Definitions on the concept of Numeracy, as presented and discussed by ALM members during conferences in past ten years

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Compiled by

David Kaye for poster session at ALM-9 in London (2002)

ALM 1 Jeff Evans & Ingrid Thorstad

Indeed, the idea of numeracy has been used to emphasise the need for "the maths" to be learned (and often used) in context. What distinguishes the context of everyday numerate thinking and problem solving from that of academic mathematics is the different activities and practices which form the different contexts. Thus the numeracies used in the work of builders, pharmacists and shop-managers are all different - because they are based in different practices and hence are specific to them. Therefore there is in principle a discontinuity between, say, school maths, and the numerate ideas and skills that are used in shopping - or between numerate aspects of two different practical activities, such as shopping and playing bridge. These ideas have been explored and developed in a wide range of recent research projects: those of Nunes, Schliemann and Carraher (e.g. 1993) in Brazil; those of Jean Lave (1988) in the USA (for a summary, see Evans and Harris, 199 1). those of Valerie Walkerdine and others in the UK (e.g. Walkerdine and Girls and Maths Unit, 1989J; and those of Nick Taylor and others working within the democratic movements in South Africa (e.g. Taylor, 1989).

Evans, J & Thorstad, I (1995) Mathematics and Numeracy in the Practice of Critical Citizenship (in proceedings of ALM1)

ALM 2 Paul Ernest

What must be emphasised is that absolutist philosophies of mathematics are not concerned to describe mathematics or mathematical knowledge. They are concerned with the epistemological project of providing rigorous systems to warrant mathematical knowledge absolutely (following the earlier crisis in the foundations of mathematics arising from the introduction of Cantor's infinite set theory). Many of the claims of absolutism in its various forms follow from its identification with rigid logical structure introduced for these epistemological purposes. Thus according to absolutism mathematical knowledge is timeless, although we may discover new theories and truths to add; it is superhuman and a historical, for the history of mathematics is irrelevant to the nature and justification of mathematical knowledge; it is pure isolated knowledge, which happens to be useful because of its universal validity; it is value-free and culture-free, for the same reason.

Mathematics as a discipline (what professional mathematicians understand as mathematics) and school mathematics should be distinguished. School mathematics is not just a subset of the discipline of mathematics. It should instead be regarded as a different subject, comprising such elementary topics as number, measurement, algebra, geometry, statistics, probability, computing and problem solving. All of these topics are studied not for their own sake but for their practical and cross-curricular applications, and as a basis for further study. Much of school mathematics is closer in content to numeracy, to contextual mathematics, to the mathematics of commerce and industry, than to the discipline of mathematics itself. The main concern of pure mathematics with axiomatic systems and the rigorous proof of theorems, for example, is largely irrelevant to school mathematics.

Ernest, P. (1995) Images of Mathematics, Values and Gender: Philosophical Perspective (in proceedings of ALM2)

ALM 2 Roseanne Benn

The Cockcroft Report (1982:71) suggested that there are three elements in mathematics teaching - facts and skills, conceptual structures, and general strategies and appreciation. The last is of interest to this paper. General strategies are defined as procedures which guide the choice of which skills to use and which knowledge to draw on. Crucially they enable a problem to be approached with confidence and with the expectation that a solution will be possible. With these strategies is associated an awareness of the nature of mathematics and attitudes towards it. An alternative approach to mathematics teaching can be developed by adopting an alternative view of the nature of mathematics. What follows are two examples of viewing mathematics, not as a certain, abstract, neutral discipline but as a human invention, a world of ideas created not by God but by human beings.

Benn, R. (1995) Mathematics: Certainty in an Uncertain World? (in proceedings of ALM2)

ALM 3 Mary Harris

The point I want to make is that in the hierarchy of human knowledge, mathematics was second only to direct revelation from God. This high status of mathematics in the Liberal Arts is of course older than Christianity, but it was Christianity that introduced the idea into English education a good fifteen hundred years ago.

Most histories of mathematics do not record much of the numerate goings on of the world outside formal education, for these are perceived by the generally liberally educated writers of the histories as something separate from mathematics. Yet in those fifteen hundred or so years when mathematics was a university matter, agriculture, trade and commerce burgeoned, people built canons, castles, and cathedrals, roads and bridges, mines and factories, indeed started a whole industrial revolution: the absence of a mathematical education does not seem to have stopped them.

