Towards a Definition of Numeracy

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Introduction

The term 'numeracy' is widely used in adult basic education, but there is little agreement among practitioners as to what it actually means. This paper examines some attempts at defining numeracy and also discusses what it means to be 'innumerate' in today's society.

Numeracy as Mathematics

The term 'numeracy' seems to have first been used publicly in a report of the Central Advisory Council for Education known as the Crowther Report, which dealt with the education of young people in the 15-18 age group (HMSO, 1959). The term occurred in a section of the report concerned with the curriculum of the sixth form. Here to be 'numerate' was defined as the mirror image of being 'literate'. Numeracy was seen as 'the minimum knowledge of mathematics and scientific subjects which any person should possess in order to be considered educated'. From later paragraphs, it appears that quite a sophisticated level of mathematical and scientific understanding was implied, including the ability to think quantitatively, avoiding statistical fallacies.

Regarding numeracy as a term to describe a discrete set of competences in mathematics assumes that mastery of numeracy equates to a specific length and level of formal education and that there are standard approaches to teaching mathematics which will automatically lead to numeracy. Such an approach also ascribes to teachers of mathematics a role as gatekeepers of mathematical knowledge and culture. The implication is that unless this knowledge has been accessed and acquired, a person cannot be considered fully educated even though they may have demonstrated high levels of ability in other subjects. And who is to judge what 'fully educated' really means? In addition, this kind of definition takes no account of the diversity of contexts in which a whole range of mathematical skills are used by both children and adults, how these may vary across different lifestyles and occupations and how they may need to change over the individual life span.

Mathematics as an Aptitude

Somewhat different from the idea of mathematics as a set of skills to be learnt is the idea that possession of numerical skills is a special gift or talent, a belief explored in some details by Castle (1992). Those who lack this particular gift may develop a complete mental block where numbers are concerned even though they may be otherwise high achievers. This may lead to what has been variously described as 'sudden death' (Tobias, 1978) or 'panic' (Buxton, 1981). However, this phenomenon might be traced back to faulty learning experiences in the past rather than to any actual mental incapacity to deal with abstractions.

Castle (1992) demonstrates how this apparent confusion between aptitude and attitude has extended beyond the classroom in that gender and cultural biases have come to influence attitudes towards mathematics in industrialised societies.

She also comments on the underlying implication that there is equal opportunity for everyone to learn and to make use of individual intelligence or predisposition. The various forces which affect access to education - at all levels - and the relevance and quality of educational experiences are not taken into account. The assumption is that if an adult lacks numeracy skills, then s/he is seen as some way at fault - the 'blaming the victim' syndrome also identified in the early days of the adult literacy campaign in the United Kingdom (Withnall, 1994).

Functional Numeracy

The persuasive idea underpinning notions of functional numeracy is that there is a certain level of competence in numerical skills which is an essential pre-requisite both for effective individual participation in society and for the economic survival of that society as a whole. Thus, there is currently an increasing emphasis on a thorough mastery of basic mathematical concepts as an essential ingredient of most vocational training and for the development of a competent workforce. The implications are that achievement in these basic skills will result in improved personal circumstances in both work and leisure contexts and in family life; and economic growth and increasing competitiveness in relation to other countries in world markets. Conversely, those who fail to master basic numerical concepts will be unable either to operate effectively in their personal lives or to make a contribution to the economic regeneration of society.

The functional approach does acknowledge that there are different kinds of numeracy, that different societies require different types of skills from their members and that the level of personal numerical skills needed to function effectively in a given society is subject to constant change in the light of technological development and socio-economic change. Accordingly, we see attempts to create specifications for the kinds of numerical skills identified as necessary to prepare people for work and to create opportunities for personal development in the United Kingdom today. These appear within the programmes of study prescribed for the mathematics National Curriculum; the Numberpower standards devised by ALBSU which are based upon a competence model; and in the National Council for Vocational Qualifications (NCVQ) Care Skills Units for number in both NVQs and GNVQs which are also based upon demonstrated levels of competence. However, the Numberpower model is very much developed from the use of numeracy in both work and non-work activities, whilst the NCVQ specification is a generic unit model closely tied to the National Curriculum (Barr, 1993).

