widely used
- it is somewhat socially acceptable to be 'bad at maths' (DfEE, 1999).

It is commonly accepted that there is less stigma about poor numeracy skills than poor literacy skills. Successful learning is equated with learning skills that are applicable in life

(PAC, 2008). Over the lifecourse, adults develop many of their maths skills through activities in their daily lives, but their beliefs about maths tend to be based on their school experiences. Many adults believe that maths is something that they cannot do and do not need to do: the maths they do in everyday life, for example, is just 'common sense' (Coben, 2003); maths done in the workplace is not seen as maths and is thus not mentally or psychologically equated with the subject they learned at school (Wedege and Evans, 2006).

However, within the context of low self-recognition of poor numeracy skills, there is a noticeable desire to improve. Among individuals born in England and Wales in 1970 (BCS70), men and women were more likely to say that they wanted to improve their numeracy skills than to say that they wanted to improve their reading or writing skills (Bynner and Parsons, 2006). This held true both for those who felt they had difficulties and for those who did not feel they had difficulties. Among those who felt they had a problem with numeracy, more than 1/3 of men and nearly 1/2 of women wanted to improve, as illustrated in figure 2.5. This greater desire to improve numeracy skills than to improve literacy skills is perhaps surprising given the higher social value reportedly attributed to literacy.

Figure 2.5: Percentage of respondents expressing a desire to improve their numeracy skills, BCS70, 2004



Very few had been on a course, however: fewer than 4% of those who self-identified as having numeracy problems had done so. The same was true in the Skills for Life survey, which found that fewer than one in ten respondents in the Skills for Life survey had ever had any training in basic maths or number skills (DfES, 2003). To date, only 10% of people with poor (Entry 2 or below) numeracy have participated in a numeracy course and only 2% have achieved qualifications that count towards the target (NAO, 2008). It seems, then, that people with the lowest skill levels and those who are least likely to perceive they have poor skills need to be persuaded that improving their skills is worthwhile (NAO, 2004).

Improved skills, improved lives?

Are improvements in numeracy skills as an adult associated with improvements in other aspects of life? There is evidence, for example, that participation on a numeracy course is correlated with economic returns: three years after non-graduates were on a course, they were on average earning 13% more than matched individuals who had not attended a course (Grinyer, 2006).

Parsons and Bynner (2007) examined this issue in some detail. Using BCS70 cohort data, outcomes were compared for two groups: those who had poor numeracy skills at age 21 and continued to have poor skills at age 34, and those who had poor numeracy skills at age 21 but had good numeracy skills at age 34. Those who fell into the first category were categorised as 'non-improvers', while those in the latter category were classed as 'improvers'. (It should be noted that no causality should be inferred from the following data. Improvements in numeracy may lead to improvements in other areas of life, but it may also be the case that improvements in, for instance, one's job, led to better numeracy. Causality may work in both directions, or some other factor may be at play: a high level of personal motivation, for example, could lead to improvements in many areas of life, including numeracy. None of these options is mutually exclusive; all may co-exist together.)

Comparing male improvers with non-improvers, Bynner and Parsons found that:

- 33% of male improvers had investments at age 34, compared to 15% of non-improvers
- 65% of male improvers used a PC at work, compared to 48% of non-improvers
- male improvers were twice as likely to have received work-related training from their employer (36% versus 19%)
- male improvers were nearly twice as likely to disagree with the statement 'I am not at all interested in politics' (28% versus 13%).

There were more associations between improved numeracy and improved life outcomes among women than among men, suggesting that numeracy matters more to female wellbeing than to male wellbeing.

- 43% of female improvers were in a full-time job at age 34, compared to 27% of non-improvers
- female improvers were seven times less likely to lack any formal qualifications at age 34 (3% of improvers lacked qualifications, compared to 20% of non-improvers)
- female improvers were more likely to have used a computer at work (80% versus 61%) and were more likely to have access to a computer at home (83% versus 69%)
- in terms of civic engagement, female improvers were almost twice as likely to have signed a petition or been on a rally or demonstration (31% versus 17%)
- female improvers were more likely to be involved in social or community organisations (55% versus 41%)
- female improvers were much less likely to report that they never got what they wanted out of life (12% of improvers versus 20% of non-improvers)
- female improvers were less likely to report that they never exercised (14% versus 31%).

ii. Engagement

Some of the numeracy findings presented in this and later sections are drawn from small-scale research projects and case studies which did not use representative samples of teachers, learners or education providers. Although caution should be exercised when generalising from these results, there is no reason to think that these contexts were particularly unusual.

Why do adults join numeracy classes?

Numeracy learners are a diverse group with diverse reasons for wanting to improve their skills. Motivations can be intrinsic and extrinsic. The former involves learners wanting to prove something to themselves about their numeracy abilities. The latter is motivation fuelled by interest in gaining qualifications, getting a job, getting onto another course, engaging in every day activities with greater ease and so forth.

Some NRDC research suggests that students seldom join and attend numeracy classes because they feel they are lacking numeracy skills in their current jobs or their everyday lives. Even getting a qualification is often not in itself a motivation for attending a numeracy course (Swain et al, 2005). By contrast, a survey conducted with an opportunistic sample of learners as part of the NRDC's Persistence, Progression and Achievement project (carried out for the Quality Improvement Agency) found that a higher proportion of numeracy learners than ESOL or literacy learners selected 'getting a qualification' as their primary motivation (Lopez et al, 2007).

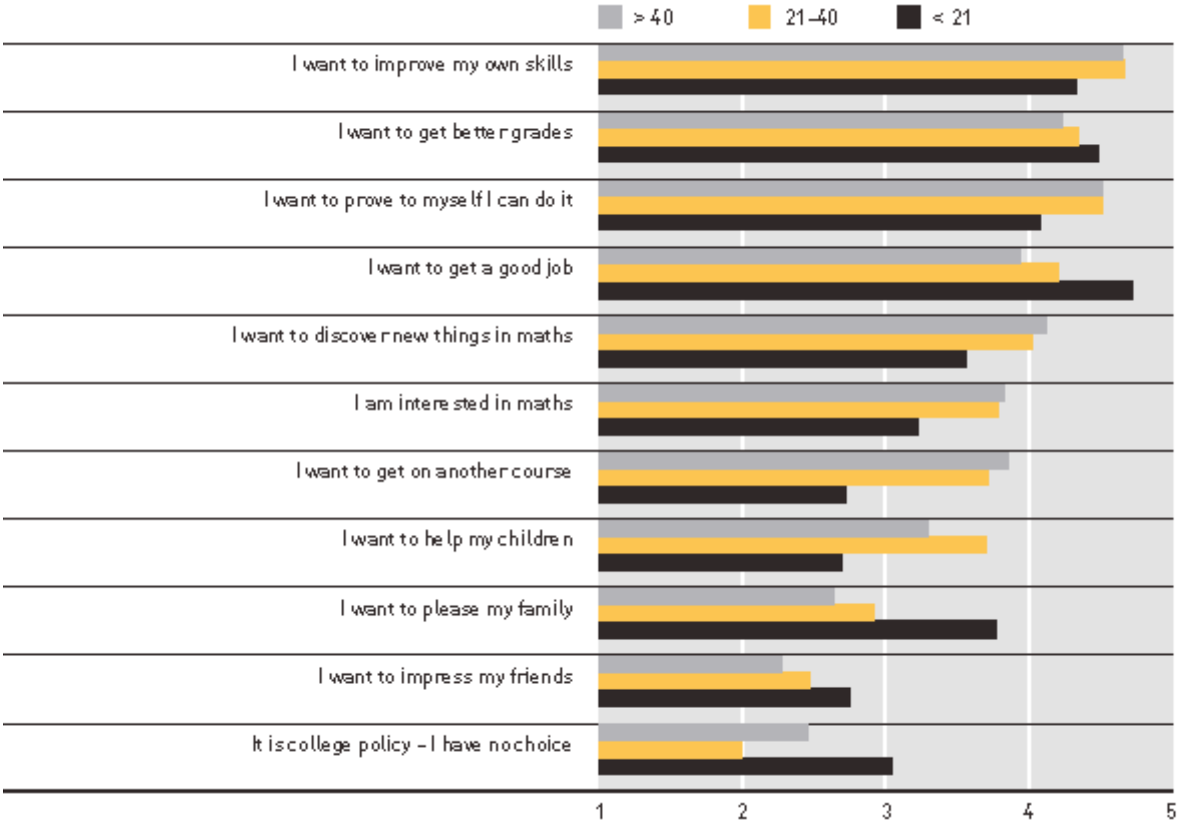
As part of a research project into adult numeracy provision in Scotland, practitioners listed some of the factors which they felt motivated adults to try to improve their numeracy. These included:

- peer pressure
- change in personal circumstances, e.g. death of, or separation from, a partner;
- helping children with homework
- work-related reasons – e.g. looking for a new/better job or promotion, or difficulty carrying out a current job that needs good numeracy
- learning to drive
- needing numeracy to pass an entrance test to another course, e.g., to enter nursing, the police or the fire service
- needing improved numeracy to live independently, e.g. to leave the parental home (Coben, 2005a)

Age appears relevant to whether motivation is intrinsic or extrinsic. NRDC's *Effective Practice: Numeracy* project found that 16 to 19 year olds tended to say that they were studying numeracy because their employers told them to or because numeracy was required for another course (Coben et al, 2007). Adults aged over 20 were more than twice as likely to say that they wanted to study numeracy to prove something to themselves, to become more confident or to help with their lives outside the classroom.