So where does Chaucer's Manciple fit into this saga? He was illiterate but that did not stop him being effectively numerate, and it clearly did not bother anyone. There are social histories that tell us how many people of a particular age were literate, but that bears no relationship to how numerate they were. I know it depends on how you define numeracy, but I believe it is a bad mistake, stemming from our own, modern insistence on teaching numeracy through and therefore after literacy, to assume that numeracy depends on literacy- It does not. It is the examining of it that does, but that is a bureaucratic, not an educational matter.

Nobody who builds a house, manages a market stall or runs a farm however small, is innumerate. It is ridiculous to think of a farmer who does not know how many chickens she has and how many eggs she expects, how much milk she is getting from how many cows, and how much winter fodder will have to be laid in for them. Nobody ploughs a furrow without some clear idea of how long it will take, how many furrows can be ploughed in a day and what the crop yield is hoped to be, whether or not the farmer writes is down. Nobody spins without knowing how much thread she will produce from how many fleeces and how much more she will have to spin before she has enough to send to the weaver.

The essential point if that the very same social forces and philosophies that established mathematics as the highest peak of human endeavour, established women as the lowest form of human life, and for nearly fifteen hundred years of education, kept the two as polar opposites.

My desire to explore mathematical thinking in the less literate, stereotypical women's work of textiles, was one reason that 1 set up, some years ago now, an exhibition carefully called Common Threads, that wove together the two most ancient and stereotyped contrasts in education, the high intellectual masculinity of mathematics and the low, unintellectual femininity of needlework. By demonstrating the undoubted mathematics within needlework itself, I aimed to expose both stereotypes for what they were. The implications went far beyond textiles and one of the effects of Common Threads was to demonstrate, not so much the mathematical nature of needlework, as the very narrow and historically gendered focus of traditional mathematics education and its expectations.

As Alan Bishop (1991) has shown, every culture that has ever been studied has developed six fundamental mathematical activities: counting, measuring, locating, designing, playing and explaining. In the colonial export model, counting and measuring predominate as they do in this country. The visual, spatial and philosophical items on Bishop's list are recognised as the activities of the privileged and are also recognisable in the work women do outside the numeracy class. Indigenous mathematics is now appearing in the school textbooks, but the structures of the books remains that of the world hegemony of mathematics education. No matter that young women do much visual and spatial work even in their imported needlework, and handle the philosophical meanings of their indigenous culture, their social status in the colonial aftermath does not permit these to be recognised.

Harris, M. (1997) Women, Mathematics and Work (in proceedings of ALM3)

ALM 3 Dave Tout

Claiming and naming numeracy

A big issue in Australia over the last few years has been that of the usage of the term numeracy itself and the concept of critical numeracy and what this means. Apart from the US there seems to have been little debate or discussion on this issue.

One of the significant things in Australia which appears different from much practice overseas is that we are now actively using the word "numeracy". There seems to be almost Australia wide agreement that yes, we can use that word to talk about what we do - it isn't downgrading what we do, it isn't inferior to mathematics - and as we said in the introduction to the Adult Numeracy Teaching course: "numeracy is not less than mathematics, but more". It was apparent that many overseas countries still viewed the term numeracy as meaning the basics numbers and some arithmetic skills - and therefore some rejected its use as a term to describe our work and field, and preferred to stick with the term mathematics with some adjective to help define it such as everyday maths.

We believe that numeracy is about making meaning in mathematics and being critical about maths. This view of numeracy is

very different from numeracy being just about numbers, and it is a big step forward from numeracy or everyday maths that meant doing some functional maths. It is about using mathematics in all its guises - space and shape, measurement, data and statistics, algebra, and of course, number - to make sense of the real world, and using maths critically and being critical of maths itself. It acknowledges that numeracy is a social activity. This is why we can say that numeracy is not less than mathematics but more. It is why we don't need to call it critical numeracy - being numerate is being critical.

