The Role of Informal Learning in Adult Numeracy

Gill Hind
BBC Education, White City, London W12 7TS
(work carried out at Dept. of Maths., University of Essex, Colchester, Essex CO4 3SQ)

I want to start by trying to explain what I mean by 'informal' learning, and before I can do that I need to talk about context. The term context can be used in two distinct ways: mathematical problems set in the context of people's lives and the methods employed for solution, and the context in which the learning of mathematical skills/knowledge takes place. This gives me then three areas for discussion: **settings** in which mathematical skills are acquired, the **methods** which are used to solve problems, the nature of the **problems** themselves, in which I can consider informal versus formal. Eventually, with particular reference to my own research, I hope to be able to consider the significance of the informal in learning.

Let us start by looking at the places. Informal settings include the home and workplace while formal settings include the classroom. Are there any differences between them and the type of learning which can take place there? Informal settings are natural, whereas formal settings are specially set aside areas often designed for the purpose. In informal settings there is a fusion between the intellectual and the emotional, the relationship with the teacher, the teacher's personality are key elements in the process. In formal settings the separation of the intellectual from the emotional is encouraged and the latter often denigrated. Because an informal setting is culturally based the learning itself supports traditional beliefs and values: meanwhile formal settings are externally provided and there may be scant regard for the learner's background and little cultural resonance. An informal setting allows for a variety of teaching/learning strategies such as imitation, identification, co-operation and observation. In a formal setting the artificiality of the arrangement of teacher and many pupils means that language must be heavily relied upon.

I want to move on to look at formal and informal methods. My washing machine broke down recently and I called in someone to mend it. The bill I was presented with is shown as fig. 1. I include this not because it seemed a large amount (I might do better to buy a new machine!) but because this is a very good example of someone calculating 17.5% VAT by an informal method. The calculation has been made, not by the school textbook method of

$$\frac{17.5}{100} \times \text{amount} = \text{VAT}$$

but by finding 10%, then 5%, then 2½% and then adding. My workman was busy solving a problem which was generated by his everyday activity. All to often we think that we can reflect the real world in the problems we set our students simply by clothing the same old classroom examples in the language of everyday.

The following problem comes from the National Assessment of Educational Progress which has been used with more than 90 000 Americans.

> A parking lot charges 35 cents for the first hour and 25 cents for each additional hour or fraction of an hour. For a car parked from 10.45 in the morning until 3.05 in the afternoon, how much money should be charged?

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INVOICE TO: Name Hilton

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DESCRIPTION	AMOUNT
Cooker Thermostat	97 98
9.70	
4.85	
2.43	

No claim can be considered without production of this invoice.

AUTHORISED SERVICE CENTRE

RETRA

SUB-TOTAL	97 98.
VAT @17½%	16 98
INVOICE TOTAL	113-98

fig. 1 Repair bill showing VAT calculation in left-margin

This question was answered correctly by only 47% of the 17 year olds tested (proving that the USA has a numeracy problem). A simple analysis of what happens in the formal test situation as opposed to real informal parking lot arithmetic challenges the validity of what is supposed to be assessed. This is based on Maier (1991).

TEST	PARKING-LOT ARITHMETIC
(1) use pencil and paper to do arithmetic	(1) mental arithmetic used
(2) complete data provided in the question	(2) gather data from a variety of sources; watch, parking-lot board, ticket, parking attendant
(3) data provided is exact	(3) round figures up/down to ease calculation
(4) use standard, approved algorithms (to gain the method marks)	(4) use non-standard arithmetic to ease mental calculation
(5) arrive at an exact, correct answer	(5) arrive at an estimation of the likely cost
(6) work in isolation	(6) ask for a second opinion if necessary
(7) work to given time constraints	(7) stop figuring it out at some point when reasonable answer reached
(8) previous experience not related to this problem	(8) use previous experience of parking lots to test for reasonableness in (7) above
(9) no further use for the answer calculated	(9) use answer to check have enough money to pay

I am sure people could add to this list without any difficulty, as well as point out that parking lots do not operate like this (even in the USA). It highlights the fact that methods of calculation are different in different situations as is the nature of the task. Note that for the supposed real-life problem no previous everyday experience was relevant, it did not matter how much you knew about cars or parking all you had to do was remember the correct algorithms. In real life adults constantly bring in extraneous information from a wide variety of sources (e.g. school, television, newspapers, work) to help with the mathematics. As Thorstadt (1992) showed, it is this inclusion of a whole variety of experience that may lead to unexpected answers to seemingly straightforward numerical problems.