In *Thinking Through Maths,* a project aimed at stimulating a positive approach to the teaching and learning of mathematics in the Skills for Life sector, learners claimed they were enrolled in maths classes because: 1) they wanted to improve their maths skills to get higher test scores; 2) they hoped that their classes (or courses) would lead to higher qualifications; and 3) they also felt that they would lead to greater opportunities in employment (Swain and Swan, 2007). As in the NRDC's Effective Practice research, learners' age influenced their reasons for taking a numeracy course, with intrinsic motivations being more common among older learners. Figure 2.6 shows learners' reasons for attending a numeracy class, broken down into age bands. (For this survey, learners were asked to rank the accuracy of each statement from one to five, with five being the most accurate.)

Figure 2.6: Skills for Life numeracy learners' reasons for attending a numeracy class, by age (Swain and Swan, 2007)



The issue of motivation is complicated by the fact that a person's motivation for joining a class will not necessarily be identical to their motivation to persist in that class. Students can often name a specific task-based reason – for example, wanting to be able to do long-division – as their reason for first coming to class, but motivation for regular attendance is more complex and can change over time and along with a student's personal circumstances.

NRDC research looking at what learners hope to get out of adult numeracy courses (Swain, et al, 2005) has identified a number of common underlying motivators for numeracy learners. Some learners want to prove (to themselves and/or to others) that they have the ability to succeed in a field – maths – which they feel signifies intelligence. Maths is viewed as challenging and even esoteric; learners who can become 'good at maths' may be seen by themselves and/or others as intelligent.

Other learners came to class out of a desire to increase their understanding and enjoyment of numbers. Some of this group wanted to learn maths that they had not had a chance to learn in compulsory schooling. By mastering this information, they could complete their 'knowledge puzzle'. For many of these and other learners, maths is seen as exciting. These learners want to be challenged, and do not want to be taught only the basics that an adult would use in his or her daily life (Swain, et al, 2007).

Some learners in this research also wanted to help their children and grandchildren. Some among this group feared being seen by their children as inadequate if they could not help them with their maths homework.

Of course, in order to make learning engaging the teacher must understand what has been the motivating factor(s) for each learner.

Case study: Attracting adult learners to numeracy courses
Maths4Life was a three-year (2004–2007) project which worked to stimulate a positive approach to the teaching and learning of mathematics, on adult learners. One of the pathfinder projects conducted as part of Maths4Life set out to investigate key factors in attracting adults to take up numeracy learning. Three different groups were studied: young adults on a childcare course who were studying Key Skills: Application of Number; Teaching Assistants in a primary school; NHS employees.

Participants were asked three questions. Would learners be put off taking a vocational course if a maths qualification was included? What form of marketing is effective in attracting teaching assistants to numeracy courses? How can workplace numeracy courses be 'sold' to employers and employees?

The project found that:

- The younger learners were not necessarily positive about maths, but high levels of tutor contact mitigated some previously poor attitudes to the subject.
- Direct contact – with trainers making visits to schools to explain courses – was the most effective way of recruiting teaching assistants to further training in numeracy.
- For some NHS employees, a degree of maths anxiety prevented them from taking part in training, though many also identified that they had training needs.

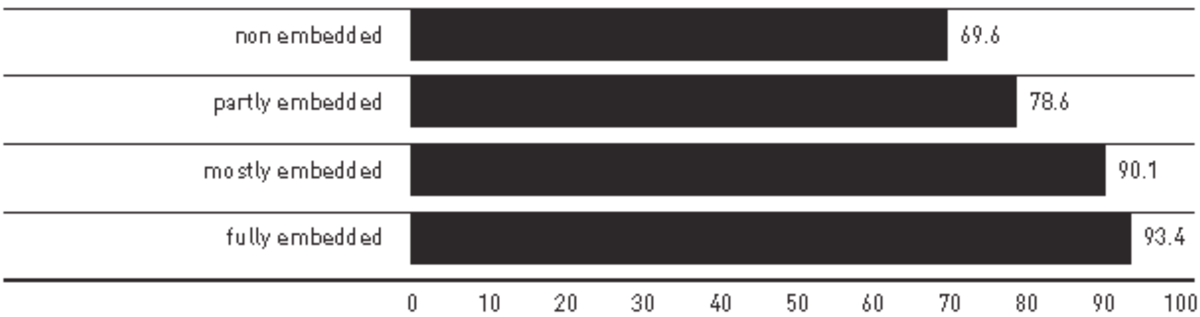
Motivating learners to persist
In keeping with findings about what makes people join numeracy classes, research shows that it is not necessarily the usefulness of maths in learners' working and everyday lives that keeps them in the classroom. This said, a NRDC-led project on learner persistence found that where numeracy learning can be made relevant to lives of learners and real-life situations, they are more likely to persist (Lopez et al, 2007).

As Swain, et al (2005) point out, the quality of engagement with maths may be what makes it seem meaningful. If adults have intrinsic reasons for learning and see numeracy as intellectually stimulating and challenging, their motivation is likely to be high. Other learners may have more functional goals. For example, one student in this NRDC project on making maths meaningful (ibid) said he wanted to learn maths to help him with his ability to calculate his darts scores. Capitalizing on the student's background context – how to calculate a darts score more easily – might increase motivation as well as making learning relevant to the student.

Although research on some courses (Coben, et al, 2007) suggests that when numeracy is taught as part of the basic skills element of a full-time course or as part of a vocational course it can be difficult to motivate learners, other research (Casey et al, 2006) found that embedding numeracy within vocational education appears to increase learner motivation and engagement – so long as the embedding was well executed.

Perhaps even more significantly, embedding appears to have a powerful effect on achievement, both in numeracy and in the vocational element of the programme. Comparing courses that offered four different approaches to numeracy – non-embedded, partly-embedded, mostly-embedded, and fully-embedded – Casey et al found that qualification rates rose steadily with the level of embedding, as illustrated in figure 2.7: from 70% on non-embedded courses to79% on partly-embedded, 90% on mostly-embedded and 93% on fully-embedded.

Figure 2.7: Percentage of learners achieving numeracy qualifications, among learners on embedded courses who were initially assessed as below Level 2 in numeracy



In courses which are mandatory, or where learners only enrol until they gain employment, teachers have found that good motivators include: students not just working from worksheets, ensuring that learners are extended as far as need be (and this might be different for each learner); pushing students beyond their comfort zone; and viewing numeracy learning as a social activity. This last point is backed by Swain, et al (2007), who found that students who feel vulnerable can be motivated where they are given the opportunity to work in a group setting.

Sometimes, successful motivation is less about supporting individuals as learners per se than about supporting them as individuals who have the capacity to succeed more generally. Hudson et al (2006) found this approach to be useful with the offender population. If individuals are used to perceiving themselves as ‘failures’ both as learners and more broadly, renewed failure in the classroom may be an insurmountable barrier to persistence and progress. Choice of task and a focus on success can be central to motivating these learners (Hudson, et al, 2006).

Of course, teachers also need to be aware of the factors that can demotivate learners. The relative lack of females pursuing mathematics as a career may make the field less attractive to other females (Becker, 1995; Boaler, 1997; Morrow and Morrow, 1995; Thompson, 1995, cited in Hudson, et al, 2006). Numeracy learners often have had particularly poor experiences of education. The NRDC-led Persistence project found that learning environments that were reminiscent of school were viewed by these learners as hostile and demotivating. This supports research by Swain et al (2005), which emphasised that if individuals had suffered negative experiences in compulsory schooling, their first contact with college was crucial, as was their first contact with their teachers.

For some learners, falling behind is devastating (Swain, et al, 2007). When these learners find themselves struggling to keep up, they ‘switch off’ and are not able to perform. The early stages of a course are therefore crucial: teachers should ensure the learners are comfortable with learning and develop confidence in their skills and abilities.

Many numeracy learners needed to learn specific skills. The NRDC’s Persistence project found evidence that these learners were less likely to be motivated and to persist in programmes with a broad curriculum: numeracy content that was perceived as irrelevant was a barrier to persistence (Lopez et al, 2007). A survey of an opportunistic sample of learners conducted as part of the Persistence project found that a far higher proportion of numeracy than ESOL or literacy learners said that illness or health problems would stop them from coming to class, and that numeracy learners were less likely then ESOL and literacy learners to engage in learning outside the classroom.

Maths anxiety and fear of maths

In a study carried out for the 1982 Cockroft Inquiry into maths, Sewell (1981) reported that at least half of the adult population, including many with excellent mathematical qualifications, had negative feelings about maths. These included a lack of confidence, anxiety and fear.

Research from the US has found that the barriers faced by numeracy learners differed from those faced by literacy learners: numeracy learners mainly face psychological and academic barriers (Meader, 2000).

A theme that emerges from research on adults' 'maths life histories' is that of the *brick wall* – the point (usually in childhood) at which mathematics stopped making sense; for some people it was long division, for others fractions or algebra, while others never hit the brick wall. For those who did, the impact was often traumatic and long-lasting (Coben and Thumpston, 1996, cited in Coben, 2005a).

For many adults, mathematics often triggered negative feelings and their lack of confidence in their mathematical ability verges on mathphobia. Abstraction and lack of relevance in mathematics is a common cause cited by students for their dislike of and failure in mathematics As are the fear of failure induced by testing and the nature of mathematics pedagogy. Women may be more prone to develop negative attitudes to mathematics, both as a result of socialisation processes and pedagogical practices.