Tout, D. (1997) Some reflections on adult numeracy (in proceedings of ALM3)

ALM 3 Dhamma Colwell

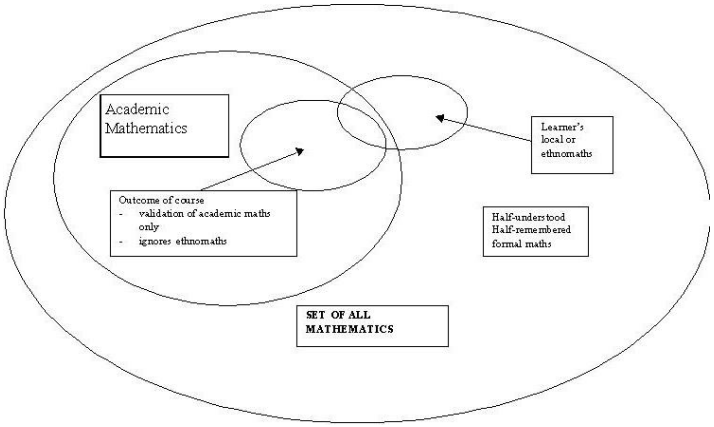
The term mathematics triggers very strong negative feelings in many people: anxiety, panic, fear, or anger [Buxton. 1981]. They may unconsciously label the everyday maths they use as ‘common sense’ to avoid triggering those emotions.

Part of the problem of definition is nomenclature: what I am referring to as 'mathematics' is often called 'numeracy' by academics and policy-makers, (but not by the general population) Although they often mean a much narrower field of knowledge and skills: what used to be called 'arithmetic'.

In doing ethnographic work there is a problem about labelling an activity as mathematical if the participants n the stud deny that that is what they are doing. I think there is a parallel here with the study of grammar in language work. Speakers of a language do not have to have any formal knowledge of the grammatical structure of the language in order to speak grammatically. They may be totally unaware that they are using grammar. Similarly people can perform all sorts of activities that can be modelled as mathematical, without being aware that they are using mathematics.

Colwell, D. (1997) Adults' experiences of learning and using maths in a second language (in proceedings of ALM3)

ALM 4 Roseanne Benn



Benn,R (1998) An Introduction to Adults Count Too (in proceedings of ALM4)

ALM 4 Una O’Rourke and John O’Donoghue

Perspectives on Numeracy

The term numeracy was first coined in 1959 by the Crowther Committee. It was strongly related to literacy at its inception. Since then it has undergone many changes in definition. A brief overview of sonic of the perspectives, which are currently evident in the literature will be presented. Firstly, one cannot but be struck by the political rather than scientific nature of the definitions and perspectives.

Examining the literature related to numeracy, three distinct broad categories of definitions can be identified. There are those which relate to social requirements (Evans 1992; Thorstad 1992 and Paulos 1988). Secondly, a set of definitions point to the

strong link between numeracy and mathematics (Sowder 1990; Edwards 1988 and Le Roux 1979). Finally a group of authors strongly tie any definition of numeracy to literacy, (Gal 1994; Skovsmose 1994; Galbraith 1992 and Chapman and Lee 1990). A common theme, which threads all of the definitions is that of communications. All authors identify a role for numeracy in enhancing the transmission of information in order to facilitate an individual's understanding of the world.

O'Donoghue, J & O'Rourke, U (1998) Guidelines for the Development of Adult Numeracy Materials (in proceedings of ALM4)

ALM 5 Willem Houtkoop & Stan Jones

The numeracy part of ILSS will focus on the ability to interpret, apply and communicate mathematical information in four domains: everyday life, work situations, societal and community situations and further learning. The Numeracy Working Group of Statistics Canada has developed a framework for the assessment, including a set of items and a background questionnaire.

Houtkoop, W. & Jones, S. (1999) Adult Numeracy: an international comparison (in proceedings of ALM5)

ALM 5 Dhamma Colwell

My teaching of basic maths to adults developed within the culture of adult literacy work: my aims have been the empowerment of students, which I have tried to achieve by helping them recognise the mathematical skills and knowledge they have acquired outside the educational system, as well as trying to promote their understanding. of mathematics and its applications. These two aspects of maths are represented by the right hand and top vertices of the triangle in the model in Fig. 2.