It might be useful to give the following analysis of informal and school mathematics, from Harris and Evans (1991), as a summary of the discussion above:

INFORMAL MATHEMATICS	SCHOOL MATHEMATICS
embedded in task	decontextualised
motivation is functional	motivation is intrinsic
objects of activity are concrete	objects of activity are abstract
processes are not explicit	processes are named and are the object of study
data is ill-defined and noisy	data is well-defined and presented tidily
tasks are particularistic	tasks are aimed at generalisations
accuracy is defined by situation	accuracy is assumed or given
numbers are messy	numbers arranged to work out well
work is collaborative, social	work is individualistic

correctness is negotiable	answers are right or wrong
language is imprecise and responsive to setting	language is precise and carefully differentiated

When I started my research project at Essex University I was charged with finding out about 'innumeracy'. I found there was no concensus on what was meant by innumeracy, but everyone thought that there was a lot of it about. In an attempt to get to grips with the concept I revisited the research that had concentrated on finding out what were the numerical skills needed or used by the adult population. In particular I read Cockcroft (1982), Sewell (1981) and Harris (1991). I thought that if I knew what 'numerate' was then the opposite must be 'innumerate'. Confidence is often a key factor in an adult's ability to use a skill, so research which aimed to find out how people feel about numeracy was also interesting. I read Bovill (1990). I began to be fascinated by this and when the opportunity arose to sample a group of people who used arithmetical skills in their workplace I decided to conduct my own mini-survey.

The methodology employed was a structured interview with 20 employees using questions from a prepared sheet. I essentially asked each interviewee about a particular numerical skill (e.g. adding decimals) whether they used it in their work, in everyday life, how confident they felt about using it, what methods they employed for dealing with the computation both at work and at home. The list of skills used was essentially obtained from Cockcroft and Harris. I have not the space to go into all my results, but I will deal with those that surprised me.

My respondents talked about 'figure work' rather than numeracy or mathematics. 'I like doing figure work' was frequently mentioned. I wondered whether this meant that they were denigrating their own skills. Do they think that what they are doing is at a lower level than mathematics or numeracy?

The survey found that the numerical skills identified as being useful for work (fig. 2) followed very much those found by Harris (fig. 3). The real surprise was the number and range of skills people identified as being used in everyday life (fig. 4). What was revealed was a very rich mixture of mathematics which was brought into such diverse everyday activities as designing counted cross stitch embroidery or sailing a boat at the weekend. While at work respondents were only required to perform routine and mundane calculations. This finding supports Evans (1991) who suggests that the contexts in which mathematics is taught should revolve around citizenship rather than the workplace. There was evidence that the areas in which adults had problems, or were least confident, were those where they had not found the skill useful in everyday life, e.g. area of a circle. There was also an indication that problems occurred where the adult was expected to remember a formula.

There were definite differences between the way that people chose to compute depending on whether they were at work or not (fig. 5). There was more use of mental arithmetic and paper and pencil in everyday life despite the fact that respondents had calculators at home. This supports the view that people use different methods for solutions in different contexts.