The notion of functional numeracy enjoys considerable popularity. Currently, it forms the basis for a great deal of practice in the United Kingdom and elsewhere. However, it is not without its critics. Even a decade ago, Riley (1984), himself a numeracy practitioner, considered that the term had been distorted and over-simplified. Writing at the same time, Penny (1984) questioned whether numeracy could ever be reduced to a checklist of coping skills. Rather, she felt it should reflect the ability to understand and use mathematical skills as

a means of communication closely linked to individual needs. More recently, in a wide-ranging critical analysis of the whole concept of functional numeracy, Castle (1992) observes that this approach with its emphasis on coping and survival skills and on training needs merely helps adults to adjust to or to accommodate prevailing social and economic circumstances rather than pursuing social change through questioning and challenging structural inequalities. It must also be pointed out that the assertion that improved levels of personal and societal functioning in respect of numerical competences - or indeed, improvements in overall levels of basic skills in any given society - will automatically lead to a range of desirable economic and social benefits is fundamentally flawed. Causation would be difficult to prove.

Numeracy in Everyday Life

The concept of numeracy in relation to the everyday needs of adult life was considered in more detail within the major government enquiry into the teaching of mathematics in schools announced in 1978. The ensuing Cockcroft Report (1982) used the word 'numerate' to imply the possession of two particular attributes:

- an 'at-homeness' with numbers and an ability to make use of mathematical skills which enables an individual to cope with the practical mathematical demands of everyday life;

- an appreciation and understanding of information presented in mathematical terms, eg in graphs, charts or tables or by reference to percentage increase or decrease. (HMSO, 1982)

Although the emphasis on being able to 'cope' still implies a functional approach, the implication of this definition is that a numerate person should have sufficient confidence to be able to appreciate and understand some of the ways in which mathematics can be used as a means of communication, a position also taken by Penny (1984). Moss (1984) agreed that numeracy is part of people's daily routine and therefore each individual determines his/her own needs. Changes in lifestyles may therefore cause changes in needs, so that numeracy is something more than 'basic maths' or 'everyday maths'. Moss also pointed to the necessity to pay attention to the **language** of numeracy and to the process of transferring the written word into a mathematical code. In this way, numeracy, literacy and language are inextricably linked and must be closely related to individuals' personal life circumstances, self-perceptions and expectations. Together they form important skills which enable adults not just to 'function' effectively, but to be in a position to take a measure of control over the circumstances of their own lives.

Numeracy as Context-Specific

Evans (1991) points out that in talking about numeracy as a set of skills which can be applied in specific practical contexts, it is also crucial to consider the following:

- the goals (and values) of the activity within which it even makes sense to pose the problem
- the social relations (including the exercise of power) in the setting within which the problem is posed
- the material resources which form the basis for the activity.

It is these aspects, he argues, which make an activity **meaningful** and the meanings are expressed by the language specific to the activity. He is then led to acknowledge that, in principle, there is a discontinuity between eg school maths and the numerate aspects and skills of other different practical activities such as shopping or playing bridge. It then follows that we need to learn and develop numeracy within specific contexts, using the languages appropriate to that activity. This approach must raise a new series of questions about the traditional ideas of what constitutes numeracy and how it can be taught and learned at different levels. In particular, there may be difficulties about people's ability to **transfer** abstract skills to other settings.

Evans moves on to examine the possible numerate aspects of everyday life for adults in industrial societies. He particularly accentuates the importance of what he calls 'critical citizenship', ie:

> engagement with discussions and debates about individual, family and public well-being and about describing, appreciating, evaluating and deciding on future directions.
>
> (Evans, 1991:23)

Being enabled to practise critical citizenship assumes the availability of appropriate **resources** including access to and understanding of official statistics, mostly those produced by government and interpreted through the media. Issues relating to the role of numeracy in the practice of critical citizenship have been further investigated through a research project based in the Department of Mathematics at the University of Essex. The project focused mainly on the kind of numerical information needed by school governors in order to fulfil their roles successfully (Thorstadt, 1991, 1992).

The Effects of Innumeracy

In a sense, 'innumeracy' may be an inappropriate term since it is unlikely that there are many people in industrialised societies who, having received at least a primary education, are completely unable to cope with very simple arithmetical operations. Evans (1989) prefers to talk about 'low levels of numeracy' among adults, noting that the consequences of this may be apparent at several levels in society. For example, an individual's freedom of access to further education and training may be restricted and job performance, may be impaired - a functional approach. At a societal level, low levels of numeracy may result in loss of production, waste of resources, even threats to life if vital mathematically-based information is misinterpreted or misunderstood. Evans also shows how low levels of numeracy can have ideological consequences at individual level in that lack of both competence and confidence in their constructive skills and critical insights can lead adults to become dependent on the views of experts or professionals and leave them open and susceptible to what he calls an alien mathematical mystique. At societal level, lack of numeracy may result in the growth of myths - ideas which are partially or completely false, but which gain currency and influence the beliefs and actions of different groups and organisations in society as well as affecting the practices of society's various institutions.