One particularly interesting finding of the Basic Skills Agency survey of 1997 (cited in Coben, 2003), which ranked the UK bottom of seven industrialised nations, was that respondents from the UK were over twice as likely to refuse to answer even a single maths problem on the survey. In the other six countries, rates of refusal ranged from 0% to 6%: in the UK, the refusal rate was 13%.

In a study of 147 adults with university degrees in subjects other than maths and science, Quilter and Harper (1988) found not only that many individuals felt that maths was of little interest to them, but that maths was a source of anxiety. Jones (1996) investigated the relationship between maths anxiety and course completion rates, finding that students who had the greatest anxiety about maths were more likely to drop out, regardless of their actual ability. Osborne et al (1997) observed that even highly qualified adults often suffered a lack of confidence in their mathematical ability. Ashcraft and Kirk (2001) found that anxiety may weaken the memory, making it more difficult to think logically and to work methodically.

The shame that many adults, including teachers, feel about their perceived lack of mathematical ability can exacerbate their difficulties and prevent them from seeking help. Bibby (2002), however, believes that reviewing the issue simply as one of maths anxiety is not helpful. She argues that rather than try to get rid of the emotion of anxiety, we should transform it into something positive. Similarly, in a study of primary school teachers, Hodgen (2003) found that there was scope for generating positive emotions about mathematics. Some commentators argue that for many people dislike and/or fear of mathematics is logical because the subject is often intimidating. Tobias (1978) argues that for many people, fear of maths is not the cause of their negative feelings about the subject but the result of those feelings – that is, they do not hate maths because they fear it, they fear maths because they hate it.

NRDC research has also uncovered findings about maths anxiety. The Persistence project found that adult learners on numeracy courses report more negative experiences in numeracy classes during compulsory schooling than literacy and ESOL learners (Lopez et al, 2007). This affects persistence, naturally, but it may also instil some phobias about success. Early negative experience may lead people to be resistant to learn again at a later stage. On a more positive note, NRDC's *Effective Practice: Numeracy* study reported that 27% of learners felt more confident in maths once they were actually on the course (Coben, et al, 2007). Thus, it might be getting over the barrier of enrolling in the first place, due to fear from compulsory schooling, that causes the greatest problem.

Given that adult numeracy learners have so often had negative experiences of school maths, it is no surprise that the learning environments that appear to work best for these learners are those which are markedly different from the normal school experience. Teachers and colleges need to ensure that the early stages of returning to education are smooth and welcoming as adult learners who problems similar to those they faced in school can have their motivation reduced and be closed off to learning (Swain and Swan, 2007). On a practical front, a positive learning environment is one in which the classes are smaller and where learners receive more individual attention as a consequence, but also is linked to having a relaxed atmosphere in which people feel secure and are not afraid to make mistakes. In this kind of environment, adults come under less pressure from teachers and peers, and are more able to be stimulated by the class work and to feel that they are making progress. Of course, a crucial difference between the learning environments of compulsory and post-compulsory education is that, for the most part, adult learners choose to attend (Swain et al, 2005; Coben, et al 2007).

Progress and achievement in numeracy as part of the Government's Skills for Life strategy

The Skills for Life strategy was introduced in March 2001. It was formulated in response to *A Fresh Start* (1999), the report of the working group chaired by Sir Claus Moser. The report concluded that up to seven million adults (one in five of the adult population) in England had difficulties with literacy and numeracy – a higher proportion than in any other European country apart from Poland and Ireland. The strategy initially set out to improve the literacy, language and numeracy skills of 2.25 million adult learners by 2010, with interim targets of 750,000 by 2004 and 1.5 million by 2007; these targets have since been met. Its aim is to 'make sure that England has one of the best adult literacy and numeracy rates in the world', and its long-term vision is 'ultimately to eliminate the problem' of poor levels of adult literacy and numeracy (National Audit Office, 2004, p.20). Skills for Life emphasises the needs of priority groups at risk of exclusion, including unemployed people and benefit claimants; prisoners and those supervised in the community; public sector employees; low-skilled people in employment, and younger adult learners aged 16 to 19.

The NRDC Learner Study in (Warner and Vorhaus, 2008) was designed in part to assess the impact of the new learning infrastructure on the experiences and achievements of adult learners, including those studying numeracy. One purpose of this study was to identify trends in participation and achievement in Adult Literacy, Language and Numeracy (ALLN) from 2000/01 to 2004/05 – the first five years of the Skills for Life strategy. It did this by analysing data from the Learning and Skills Council Individualised Learner Record (ILR), the most comprehensive available. The ILR records data on learning aims: that is, the goal, or goals, that individuals aim to achieve at the beginning of a learning programme. All figures in the following section are based on 'learning aims' rather than individual learners.[*]

Although the Moser Report (1999) identified numeracy skills amongst adults as a greater 'problem' than poor literacy skills, the numbers engaged in Skills for Life numeracy provision

[*] The purpose of the Learning and Skills Council (LSC) dataset is to monitor funding, not to record individual progress and achievement. Within the LSC dataset, one learner is not equal to one learning aim, because an individual learner may have more than one learning aim – for example, a learner who is taking both literacy and numeracy course will have two learning aims.

were lower than for literacy throughout the five-year period from 2000/01 to 2004/05. Nevertheless, total numbers for participation and achievement in numeracy rose considerably between 2000/1 and 2004/05. Over the five-year period enrolments showed an increase of 89%, from roughly 360,000 to 686,000.

Achievements nearly tripled in this period, rising from just under 120,000 to more than 345,000. The rate of achievement as a proportion of enrolments rose steadily from a third (33%) of all enrolments leading to achievement in 2000/01, to a 50% achievement rate in 2004/05.

Achievements were most common at Level 1, rising from roughly 46,000 in 2000/01 to more than 200,000 in 2004/05, a four-fold increase. At Level 2, achievements rose from 59,000 to 89,000, a rise of over 50%.

Because the LSC data does not disaggregate achievements and enrolments at the various entry levels, the achievement levels at Entry 3, Entry 2 and Entry 1 cannot be ascertained. However, even when combining all three Entry Levels, achievements were much lower than at Levels 1 and 2, rising from 14,400 in 2000/01 to nearly 55,000 in 2004/05. This would suggest that individuals with poor numeracy skills have been the least likely to take advantage of government-funded Skills for Life provision.

Looking at all levels combined, total achievements rose from roughly 129,000 in 2000/01 to 345,000 in 2004/05, a nearly three-fold rise in only five years. This increase is considerable, and represents a significant triumph for both policy and practice.

Given the gendered nature of numeracy performance in tests, coupled with the fact that women are more likely than men to enrol on literacy courses, we might expect female numeracy enrolments to be lower than those for males. Encouragingly, this is not the case. In each year analysed, women were better represented in numeracy courses than were men, both in terms of enrolments and achievements. Taking all five years together, women accounted for 54% of enrolment and 58% of achievements. There was some age-related variation in these figures, with males making up a slightly higher proportion of enrolments and achievements among 16- to 18-year-olds, while females represented a considerably higher proportion of those aged 19 and over.

Recent figures from the House of Commons Committee of Public Accounts (2008) show that numeracy enrolments have grown from 342,000 to 935,000 since the inception of Skills for Life in 2001, a 173% increase in numbers of people undertaking numeracy learning, compared to 140% growth in literacy. Numeracy is growing faster than literacy but from a lower base.

Fewer people, then, have participated in and achieved qualifications (or relevant learning aims) in numeracy than in literacy. Only 10 numeracy qualifications have been achieved for every 100 people with numeracy skills below Level 2, compared with 18 literacy qualifications for every 100 people with literacy skills below Level 2. There are 17 numeracy course participations per 100 compared to 30 literacy course participations (NAO, 2008).

Numeracy research undertaken as part of the NRDC's suite of Effective Practice projects found that once enrolled on a Skills for Life numeracy course, females make larger gains than males. Those from ages 30–49 make the smallest gains on average. Individuals who lacked formal qualifications in maths prior to enrolment also tended to make greater gains. Learners from non-white background tended to make greater progress (Coben, et al, 2007). Those who wanted to become more confident in their abilities improved by twice as much as those who did not claim this as a reason for enrolment. Those who said before the course that one of their motivations was to obtain a better job also improved by twice as much as those who did not have this motivation (Coben, et al, 2007).

Do numeracy learners improve their skills when on Skills for Life courses?
Numeracy learners on Skills for Life courses make significant progress. The NRDC Learner Study research project (Warner and Vorhaus, 2008) assessed learners before and after their Skills for Life numeracy courses, with skills assessed on a scale of 0–60. Before the course, the average score was 22.9; after the course, the average score had risen to 26.2, an increase of more than 5%. In terms of Skills for Life levels, this was the equivalent of learners moving on average from the upper end of Entry 3 to Level 1. Importantly, it was not just the mean score that increased – if this had happened, it could have been the result of some learners making a great deal of progress but most learners making little if any. Instead, the median score also increased: there were improvements across the board, with fewer low scores, more high ones, and a higher mid-point.

Further research (Cara and de Coulon, 2008) indicates that teacher qualifications explain at least some of this progress. Learners made more progress when their teachers were qualified to at least Level 3 in maths, i.e. A-level or equivalent. Experience matters as well: when teachers were more experienced, learners made more progress and had more positive attitudes about numeracy.