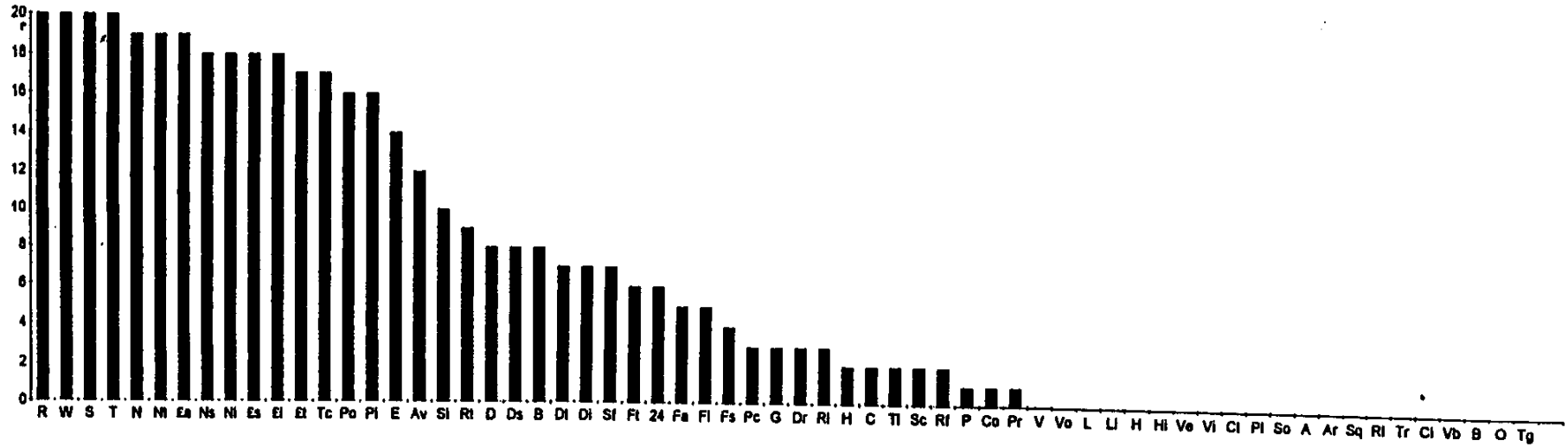
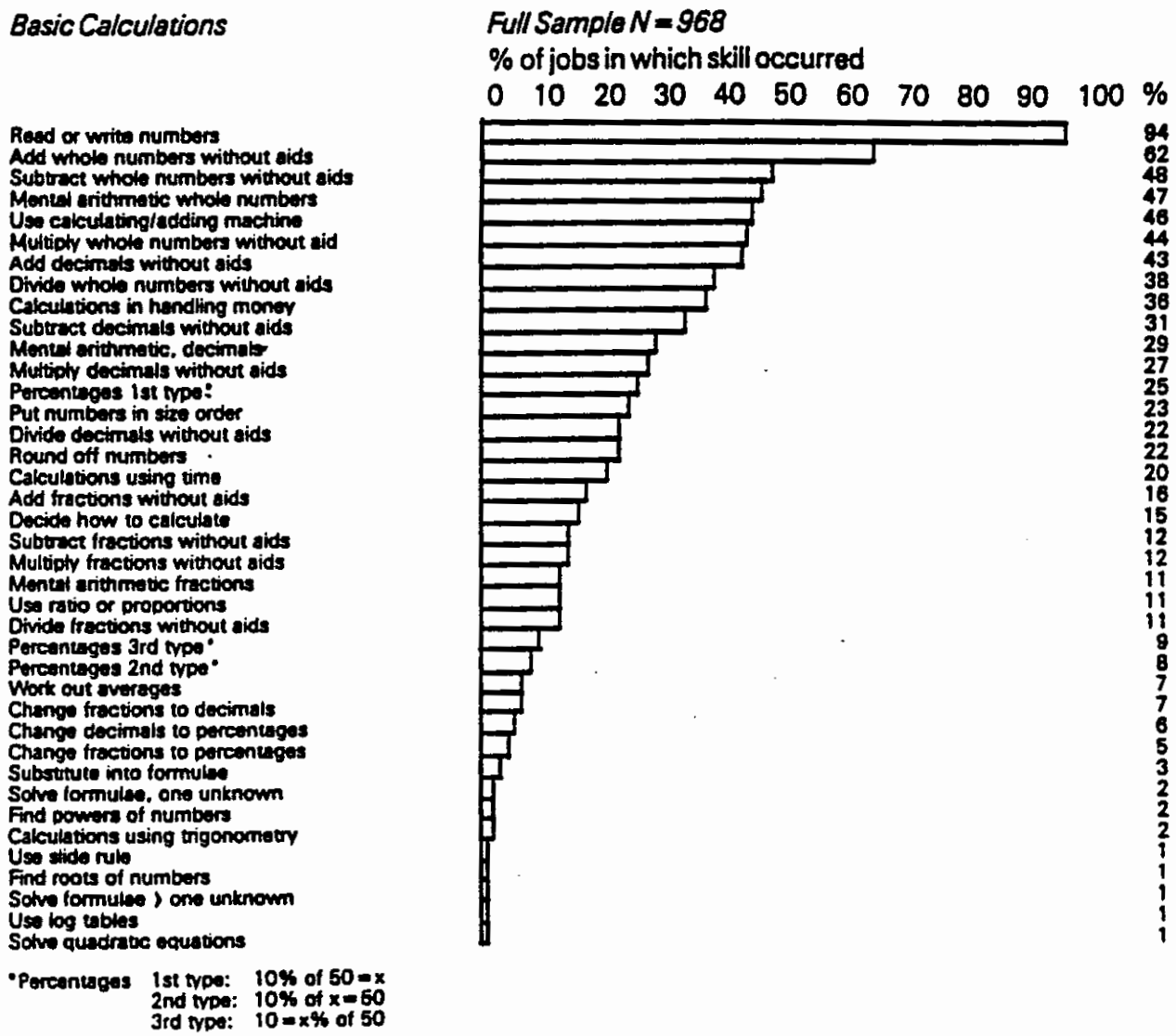