Further examples of the ideological consequences of low levels of numeracy have been explored in the USA. Paulos (1988), writing about innumeracy as 'mathematical illiteracy' demonstrates how lack of ability and confidence in dealing comfortably with the fundamental notions of number and chance can lead to an uncritical acceptance of meaningless co-incidence and pseudoscientific theory as well as a misinterpretation of simple statistical information. Dewdney (1993) takes these arguments a stage further by showing how politicians, advertisers, stockbrokers, salespersons and others who make use of numbers, charts and graphs can manipulate individuals by playing upon their innumeracy. This he describes as the common inability to **understand** the rules of percentages, ratios, statistics and basic mathematical logic. In this way, it is easy for even highly educated adults to be left open to the chicanery of those he calls 'maths abusers'.

Emergent Issues

The foregoing exploration of competing approaches to the concept of numeracy demonstrates clearly that different writers have based their definitions on a range of different assumptions. In one sense, we have come full circle. The Crowther report put a certain emphasis on the ability to think quantitatively and on the importance of avoiding statistical fallacies. More recent writers have stressed the need for individuals to be more aware of ways in which statistics can be used to manipulate their thinking. They show how this awareness might be achieved through an emphasis on understanding how mathematical rules can be subverted together with a healthy degree of scepticism and the ability to think critically rather than through knowledge of any advanced mathematical or statistical techniques.

In exploring the use of numeracy in everyday life, it is suggested that numeracy is something other than a set of mechanistic, discrete mathematical skills which can be acquired in an artificial context and then transferred to real-life situations. Neither is it merely a set of various skills to be used to enable individuals to function more effectively in a given context which may, in any case, be subject to dislocation and change. Rather, it appears that numeracy consists of being able to make an appropriate response to a much wider range of personal needs occurring in individual lives to different extents. These needs call for the ability to understand broader contexts in which numerical demands are located, to make use of appropriate communication skills, to be able to interpret information presented in a variety of mathematical codes, to exercise judgements according to the nature of the activity and the desired outcome. Such a stance obviously has profound implications for the way in which numerical skills are taught and learnt in adult basic education programmes.

The Lancaster Research

Some of the above issues are currently being explored through a research project underway in the Department of Continuing Education at Lancaster University. Although the research is concerned with an examination of the numerical skills used in everyday life, by people in retirement, preliminary fieldwork with two small groups of older people has already revealed a range of ways in which numerical skills might be required in their daily lives, eg:

1. Domestic numerical skills: perceived as necessary by the individual for personal activities and domestic tasks.

2. Consumer numerical skills: mainly concerned with aspects of managing financial affairs, making purchases, etc.

3. Technological numerical skills: required to understand and operate modern appliances, usually domestic; may also involve computer-based skills.

4. Leisure numerical skills: concerned with a whole range of leisure activities whether personal hobbies or more complex pursuits involving others.

5. Numerical skills for citizenship: understanding and interpreting statistical and other information available within the public domain.

6. Numerical 'mental notes': remembering and visualising numbers and number sequences for a range of purposes, or for curiosity.

This table is by no means exclusive since many of the categories of activities are inextricably linked. For example, purchasing and learning to operate a washing machine requires domestic, consumer and technological skills together with a grasp of statistical information as an informed citizen capable of making choices. A further point relates to the range of skills utilised within each category. For example, respondents in this exercise pursued a variety of leisure activities ranging from knitting - itself requiring the ability to follow complex algebraic sequences and to visualize geometric shapes - to acting as treasurer of a voluntary organisation. The skills required for this latter activity are also complex, but of a different order. These observations go some way to illustrating the points made by Evans (1991) - that it is the goals and values, the social relations and material resources available which are crucial to understanding a particular activity. In particular, the goals of the activity may influence the degree of precision required. These issues will be explored in more depth during the Lancaster project's main fieldwork phase. It may be that the outcomes of the research will have implications for adults generally, not just those in later life.

Conclusion

At present, there is a tendency for policy-makers, practitioners and researchers alike to talk about 'numeracy' as though they shared a common understanding of its meaning. In examining some of the attempts to grapple with a definition already made, it has to be concluded that we do not, as yet, have an all-embracing operational definition with which to work. Nor, it seems, is it necessarily desirable to do so. Numeracy must remain a fluid term capable of re-conceptualisation according to the contexts in which it is used and by whom.

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