However, in other research, Swain, et al (2008) urge caution when assessing changes in skills levels, pointing to the heterogeneous nature of adult numeracy learners. The diversity of the body of adult numeracy learners makes it difficult to assess how well they learn and progress. For example, the 412 learners reviewed as part of the Effective Practice project included 40% aged between 16 and 19 years old; 40% White British learners and 24% Bangladeshi; 15% in full-time employment and 40% in full-time education. Just under 40% of those in the study already held at least one numeracy qualification. Just under one quarter of the learners (23%), claimed at least one factor that had negatively impacted their ability to learn, such as dyslexia (Coben, et al, 2007). Devising an assessment instrument to accurately measure for increases in skills of such a heterogeneous group is challenging. Age, ability, disposition, purpose for enrolling in classes and aspirations all vary. The capacity for teaching to be flexible may help to compensate for the vast differences in the learner profiles.

How do Skills for Life courses and teachers affect learners' attitudes to numeracy?
The NRDC Effective Practice study investigated changes in learner attitudes over the life of a Skills for Life numeracy course (Coben, 2007). In terms of age, learners who were aged 20 years and above had more pos and at her itive attitudes towards numeracy learning than learners aged16–19 years. This finding held for both times measured, at the beginning and end of the course.

At the beginning of the course, learners from non-white ethnic background were more positive towards learners, but by the course end, there were no significant differences. This indicates that white ethnic learners had more change in their attitudes across the course than did learners from minority ethnic groups (Coben, et al, 2007).

As a cautionary note, not too much weight should be given to the influence of attitude on attainment. The Effective Practice study showed non-significant correlations between the two and this was also the case between attitude scores and gains in assessment. International studies (as cited by Coben et al, 2007) highlight the typical negative correlation between attitude and attainments scores. This means learners may have higher attainment in more difficult courses, but leave the courses feeling less confident.

The complicated relationship between attitude and attainment is also highlighted in a study by Cara and de Coulon (2008). Learners had a more positive attitude towards numeracy when their teachers were well qualified in maths (i.e. had a degree or postgraduate degree in maths). Learners with more qualified teachers also appeared to enjoy numeracy more. However, even though learners taught by more highly qualified teachers showed greater progress and expressed greater enjoyment of numeracy, they appeared to be less self-confident about their ability once the course was over.

iii. Teaching and learning

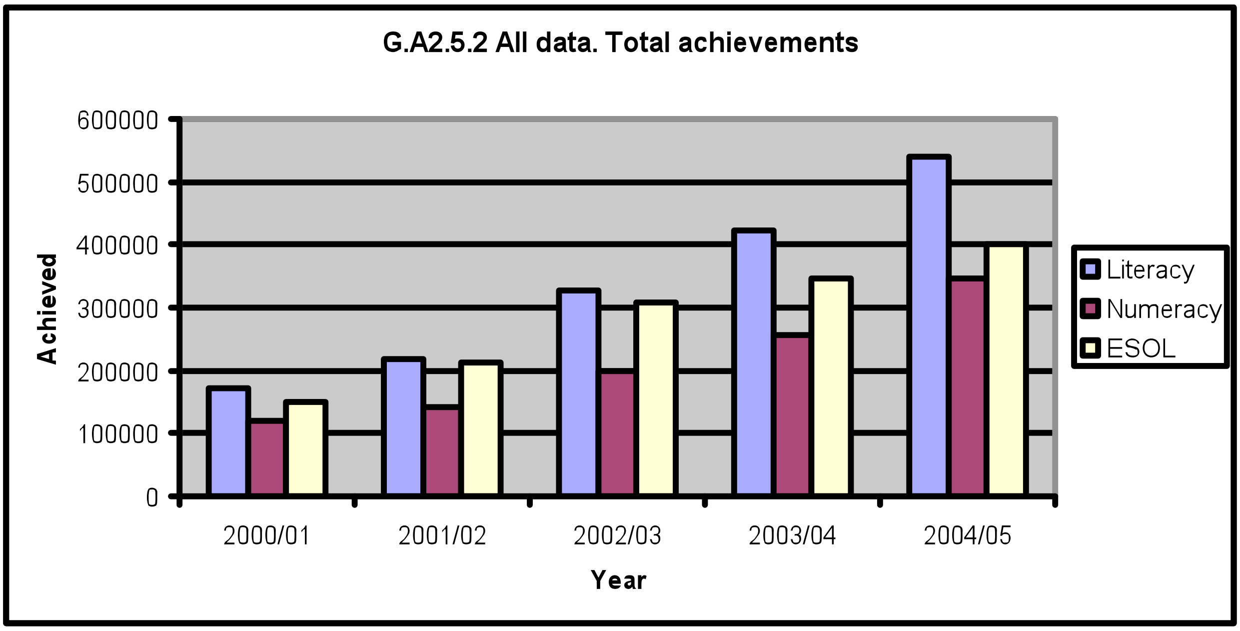
Numeracy provision

Numeracy courses are less expensive than ESOL or literacy courses. The average cost per numeracy course or qualification is £460, compared to £510 for literacy and £1030 for ESOL. However, there is less provision for numeracy than for literacy (NAO, 2008), even though studies such as the Skills for Life Survey of need (DfES, 2003) and those utilising the British Cohort Study 1970 – e.g. *Does Numeracy Matter More?* (Parsons and Bynner, 2005), *New Light on Literacy and Numeracy* (Bynner and Parsons, 2006) and *Illuminating Disadvantage* (Parsons and Bynner, 2007) – consistently show numeracy needs to be equal to, or greater than, literacy needs. There are fewer qualifications leading to functional numeracy level as compared with functional literacy (NAO, 2008). NRDC research (Coben, 2005b) also suggests that the provision of financial literacy education is patchy and piecemeal – despite the strong link between poor financial understanding, poor literacy and numeracy, poverty and social exclusion. Employers and trade unions generally do not provide or support financial education courses for employees.

As we have seen earlier, a high level of numeracy need does not necessarily translate into a high level of numeracy demand, though the government is attempting to stimulate the latter. Nor is there a particularly high level of numeracy supply, at least in comparison to the number of English as a Second Language (ESOL) and adult literacy courses available in Skills for Life. The number of adults taking government-funded numeracy courses consistently trails the numbers taking literacy and ESOL courses.

That being said, all available figures indicate that the number of numeracy qualifications achieved has grown significantly (Warner and Vorhaus, 2008), as indicated in figure 2.8.

Figure 2.8: Total number of achievements in LSC-funded Adult Literacy, Language and Numeracy provision in England, 2000/01 to 2004/05



Research by the National Audit Office (2008) suggested a number of possible reasons for the lower rate of demand for numeracy courses. In part it was suggested that there may be a lack of specialist numeracy representation in providers at middle and senior management level, with an impact on the nurturing of numeracy provision and capacity. Also impacting on capacity is the fact that there are fewer numeracy teachers than literacy teachers. Among potential learners, attitudes towards numeracy and maths ranged from apathy to phobia – it was common for respondents in this research to talk of people being 'scared' of numeracy, or seeing mathematics as a 'difficult' subject that only 'clever' people can understand. As this suggests, lower demand for numeracy courses is linked to feelings of inadequacy and low self-worth (NAO, 2008). Potential learners may also question the relevance of existing programmes and courses.

Numeracy teachers

The most in-depth look to date at the Skills for Life numeracy teaching workforce appears in a report entitled 'The Skills for Life Teaching Workforce in England 2006', published by Lifelong Learning UK (LLUK) (forthcoming 2009). This report is based on workforce data through the end of 2006, at which time there were just under 6,100 individuals teaching government-funded (Skills for Life) adult numeracy in England. For comparison, there were just over 8,000 individuals teaching literacy and nearly 9,800 teaching English As a Second or Other Language (ESOL).

Part-time work is common in adult education. The 6,095 individuals teaching numeracy filled the equivalent of 3,339 full-time equivalent (FTE) posts, which yielded an FTE ratio of teachers to full posts of 0.55. That is, numeracy teachers were, on average, employed to work slightly more than half time.

Looking at this figure in more detail, just over one-third (36%) of numeracy teachers were employed full-time, 24% were employed on a fractional basis and 39% were hourly-paid. This may have an impact on teaching quality, as part-time teachers may lack time to prepare teaching materials as they are caught up in paperwork (Swain and Swan, 2007). Forty per cent of numeracy teachers were employed by further education (FE) colleges, a much lower percentage than in literacy (49%) and ESOL (64%). In some learning environments, teachers have no access to technology and ICT is not used readily by all teachers (Swain and Swan, 2007).

In terms of the Skills for Life workforce as a whole, numeracy accounted for both the lowest number of teachers and the least amount of provision. Looking at headcount and FTE in each subject:

- numeracy accounted for 25% of teacher headcount and 28% of FTE
- literacy accounted for 34% of teacher headcount and 37% of FTE
- ESOL accounted for 41% of teacher headcount and 35% of FTE

Over half (55%) of the numeracy workforce had fewer than four years' experience teaching numeracy. Roughly a quarter (23%) had four to six years' experience, 9% had seven to 10 years', and 13% had 11 years' or more. These figures are similar to those for the literacy workforce.

The numeracy workforce had the most even gender split of the three Skills for Life subjects. Even so, teachers were overwhelmingly female: only about one in three numeracy teachers was male (35%). In the Skills for Life workforce as a whole, only 23% of teachers are male.