fig. 2 USE OF NUMERACY IN THE WORKPLACE (FREQUENCY ORDER)



*Percentages 1st type: 10% of 50 = x
2nd type: 10% of x = 50
3rd type: 10 = x% of 50

NB. These figures represent the numbers of people who answered specific questions. The same people sometimes show that they are in fact using some of the above skills when they answer questions from the other questionnaires. The figures above should therefore be taken as minima, not absolutes.

fig. 3 Use of numeracy in the workplace (Harris)

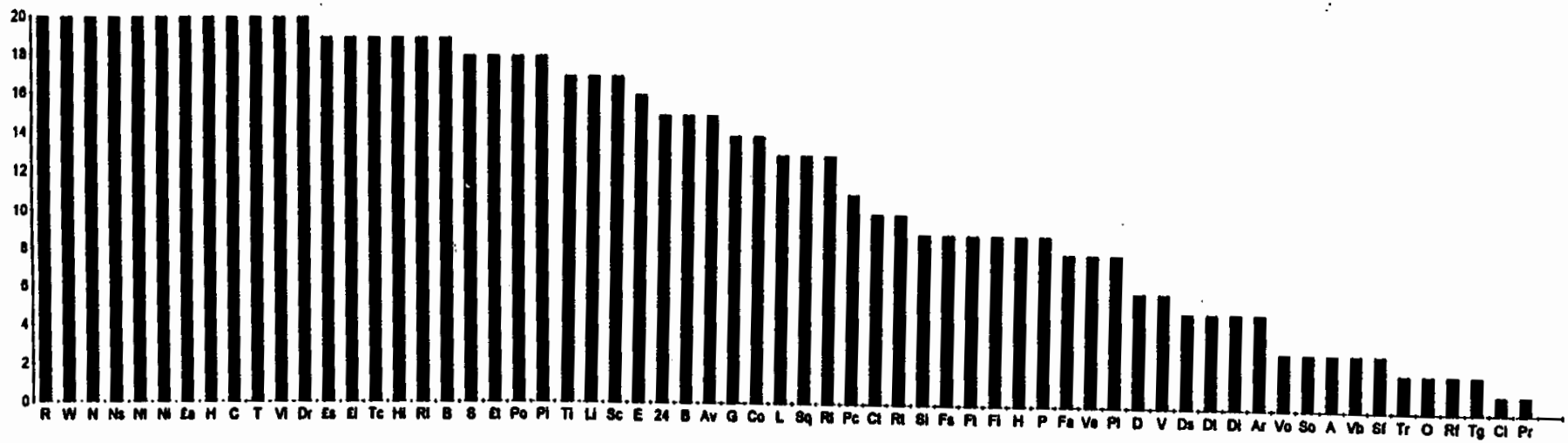
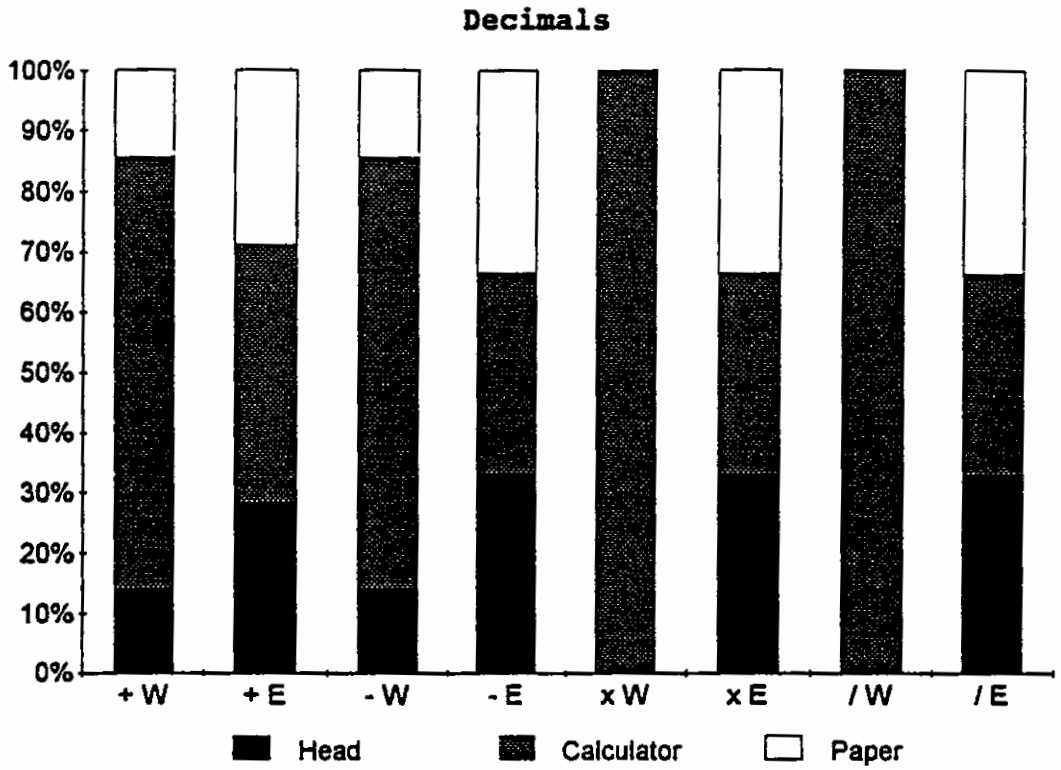