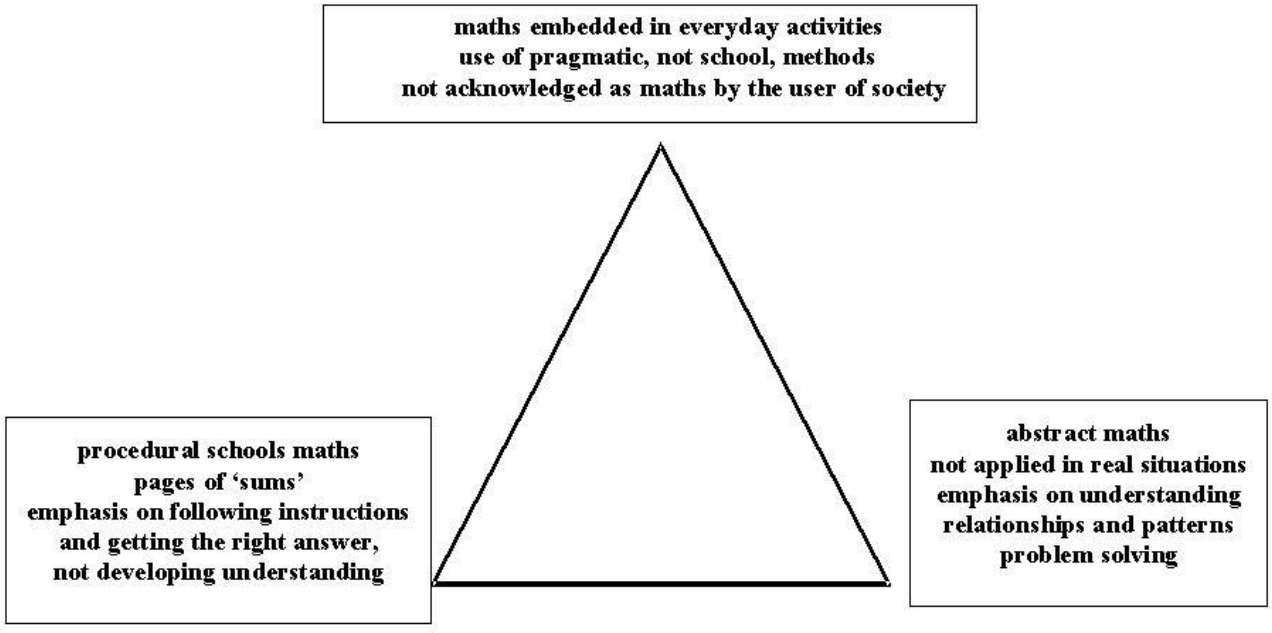
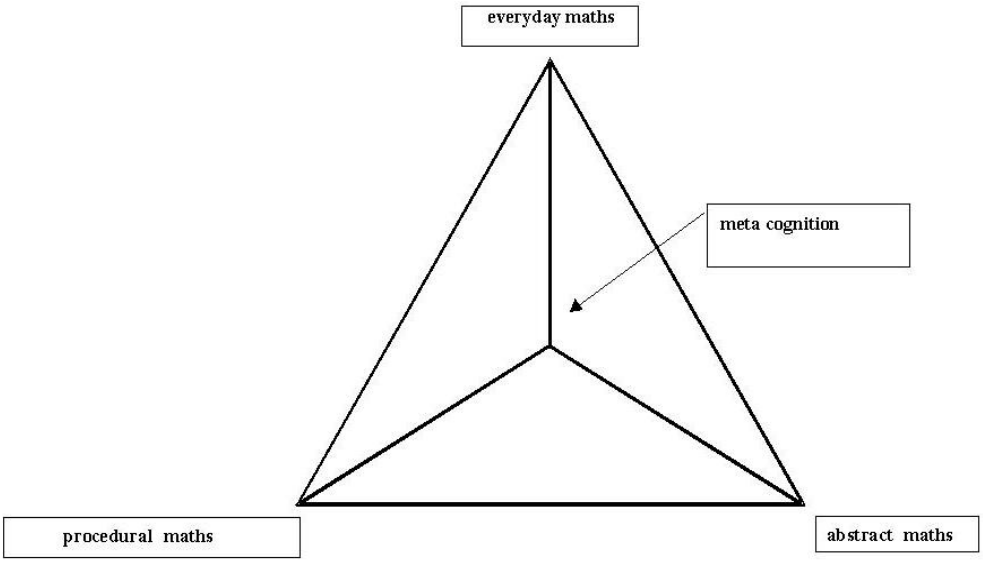


Fig 2 Dhamma's version of three approaches to teaching basic maths

In our triangular model, there is no place for students' reflections on their own learning. I have represented this by the apex of a tetrahedron in Fig. 3, with the original triangle as the base.