The numeracy workforce was overwhelmingly White (90%), making it less ethnically diverse than the literacy workforce (92% White) but markedly less so than the ESOL workforce (82% White). Seven percent of Skills for Life numeracy teachers were Asian or Asian British and 3% were Black or Black British. (For comparison's sake, the population of England in 2001 was 91% White, 4.6% Asian or Asian British, and 2.3% Black or Black British (Commission for Racial Equality, 2007).)

30% of numeracy teachers were under age 30, 33% were in their forties, 30% were in their fifties and 6% were aged 60 or over.

A key plank of the government's Skills for Life strategy is the professionalisation of the Skills for Life workforce. New mandatory qualifications have been introduced with the hope that by 2010 all Skills for Life teachers will be fully qualified, which means that they will have both a generic teaching qualification and a subject specialist qualification in adult literacy, numeracy or ESOL.

LLUK data indicate that the majority of numeracy teachers are not fully qualified. The majority may not even be numeracy specialists. As of December 2006, two-thirds of numeracy teachers were teaching at least one other subject, usually literacy. Of those teaching both literacy and numeracy, only 13% were fully qualified in numeracy.

Among the much smaller number who taught numeracy only, however, the situation was much better: well over half (57%) were fully qualified as numeracy teachers. In fact, this group was the most qualified subset of teachers within Skills for Life: those who taught numeracy only were almost twice as likely to be fully-qualified as ESOL-only teachers and nearly three times as likely as literacy-only teachers.

There are further encouraging signs for the quality of numeracy teaching. In comparison to literacy, for example, younger numeracy teachers are more likely to be fully qualified. Whereas numeracy teachers over the age of 50 tend to have fewer qualifications than their peers in literacy, 28% of numeracy teachers aged under age 30 are fully qualified, as are an impressive 49% of those aged 30–39. This compares very favourably to the 14% and 15% of the equivalent groups of literacy teachers

In order to meet its ambitious new numeracy targets, which will demand a significant growth in numeracy provision, the Department for Innovation, Universities and Skills (DIUS) plans to increase the number of numeracy teachers. However, there are serious questions over where these hundreds and possibly thousands of new, fully qualified numeracy teachers will come from, particularly given the fact that teachers in adult education are paid less than those in compulsory education. There is a very real chance that the shortage of suitably qualified numeracy teachers will become more rather than less acute (Hudson, 2006).

Meaningful maths

As part of the process of engaging with numeracy classes, learners have to be able to switch from informal numeracy practices outside the classroom to the rules and processes of the formal numeracy practices inside the classroom (Baker, 2005). The term 'street math' is used in the literature of adult mathematics research to refer to the knowledge that adult learners bring to the mathematics classroom of situations that require mathematics as well as the methods, sometimes rather ingenious, they have devised to solve problems involving mathematics. According to Safford (2000), one role of the maths teacher is to mediate between 'street math' and 'school math', to aid students in clarifying knowledge they already own, and to alter and enhance it with new knowledge acquired in the classroom.

Although teachers often need to set mathematics in real contexts, and use real examples to make it more understandable and interesting, mathematics is not necessarily made any more meaningful by making it more directly applicable to a specific adult's everyday life. In actual fact, many students want to engage with abstract mathematical concepts, not just basic numeracy (Swain et al, 2005).

Drawing from Piaget, constructivism in maths teaching advocates that students should explore mathematical situations and work out the general rules of mathematics from those experiences (Safford, 2000). This model of learning emphasises that teachers should build on what learners already know. But to discover what learners know, it is not enough to give them a formal test which assesses only cognitive learning. Teachers need to find out more about their knowledge, experiences, histories, identities and images of themselves; about their attitudes, dispositions, desires, values, beliefs, and social and cultural relations; about their relationships with learning, teachers and mathematics itself; and about their numeracy practices beyond the classroom. In other words, constructivism involves looking at the whole person who is learning. An approach that centres on an understanding of what learners bring to the classroom allows us to make the teaching and learning of numeracy less boring and more relevant and, at the same time, to contribute to social and economic inclusion (Baker, 2005).

Lave (1988) believes that once numeracy knowledge is learned it may be applied to any situation requiring calculation. Broadly, the idea of learning is transferred from one context to another. Since maths is, as a concept, applicable to many domains outside of the classroom, it lends itself to functions in the 'real world' (Bhattarai and Newman, 2006). Learners need to understand how to apply their knowledge to practical problems, and to problems in new areas. In a study of adult numeracy use in Brazilian workplaces, Nunes et al (1993) found that workers were able to solve problems outside of their normal working context, for example calculating uncustomary ratios or utilising building plans with unfamiliar scales. Fishermen were able to calculate ratios in non-marine contexts.

Furthermore, Baxter et al (2006) argue that the view of numeracy as a set of decontextualised skills and facts is damaging to students and teachers, and to society in general. An American expert on adult numeracy teaching recommends that maths teachers recognize mathematical 'moments' in their daily lives and start off the class with a problem structured on those experiences. A moment might be a sound bite from the news, something that happened in the supermarket, or a mathematical pattern teachers noticed (Safford, 2000).

Effective teaching practice

In many ways it is easier to quantify 'bad practice' in numeracy teaching than to define 'good practice'. According to Swain (2005) 'bad' practice involves the teacher using a series of procedures, with the students learning by rote without understanding. No connections would be made to other areas of maths (e.g. the relationship between decimals, fractions and percentages); the learners would not be expected to know why they were learning what they were learning; there would be little talk or discussion between learners; and they would be listening rather than 'doing'.

Askew et al., (1997, cited in Mellar et al, 2004) described three orientations adopted by primary school numeracy teachers. 'Connectionist' teachers focus on helping learners develop their conceptual understanding of mathematics. 'Transmission' teachers emphasise learners' acquisition of a set of standard methods or 'rules and truths' (Swain and Swan, 2007) for solving problems, with those methods ingrained through extensive practice. Askew et al found that transmission teachers were only somewhat effective, whereas connectionist teachers, with their emphasis on collaboration and the exploration of mathematical ideas, were highly effective. A third category of teachers, 'discovery' teachers, focus on learners' development of concepts and strategies through practical activities. As with transmission teachers, Askew et al found discovery teachers to be only moderately effective.

Malcolm Swan among others has subsequently investigated the impact of these different teaching styles in adult education, focusing particularly on the differences between transmission and connectionist teaching styles. As in primary schools, Swan finds that connectionist teachers appear to achieve the best results (see e.g. Swain and Swan, 2007).

However, recent NRDC research on effective teaching and learning (Coben et al., 2007) suggests that the dominant mode of teaching numeracy to adults remains one of transmission, in which teachers show learners procedures, break concepts down into smaller parts and demonstrate examples. Worksheets – for the whole class and for individual learners – are still the most common forms of organisation. There is little group or collaborative work, and use of practical resources or ICT is in its infancy (Swain and Swan, 2007).

An Ofsted report on maths for learners aged 14–19 (cited in Swain and Swan, 2007) concluded that the best teaching gave a strong sense of the coherence of mathematical ideas; it focused on understanding mathematical concepts and developed critical thinking and reasoning. Careful questioning identified misconceptions and helped to resolve them, and positive use was made of incorrect answers to develop understanding and to encourage students to contribute. Students were challenged to think for themselves, encouraged to discuss problems and to work collaboratively. Effective use was made of ICT.

Analysis of adult numeracy courses indicates that there are many things that teachers are doing well (Swain et al, 2007). These include:

- having sufficient subject area knowledge

- providing coherent explanations
- giving learners time to understanding the concepts on their own
- providing numerous learning opportunities
- understanding the learning process and giving feedback to learners
- giving learners the chance to express themselves.

Good teachers are flexible and can call on a variety of approaches and provide a variety of activities to give people the chance to excel in one area or understand one aspect of maths even if they have weaknesses in other areas, found Swain et al (2007). This resonates with American research which found that continuous goal-setting had a positive impact on numeracy learners (Meader, 2000).

Effective practice provides learners with the opportunity to make connections from one area of numeracy to another, and to bring their own methods for learning to the learning process (Swain, et al 2007). This 'connectionist' teaching entails an emphasis on listening to learners and observing what they do (Coben, 2005a).

Good practice depends on the expectations of the students, not the preferences of the teacher, and also involves teachers showing learners that mathematics is exciting (Swain, 2005). Learners also benefit where they are extended beyond the point where they feel comfortable (Swain, et al 2007). With this in mind, Swain, et al (2007) caution that teachers should be wary of being overprotective of their learners should avoid prejudging learners' abilities. Learners can have spiky profiles: good in some areas, weak in others. If a learner finds one concept particularly difficult, it does not mean the next concept will also be difficult. Even though maths learning is hierarchical in the sense the skills build upon previously learned skills, there are instances where this is not the case (e.g., multiplication and symmetry). Teachers need to develop knowledge about how learners understand maths and then provide teaching that further enhances skills (Swain, et al, 2007).