fig. 4 USE OF NUMERACY IN EVERYDAY LIFE (FREQUENCY ORDER)

KEY

E	rounding off	NUMBERS
R	reading	
W	writing	
S	spoken	
Si	size order	
N	addition	WHOLE NUMBERS
Ns	subtraction	
Nt	multiplication	
Ni	division	
£a	addition	MONEY
£s	subtraction	
£t	multiplication	
£i	division	
H	handling	
C	giving change	
D	addition	DECIMALS
Ds	subtraction	
Dt	multiplication	
Di	division	
Fa	addition	FRACTIONS
Fs	subtraction	
Ft	multiplication	
Fi	division	
Po	of an amount	PERCENTAGES
Pi	increase/decrease	
V	VAT on	
Vo	VAT out	
T	digital/analogue	TIME
24	24 hour	
Ti	time table	
Tc	time calculations	

L	length	metric	MEASURE
Li	length	imperial	
H	weight	metric	
Hi	weight	imperial	
Ve	volume	metric	
Vi	volume	imperial	
Ct	convert	metric/imperial	
Rt	read table		GRAPHICAL
P	pictogram		
B	bar chart		
Pc	pie chart		
G	graph		
Pl	plane shapes		GEOMETRY
So	solid shapes		
A	angle with protractor		
Ar	recognise angles		
Sq	square		AREA
Rl	rectangle		
Tr	triangle		
Ci	circle		
Vb	brick		VOLUME
Dr	directions		MAPS
Sc	scale		
Co	co-ordinate		
Ri	adapt		RATIO
B	best buy		
Av	average		STATISTICS
Pr	probability		
O	odds		
Sf	substitute formula		ALGEBRA
Rf	rearrange formula		
Tg	trigonometry		TRIGONOMETRY



METHODS USED TO COMPUTE DECIMALS

(W = WORKPLACE E = EVERYDAY LIFE)

fig. 5

The use of imperial and metric measure is illustrated by fig. 6. Respondents overwhelmingly used imperial measure when given the choice, even though they may have been taught the metric system at school. There appeared to be various reasons for this:

imperial units seem to be a more 'natural' unit, for example, they are related to parts of the body

the size of the imperial unit is more useful than corresponding metric units, for example, 8 oz. of flour is more user friendly than 250 g