ALM 5 Sue Elliott

The name of the course, 'Advanced Numeracy', reflects the need for a 'legitimising label' in order to gain recognition and approval for accreditation from the institution. It also, much more importantly, reflects the complexity and status that we ascribe to the term numeracy. This advanced numeracy is not the utilitarian ability to perform basic arithmetic operations. The term 'advanced numeracy' has at its heart what Marilyn Frankenstein describes as 'The kind of mathematical literacy needed to clarify issues, to understand the structure of society, and to support or refute options (which) is more than the ability to calculate...' (1989). It embodies the ideas of critical mathematics and recognises mathematics both as a powerful tool and a tool of power.

ALM 5 Beth Marr and Dave Tout

The Learning Outcomes are organised into four different categories or domains, according to different purposes and functions of using mathematics.

Numeracy for Practical Purposes addresses aspects of the physical world to do with designing, making and measuring. There are two learning outcomes: Numeracy for Practical Purposes - Design and Numeracy for Practical Purposes - Measuring.

Numeracy for Interpreting Society relates to interpreting and reflecting on numerical and graphical information of relevance to self, work or community. The two learning outcomes are: Numeracy for Interpreting Society - Data and Numeracy for Interpreting Society - Numerical Information.

Numeracy for Personal Organisation focuses on the numeracy requirements for personal organisational matters involving money, time and travel. There are two learning outcomes, one dealing with money and time, the other to do with location and direction.

Numeracy for Knowledge is only introduced at level 3 and deals with mathematical skills needed for further study in mathematics, or other subjects with mathematical underpinnings and/or assumptions. There are learning outcomes to do with problem solving, algebraic and graphical techniques.

Marr, B. & Tout, D. (1999) A Numeracy Curriculum (in the proceedings of ALM5)

ALM 6 Noel Colleran, Eamonn Murphy, John O'Donoghue

Therefore, problems have to be non-routine. They have to engage the real world of the learner and they have to be meaningful. In relation to quantitative problems and problem solving learners who are presented with novel quantitative situations, which are realistic and meaningful for them, should engage in quantitative problem solving. The result should be a successful application of mathematical concepts in concrete, real world situations. This activity can also be regarded as numeracy or quantitative literacy (OECD, 1997). Numeracy, therefore, is more than mathematics. It requires the manipulation of numbers, in a critical manner, which makes connections between mathematics and the real world (Johnson. 1994).

Colleran, N., Murphy, E. & O'Donoghue, J. (2000) Improving Adults' Quantitative Problem-Solving Skills (in proceedings of ALM6)

ALM 6 Mieke van Groenestijn, Mary Jane Schmitt

The concept of numeracy is specifically related to the dialogue about the goals and especially outcomes and impact of school mathematics education. More educators now encourage links between knowledge gained in the mathematics classroom and students' ability to handle real-life situations that require mathematical or statistical knowledge and skills (van Groenestijn, 1998). In the ILSS Numeracy Framework, numeracy is seen as a bridge that links mathematics and the real world. The goal was to develop a conceptual framework of "numeracy" that is couched in assumptions about how adults 'know' and 'do' math in the real world, using not only their formal knowledge (of mathematics, of literacy, and so forth), to the degree it exists, but also other, experience-based knowledge. The ILSS Numeracy Working Group has therefore defined numeracy as: The knowledge and skills required to effectively manage the mathematical demands of diverse situations.

Figure 1: Numerate Behaviour and its Facets

Numerate behaviour involves:

managing a situation or solving a problem in a real context

everyday life

work

societal

further learning

by responding

identifying or locating

acting upon

interpreting

communicating about

to information about mathematical ideas

quantity & number

dimension & shape

pattern and relationships

data & chance

change

that is represented in a range of ways

objects & pictures

numbers & symbols

formulae

diagrams & maps

graphs

tables

texts

and requires activation of a range of enabling knowledge, behaviours, and processes

mathematical knowledge and understanding

mathematical problem-solving skills

literacy skills

beliefs and attitudes

van Groenestijn, M. & Schmitt, M. J. (2000) Numeracy Assessment for the International Life Skills Survey (in the proceedings of ALM6)

ALM 6 Janet Duffin

Recently I have come across a book by a neuropsychologist (Butterworth 1999) which appears to authenticate my thesis. He postulates that there is a Number Module in the brain which is the source of our ability to operate with numbers.