In this process, the relationship between the learner and the teacher is vital. Sensitivity to attitudes, beliefs and emotions in relation to numeracy and mathematics amongst learners (and tutors) is important (Coben, 2005a). Learners value teachers with good communication skills, who explain things in more than one way, respect the learners, are approachable, make numeracy interesting, give individual help when needed, understand the topics well and do not rush through work. Being allowed to develop critical thinking and reasoning, with the support of the teacher, is also essential (Swain, et al 2007). Teaching and learning approaches which are designed to encourage learner autonomy, rather than dependence on the tutor for the 'right answer', should be encouraged. These can include group work as well as one-to-one teaching; creative and investigative work and problem-solving; discussion; practical and collaborative activities on a variety of topics of interest to adults; mental and written methods of calculation; and data handling (Coben, 2005a).

Teaching need not be thought of in a static way. One teacher from NRDC's *Effective Practice: Numeracy* study thinks of herself as a 'facilitator' and someone who help learners to sort out misconceptions, rather than a lecturer or purveyor of knowledge (Coben et al, 2007). Getting learners to articulate their ideas can improve learning as well. Learning then is not rote but more interactive.

Not all teachers subscribe to such active teaching methods, however. Many teachers feel the need to follow a set plan of work, and it is atypical for them to include the learners' personal interests in the class environment. Factual recall-type questions are used with greater frequency than higher-level questions requiring maths reasoning. Teachers guide learners on a direct or relatively direct route from the problem to the deriving of a solution.

This type of learning may seem outwardly/superficially efficient, but it is not the most effective for the learner (Swain and Swan, 2007). Formative assessment and learner development of how to organise maths thinking is much more useful.

There is still much work to be done in facilitating effective practice in numeracy teaching, and much that can be achieved through Continuing Professional Development (CPD). CPD also allows numeracy tutors to meet to develop and share ideas and exchange teaching and learning materials. This sort of interchange is highly valuable, but is often out of the reach of numeracy teachers, particularly those in rural areas. More opportunities need to be created that would allow numeracy teachers to compare and encourage effective practice. Opportunities should also be made for critical debate and discussion about ideas of good practice and ways forward (Coben, 2005a).

Results from Maths4Life

Maths4Life was established at NRDC by the Department for Education and Skills in 2004, with the aim of contributing to the development of high-quality, attractive numeracy and mathematics provision in the post-16 sector. After being led by NRDC during its first stage of existence (ie between 2004 and 2007), Maths4Life is now run by the National Centre for Excellence in the Teaching of Mathematics (NCETM).

The focus of the final year (2007) of the first stage of Maths4Life was *Thinking Through Mathematics (TTM)*. This major research and development project attempted to transform educational practices in numeracy/mathematics classrooms within the Skills for Life sector by helping teachers to develop more ‘connected’ and ‘challenging’ teaching methods. These in turn enable learners to develop more active orientations towards their learning. As part of the project, NRDC developed a series of teaching and learning materials based on principles derived from many years of research by Malcolm Swan. Those principles state that numeracy teaching is more effective when it:

- builds on the knowledge learners already have
- exposes and discusses common misconceptions
- uses higher-order questions
- uses cooperative small group work
- encourages reasoning rather than ‘answer getting’
- uses rich, collaborative tasks
- creates connections between topics
- uses technology.

This research studied the feasibility and potential impact of these teaching and learning approaches. Throughout the process, research and design were intertwined – teaching approaches and resources were iteratively modified and developed in the light of arising issues and emerging findings, and the revised versions were used to generate new research findings.

Whereas teachers generally rated their practice before the project began as being learner-centred, their own learners tended to see them as being more teacher-centred. Over the course of the project, the teachers’ practice changed, particularly in terms of their organisation (more group work), classroom ethos (learners were more relaxed and felt less worried about making mistakes), and learners’ practices (learners were given more choices and encouraged to ask questions).

However, the project also found that teachers’ actions did not always follow their beliefs. For example, whereas teachers said that ‘exposing and discussing misconceptions’ was an important principle, researchers did not observe this being used effectively in the classroom, nor on a consistent basis. Almost all of the teachers reported that there had been pressures and constraints that prevented them from using the approaches in the best possible ways, particularly the pressure from senior management to prepare learners for accredited tests, and to map learning outcomes to particular content areas.

Teachers' general pedagogical knowledge varied considerably, and successful use of some teaching and learning activities was directly related to teachers' knowledge of subject-specific pedagogy. This included anticipating learners' questions, and adopting a more flexible approach by being able to respond to learners' needs. Some teachers had significant gaps in their deeper understanding of basic mathematical concepts.

Although many learners had suffered a negative experience of learning mathematics at school, their attitudes towards learning mathematics were generally very positive.

Most learners noticed a major change in their teachers' practices, and by the end of the project the vast majority seemed very supportive towards the project and embraced the approaches. Many learners particularly enjoyed group work, and felt less threatened and more relaxed when they worked towards making a group decision.

What the learners say

The following section offers a selection of comments and observations made by Skills for Life numeracy learners. These thoughts arose during qualitative interviews conducted by NRDC investigators doing research for the report *'Beyond the daily application': making numeracy teaching meaningful to adult learners* (Swain et al, 2005), and cover a range of issues, including self identity, motivations and experiences of school mathematics.

'I had a bad experience in school years ago with a maths teacher. He made me stand up in the middle of the class and do something on the board that I didn't understand. It petrified the life out of me and made me feel really stupid and have been petrified of maths ever since.' *– p. 67*

'When I was at school it was written on the blackboard and if you hadn't had it then, tough. The teacher just went on with something else. Here you've actually get teachers who will sit down and explain it to you. It just makes learning so much more enjoyable.' *– p. 67*

'Maths was one of those classes I messed about, because if I didn't understand something I was embarrassed to ask the teacher to explain. So I just coasted after a while... opted out.' *– p. 67*

'I fell behind in school in maths and that was it.' *– p. 67*

'If you haven't understood the first bit, you're not going to get the third or the fourth; it's not like East Enders where you can pick it up half way through, is it?' *– p. 68*

‘I enjoy it now. It's a completely different set up to when I was at school. When I was at school I had to do it. Here I don't have to do it. It's my choice to do it. And that's the difference.’ *– p. 67*

‘I want him to see that his mum can do it, so whatever happens he can do it.’ *– p.76*

‘I was very worried that once [my daughter] got to secondary school there was no way I was going to be able to help her. And that made me feel inadequate.’ *– p. 47*

‘[My daughter] has watched me struggle with it… and go from having 92 understanding. And she has watched me fall in love with it, get excited, punched the air over it, read books about it. I think it is a virus (a happy one), and she caught it. She seems to realise that it's okay to get things wrong, try again, be brave with it and enjoy it.’ *– p. 47*

‘I tell you the most embarrassing thing is when I had to send my children to the shop, or they came with me, and I used to say to them [….] how much have I got to give them? I had to ask them and that's embarrassing for a mother, let alone an adult, asking 7- to 8-year-old how much money do I give them, how much change do I get back? I'm not so bad now, I can near enough to do it but it was very embarrassing.’ *– p. 49*

‘Why I want to study maths is to find out if I can... in a way to show myself like I can do maths and be sure of sums and things like that […] I'm trying to prove in my own mind something I never have a chance in my life to do. And I want to try my best and try and make my mind think.’ *– p.72*

‘You do get fed up with your life to a certain extent. But I think it's usually a catalyst that makes you stop and think of your life change […] I think you have to reach a point where enough's enough – I'm going to do something. ‘ *– p.75*

‘I'd convinced myself that I'd got to do something. It was a matter of like, things happening, I'd have to go into detail and you'd think I'm weird in the head, but... the first day I was at the college I stood there. And I thought – you are doing this girl. You are going to go through that door. And part of you is like – no... And how many years...? […] I started to count... over 20 odd years. And after all the years of never being in education and that apart from being in school, and you stand there and take – am I kidding myself? […] So you've got that first step which is pushing yourself through their door. And you are going in a room with total strangers and you don't know if you are going to make a complete idiot of yourself.’ *– Swain, 2008, p.11–12*

‘I want to see how far my brain will go.’ *– p.76*

‘I think you find more in yourself and you realise you are not this waste of space, or useless, or whatever, that there is something there, you don't put yourself down as much. But there is still that little frightened but inside you thinking – are you pushing yourself too much?’ *– p.76*

‘I think it's a case of confidence. Proving to yourself that you are worth something.’ *– p.76*

‘If you've overcome that fear you can do more which you never thought you could do.’ *– p.74*

‘What I'm doing is to improve me, to find me.’ *– p.78*

‘I'm not really sure that I can use maths but I just want to learn it for me, it's just something that want to achieve for myself.’ *– p. 45*

‘I want to fill in the bits I haven't been taught. To be complete [....] what I should have learned then, I am learning it now.’ *– p.45*

‘Because maths has had the label of being hard and complicated, if a person feels like – oh I'm stupid – or anything like that, and you sit them down and get them to do... [a] problem and they realise – Oh wow, I can do it. It will make a person feel really good about themselves. ‘ *– p. 46*

‘I know basic maths but I want to be able to do some of the things I've seen with mathematics [....] because then you are pushing your brain around.’
– p. 47–48

Part 3: Numeracy and ICT

This section looks at what is known about the relationship between adult numeracy skills and access to and use of ICT and digital technologies. The first area to be addressed is the 'digital divide', which in this context refers to the increased likelihood that individuals with poor numeracy skills will lack access to or competency with computers. Next, this section will summarise the limited amount of research evidence looking at the impact of the use of ICT in adult numeracy education, while briefly looking at the reasons why there is so little research in this area.