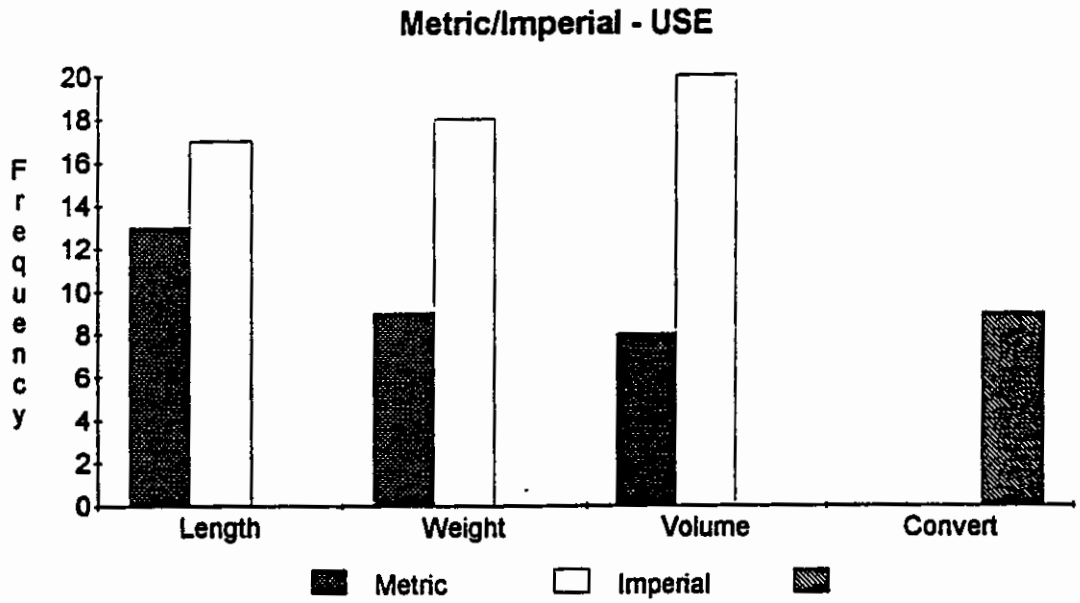
the UK has still not gone metric; try buying a kilo of apples, driving a kilometre and drinking a litre of beer at your local!

imperial measure is used in the home.

If I go back to the original theme of informal learning, I think that this research supports the view that informal settings are more efficacious than formal ones. Further analysis of the use of imperial rather than metric units had respondents saying "I was not taught feet and inches at school only metric - I've used it with my father and my grandfather". "If I measure I use metric - with Dad I use feet and inches". "Metric length wouldn't mean anything to me - at school it was metric, but my parents talked in imperial". It was also clear that respondents were making extensive use of conversions between metric and imperial units, and knew the most common ones. Imperial measure is learned informally. Metric measurement is taught in schools; it relies on language and it challenges common sense ideas about the size of units. Is there little wonder that it is so readily discarded?

Finally I must note the finding that there is a greater breadth of use of mathematics in everyday life and a narrowness in the skills required in the workplace. Respondents were able to identify mathematics in a whole range of hobby and leisure interests. It was fascinating to note from the long list of examples cited by respondents how practical the mathematics was. One respondent said, "I could adapt a recipe practically but not mathematically". This would imply that, for her, physically dividing/multiplying quantities is not mathematics. Perhaps she feels 'real' mathematics only happens on a piece of paper. Doing long division is mathematics, separating objects into piles is not. This is another example of people denigrating their skills, which is sad. A real understanding of a great deal of mathematics comes only through handling physical objects, people need to be given the confidence to recognise this as valuable.

In conclusion, are there any messages here for adult educators working in the field of numeracy? I would suggest that a lot of good practice in adult education has already emerged from a deep understanding of the importance of informal as opposed to formal settings for learning. Although adult classes take place in set aside areas, tutors pay careful attention to the ambience of the classroom. The relationship between tutor and learner is always recognised as key by both parties. This is why my adult students still expected to carry on discussing their essays when they met me in Sainsbury's. Adult tutors recognise the importance of previous learning by their students and will seek to build on both intellectual and emotional experiences. The teaching methods employed often encourage imitation, identification and observation and adults are expected to work in self-supporting groups co-operatively. Due recognition of the importance of the learner's cultural identity is taken when designing learning materials and in classroom practice.