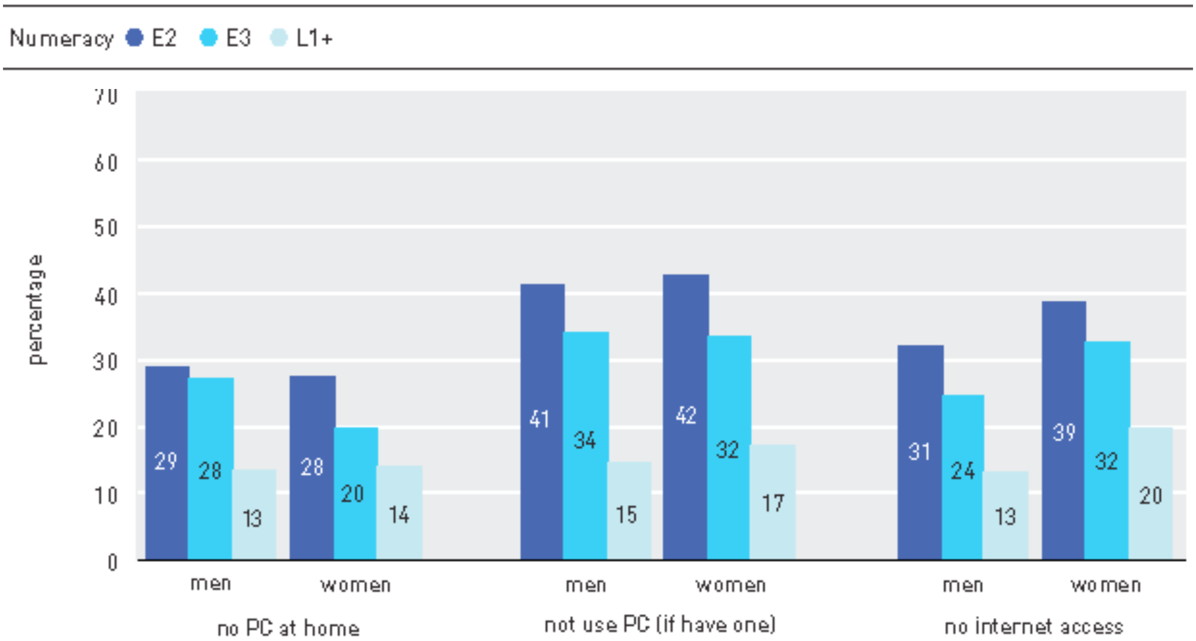
i. The digital divide

In 2003, the Skills for Life survey (DfES) assessed working age adults' ability to carry out a range of practical computer tasks, and then compared the results of this assessment with their numeracy levels. There were strong correlations between the two: among individuals with entry level numeracy, 75% had scored at entry level on the test of practical computer skills. Among individuals with Level 1 numeracy skills, 55% had Level 1 or above computer skills, as did 76% of those with Level 2 numeracy.

Our best picture of the relationship in England between numeracy skills on the one hand and ICT access and use on the other comes from the British Cohort Study 1970. In a report for NRDC, Parsons and Bynner (2007) found a worrying digital divide between adults who had good basic skills and those whose basic skills were poor, with the former much more likely to have access to and use computers and the Internet. This divide is worrying, as computer use and Internet access are becoming ever more central to modern living and employment.

Comparing respondents' numeracy skills with their access to and use of computers and the Internet, Bynner and Parsons found that the poorer an individuals' numeracy skills, the less likely he or she was to have and/or use a computer or the Internet, as Figure 3.1 illustrates. This relationship was consistent across genders. Figure 3.1 also shows the clear gradient in which each successive level of poorer numeracy skills is associated with less use and access to computers and the Internet.

Figure 3.1: Evidence of the digital divide by BCS70 cohort members' numeracy skills at age 34



Women at all levels of numeracy skills were somewhat more likely than men to use computers at work, indicative of the different types of jobs available to males and females with low to medium skills. More than half (56%) of women with poor numeracy skills (Entry 2 or below) used a computer at work, as did 68% of those at Entry 3, 84% of those at Level 1 and 88% of those at Level 2 and above. This suggests that for women, basic ICT skills are becoming an ever more essential prerequisite to employment, even in jobs that did not traditionally require numeracy and literacy skills.

Hoyles et al (2002) notes the dependent relationship between mathematical literacy and IT use in workplace settings. This is not always appreciated. To the degree that employers are aware of numeracy needs in the workplace and their relationship to ICT usage, it may well be useful for those employers to be involved to some extent in adult ICT and numeracy training. This, feels Hoyles et al, could help make learning as relevant as possible. However, Hoyles et al's report was written six years ago and it is important to reassess this issue to determine whether employers now realise the connection between numeracy and ICT.

ii. The use of ICT in adult numeracy education

A number of policy documents published over the past several years emphasise the importance of including ICT in numeracy learning (e.g., the Moser Report (DfEE, 1999), Smith Report (Smith, 2004), Tomlinson Report (DfES, 2004), 14–19 Education and Skills White Paper (DfES, et al, 2005), and the Skills White Paper (DfES et al, 2005). In part, this emphasis is due to beliefs about the importance of ICT skills per se; it is also due to beliefs about the capacity of ICT to improve teaching and learning in numeracy. For example, the Moser Report (DfES, 1999, cited in Mellar et al, 2007) argued that 'at the heart of improved quality in delivery and materials must be increased use of Information and Communication Technologies (ICT) to improve basic skills'. That report went on to state that:

- ICT is a powerful tool to raise levels of literacy and numeracy
- Computers and multimedia software provide attractive ways of learning

- The web enables access to the best materials and the most exciting learning opportunities
- ICT offers a new start for adults returning to learning
- The internet and digital TV technology can reach into the home
- Learners who use ICT for basic skills double the value of their study time, acquiring two sets of skills at the same time.

Despite the strength of some of these claims, there has been very little robust research on the value of ICT in adult numeracy education, in part because of the limited use of ICT in adult education environments (Mellar, et al, 2004, 2005). However, the lack of research in this area may also be attributable to the prevalence of findings from the compulsory education sector (where it is much easier to set up control groups and conduct rigorous research) that while the use of ICT may have some positive impact on learning, this impact is limited and tends to be less than that of many other typical interventions. The research evidence also suggests that the size of the positive effect from using computers decreases with age, being greatest in primary school, weaker in secondary school, and weaker still in college and university (Hattie, 1999).

Uses of ICT in adult education

Ginsburg (1998, cited in Mellar et al, 2004) observed four approaches utilised by teachers who were incorporating ICT into adult basic skills education: technology as curriculum, technology as delivery mechanism, technology as complement to instruction, and technology as instructional tool.

In the 'technology as curriculum' approach, the curriculum is focused on specific technology applications, such as computer skills. When technology is used as a delivery mechanism, lessons are programmed and learners or assigned to or able to choose the level/lesson that is appropriate for them. In this approach, learners do not have to work on techniques they have already mastered and are not given tasks for which they have not displayed the prerequisite knowledge or skills. When technology is used as a complement to instruction, traditional teaching is supplemented with opportunities for learners to use computers to practise skills taught in class. Finally, when technology is used as an instructional tool, ICT is 'seamlessly integrated into the instructional activities of the class' (Ginsburg (1998, p. 41, cited in Mellar et al, 2004). However, even with this approach the development of ICT skills is a secondary outcome; the purpose of the use of ICT is to improve literacy, language or numeracy.

In an analysis of adult numeracy classes in England, Mellar et al (2004) found that ICT was most likely to be used as a complement to instruction. When Coben et al (2005) undertook an action research and staff development project regarding ICT use in Scottish adult numeracy classrooms, they found that most teachers were using ICT as a delivery mechanism and as a complement to instruction, but that there was evidence of increasing use of technology as an instructional tool. Coben et al found a great deal of interest among tutors in using ICT and in developing resources and approaches, but also noted significant anxiety about time and other resources.

The aim of Coben et al's action research and development project was to 'explore, extend and improve' the use of ICT in adult numeracy teaching in Scotland (Coben et al, 2007, p. 5). It did so by involving numeracy tutors from a wide range of settings in 16 projects. One year in, tutors identified three key factors which they felt supported the use of ICT in adult numeracy. These were (Coben et al, 2007):

- Time for tutors to develop their skills and knowledge in order to use ICT well. At the start of the project, many tutors lacked either the skills to use ICT or the time to find software that was appropriate for their classes, or both. Lack of time can be a particular problem with hourly-paid teachers in adult numeracy. As these teachers make up a significant proportion of the workforce, this may present a systemic barrier to the effective use of ICT in adult numeracy classrooms.
- Systematic training for tutors in ICT skills. Most tutors said that they did not have sufficient opportunity to engage in training and continuing professional development in order to develop the skills they need to effectively use ICT in numeracy teaching.
- Access to a range of ICT resources, and the opportunity to test the usefulness of these resources. Tutors did not want to use ICT just to be using ICT; they wanted to be able to seek out and find the resources they felt would be right for their learners.

The impact of ICT on adult numeracy education

Early research carried out by the University of London's Institute of Education (Mellar et al, 2001) provided a general picture of the use of ICT in adult literacy, language and numeracy (ALLN) classrooms. Despite noting some positive practices, this research suggested that the impact of ICT on ALLN was limited. A later study (Mellar et al, 2004) was then carried out with the aim of finding more effective ways of using ICT to improve learning for adults with poor literacy, language or numeracy. Based on detailed observational research in classrooms, this research sought to identify the key factors associated with the effective use of ICT in the teaching of ALLN.