Metric/Imperial - USE
Frequency
20
18
16
14
12
10
8
6
4
2
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Length
Weight
Volume
Convert
Metric
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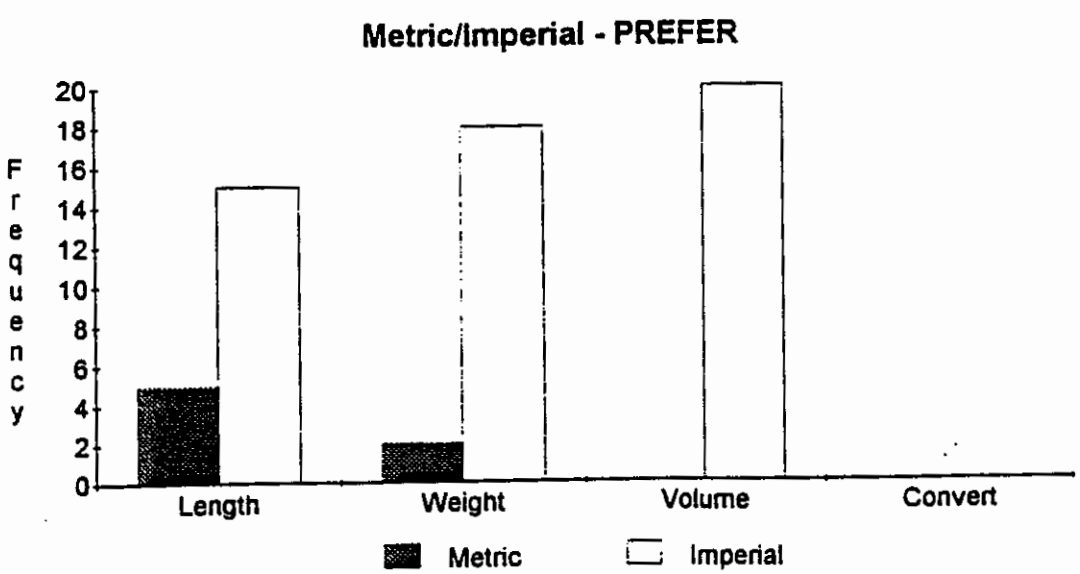
Metric/Imperial - PREFER
Frequency
20
18
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14
12
10
8
6
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2
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Length
Weight
Volume
Convert
Metric
Imperial

fig. 6

Adult numeracy tutors still have problems deciding content. I think the key is to base work in everyday uses of mathematics rather than the supposed needs of the workplace. I suggest this partly because there is a greater richness in the mathematics used there, but also because the changing nature of employment and the frequent need for retraining render some computational skills ephemeral. Clearly the best people to set learning agendas are the adult learners themselves. Tutors need to have the confidence to cope both with this and the need to allow learners to develop their own informal methods of computational solution. It is only by learners developing methods which are meaningful to themselves that skills can be improved. There is a further point here about the application of concepts and skills learned in one context being applied to another. Lave (1988) writes

> conventional academic and folk theory assumes that arithmetic is learned in school in the normative fashion in which it is taught and is then literally carried away from school to be applied at will in any situation that calls for calculation

As Harris and Evans (1991) point out transfer is

> an assumption rather than a finding.....the viability of the concept of transfer remains largely unquestioned in England and Wales, particularly so in the sectors of government that determine curriculum content

Hence we need to make sure as educators that our students own their own learning and have a large number of different contexts in which to practise their skills.

I wonder whether there is genuinely a problem with innumeracy. As the discussion on parking-lot arithmetic showed, we must be wary of results which have been obtained by using tests. Perhaps I am wearing rose-tinted spectacles when I see numerate adults everywhere engaged in exciting mathematical activities. It is not that people are innumerate: it is just that they are doing 'figure work' while the people they think of as proper mathematicians struggle with the long divisions.

I would like to thank Prof. Stephen Barnett for his help and encouragement during my period at Essex University.

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