Among the courses observed was a numeracy course for learners at Level 1. In this course, computers were used as a way to practise numeracy skills, but improved ICT skills was not one of the aims of instruction: the learning objectives consisted solely of numeracy aims.

The course teacher highlighted two advantages of using computers in teaching numeracy: the ability to display number concepts visually (which she found particularly useful when teaching fractions) and the increased potential for learners to work at their own pace, practising and reinforcing skills they particularly needed to develop (Mellar et al, 2004). Central to this was computer feedback on learner performance in various tasks. The software used for this purpose gave learners immediate feedback on their performance, allowing learners to see what they had got wrong and to repeat exercises if they wished. Learners generally saw this feedback as useful, particularly when practising work that they had a good understanding of. It enabled them to concentrate on weaknesses and work at their own pace. However, computer feedback was seen as much less useful when learners were working on tasks they did not understand well. In the latter situation, learners will likely to need more (and more complex) feedback than a computer could provide.

On the whole, however, learners in this study seemed to enjoy working with ICT as a way of learning numeracy. One learner attributed this to the ability to see visual representations of numerical concepts. Another, who tended to be withdrawn in whole-class teaching, worked with concentration when on the computer.

In this study, Mellar et al suggested a range proposed practices for effectively incorporating ICT into adult numeracy and literacy courses. These included:

- Clear lesson aims discussed at the start of each session, coupled with a review of what has been learned at the end of the session
- Multiple ways of providing information
- Peer learning
- Flexible classroom management.

The study also identified a number of areas where development was needed. These included:

- The need for tutors to reflect on why they were using ICT and to match the use of ICT to their teaching aims
- Use of a wider range of ICT technologies
- Greater experimentation with teaching styles and forms of classroom management should be encouraged
- Development of appropriate ways for learners to work effectively together using ICT.

Computer games, calculators and other digital devices

The vast majority of the research on mobile learning technologies has been carried out on schoolchildren and university students (see e.g. Attewell and Savill-Smith, 2004a) However, there has been a small amount of research on adult numeracy learners and mobile technologies. In 2001/02, Ufi commissioned two educational computer games designed for Skills for Life learners (Kambouri et al, 2003). One of these, Max Trax, was a sports simulation game which focused on numeracy skills. Learners of all ages and abilities (and both genders) perceived the game as enjoyable, and most learners were able to quickly put together numeracy and driving for optimal game-playing. However, individuals aged over 30 who had limited or no experience playing computer games suffered a steeper learning curve. Tutors felt the game could help to attract new learners, keep them motivated and encourage collaboration. Some tutors said they would like to use this and another Ufi-developed (literacy) game as informal diagnostic tools. Evidence from this research suggests that both games offered non-threatening, pleasurable means of re-engaging learners with literacy and/or numeracy needs.

In a multinational research project looking at the potential of mobile phones as learning devices for young adults (aged 16–24), Attewell and Savill-Smith (2004b) found that almost half of UK survey respondents (44%) expressed an interest in using phone-based games to improve their maths skills. However, many of these young adults stressed that educational games must be fun or even quasi-addictive in order to sustain interest. In the second phase of this same research project, Attewell (2004) reported findings from a total of 128 learners in the UK, Italy and Sweden. These individuals covered a broad range of demographics, and at least 80% were unemployed. After experimenting with mobile learning, 62% said that they felt more enthusiastic about taking part in future learning. Of this group, 91% expressed a preference for learning with laptops, 80% with mobile devices and 54% at college. 78% of all respondents felt that mobile learning games could help them improve their maths.

There is also evidence that digital technologies can add to learning opportunities in the classroom. For example, on one course investigated by Coben, et al (2007), learners were instructed to take pictures of maths in the real world. Car parking charge signs, angles of buildings and other shapes were posted on a classroom board. These photographs were then used to instigate discussion in the classroom.

Calculators might also contribute to numeracy learning. However, despite their widespread availability (e.g. on mobile phones), calculators are not readily used in numeracy classroom teaching. Hembree and Dessart (1992) claim that if used appropriately and in an imaginative way, they could be an integrated part of teaching and learning, as they allow for self-directed and self-paced learning. The key is for calculators to be used to help learners understand mathematical operations, rather than to do the operations for them. To the extent that calculators are present in numeracy classrooms, Newmarch et al (2007) found that their use was restricted to students checking answers. Calculator-based work was otherwise almost non-existent. Likewise, in the NRDC's *Effective Practice: Numeracy* project, calculators were readily available but rarely used (Coben, et al, 2007).

Mellar, Kambouri and colleagues have carried out a number of evaluation studies looking at the use of ICT (including interactive digital TV, CD-ROMs, web-based and hybrid technologies) in the teaching of adult literacy and numeracy. This research has found some positive signs, but, writing in 2007, Mellar et al suggested that if the expectations of the impact of ICT on learning for adult basic skills learners were to be met, there was still a long way to go.

One ICT-based course that did appear promising was CyberLab, an experimental course delivered over eight months during 2003–4 at an adult basic education provider in Wales (Harris, 2005). Participants had numeracy skills ranging from poor (Entry 2) to good (Level 1), and worked to improve their skills in numeracy, literacy and ICT through participation in activities that enabled them to 'do science' via ICT-supported experimental investigations. Over the course of the programme, NRDC researchers found that in addition to improving their understanding of and facility with ICT, participants learned new mathematical concepts and developed new numeracy skills. Despite the low-to-medium level of participants' numeracy skills, challenging numeracy concepts were incorporated into the programme, including fractals, the Fibonacci sequence and the Golden Ratio. These were taught through activities involving cameras, the Internet, computer programming, numerical calculations and data tabulation.

Evaluations of CyberLab suggested that learners became able to use new numerical concepts and skills in meaningful ways, and that the use of digital technologies had contributed to that learning. Persistence was high: though only a small number of learners (nine) were enrolled on the course, all completed it. Researchers saw evidence of autonomous learning, as learners worked together through breaks and outside of class hours. Learners themselves reported developing transferable skills in planning, problem-solving and self evaluation. However, it was also suggested that insufficient allowance had been made for learners' varying levels of ability. Despite this, all participants successfully gained a level 1 qualification.

Motivation and progress

It is often argued that ICT will increase motivation; however, few research studies have investigated this issue among adults. In one study that did, Gorard (2003) argued that access to ICT did not make adult learners in Wales any more likely to engage or re-engage with learning. Coben et al (2007b, p.35) observe that the key to any increased motivation that does exist may lie not with ICT but with the interaction that it can encourage: 'Many kinds of interactivity will help to [hold learners' interest], not only those involving the use of ICT.'

In a study by Mellar et al (2001) of literacy and numeracy classes that incorporated ICT, 92% of learners said that they found the use of ICT motivating. Learners who found ICT motivating tended to be young men, whereas the majority of those who did not consider ICT to be motivating were women. In interviews, 64% of learners said that ICT helped them to learn; many also said that it helped them to concentrate. Many learners felt that they had improved ICT skills, though this had not been one of their initial goals. A further 26% indicated that their employment aspirations had changed, and that they now wanted to use ICT more at work.

Torgerson et al (2004) conducted a review of research investigating whether or not ICT enables adult learners to make better progress. In this review, the authors looked at research both on adult numeracy and literacy, and reported findings for the subjects together, rather than individually. That is, they reported on the impacts of ICT on ‘adult literacy and/or numeracy’ rather than on numeracy and literacy separately. This makes it difficult to assess the impact of ICT on numeracy alone. However, the drawbacks of this method becomes less important when one looks at the report’s conclusion, which is that there is no strong evidence that ICT improves progress in adult literacy and/or numeracy. Specifically, the three Random Controlled Trials (RCTs) that Torgerson et al reviewed produced results which were not statistically significant. This means that even if a positive effect was found, it was small enough that it was likely caused by chance rather than through the impact of the ICT intervention. Of the 16 controlled trials the researchers reviewed, three had no clear result, seven had results which were not statistically significant, four showed ICT to have a positive effect, but two showed it to have a negative effect in comparison to traditional teaching. Taken altogether, these review show no effect, either positive or negative, of ICT on progress in literacy and/or numeracy.

Maths4Life ICT Pathfinder

Maths4Life was a three-year (2004–2007) project which worked to stimulate a positive approach to the teaching and learning of mathematics in the Skills for Life sector. Maths4Life featured several pathfinder projects, one of which investigated the role of new ICT technologies in engaging learners to improve their numeracy (Hudson et al, 2006). The issues addressed on this pathfinder were:

- Can ICT be used to engage learners and motivate them to improve their numeracy?
- Is tutor lack of confidence and competence with ICT a barrier?

The project used mobile technologies (phones and similar hand-held devices which were capable of multi-media messaging) to explore learners’ motivations. They were used to complete ‘closed’ numeracy activities (e.g. calculating stopping distances) and in more open contexts, for example, taking photographs and sending them to an internet mediaBoard.

The reported benefits of these devices were that they could be used privately, on the move and in more formal settings.

In the context of the devices on trial, the project concluded:

- In terms of finding the factors which motivate learners, the communication potential of the devices was central to their success. However, it was important to understand that the devices themselves did not perform this function, rather they opened up a wider range of possibilities.
- Practitioner lack of confidence was not a barrier – mainly because it was overcome by training and a period of familiarisation. It is unclear whether this problem would remain if more complex technologies were involved.

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