The last sentence of the introductory chapter of the book is as follows:

Even if you are not convinced by anything else in this book, I hope that you will be convinced that our ability to use numbers is fundamental to the way we think about the world, that it is the basis of much of what we call civilisation, and that to understand our common humanity we need to understand how we understand numbers, (Butterworth), 1999:22).

Duffin, J. (2000) Understanding Number (in the proceedings of ALM6)

ALM 7 Myrna Manly, Dave Tout, Mieke van Groenestijn, Yvan Clermont

What is Adult Numeracy

One of the scales of the International Adult Literacy Survey (IALS), the quantitative Literacy Scale, was a measurement of the respondent's ability to apply arithmetic operations to numbers embedded in diverse texts. While this scale produced useful data, survey developers recognized that it was limited in scope. The Numeracy scale of ALL (new name for ILSS) is designed to go above and beyond the QL scale, while avoiding reliance on formal, curriculum-based knowledge of mathematics.

The working definition we have for numeracy in the ALL survey is :

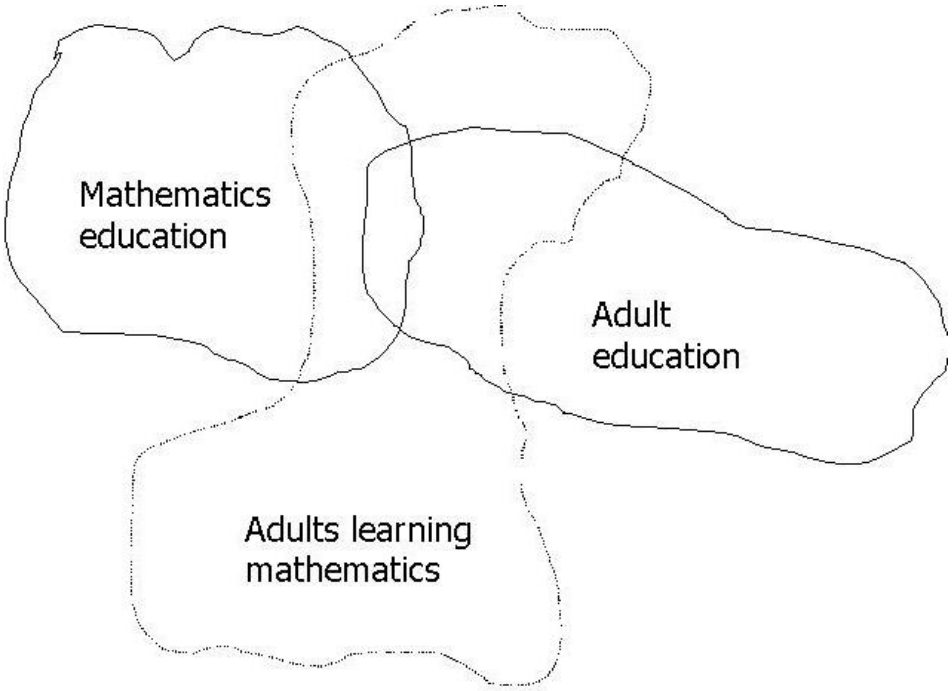
The knowledge and skills required to effectively manage the mathematical demands of diverse situations

Overall, numeracy is a multifaceted and sometimes slippery construct. Our basic premise is that numeracy is the bridge that links mathematical knowledge, whether acquired via formal or informal learning, with functional and information-processing demands encountered in the real world. An evaluation of a person's numeracy is far from being a trivial matter, as it has to take into account task and situational demands, type of mathematical information available, the way in which that information is represented, prior practices, individual dispositions, cultural norms, and more.

Manly, M., Tout, D., van Groenestijn, M. & Clermont, Y. (2001) What Makes One Numeracy Task More Difficult Than Another? (in the proceedings of ALM7)

ALM 7 Tine Wedege

Figure 1: "ALM" Situated in the Borderland Between Mathematics and Adult Education



Wedege, T. (2001) Epistemological Questions About Research and Practice in ALM (in the proceedings of ALM7)

Five Conclusions on ALM

The reconnaissances have resulted in five conclusions on the international research forum "Adults Learning Mathematics" (ALM).

(1) Preliminary place in the scientific landscape:

The ALM community of practice and research is accepted as a domain within the didactics of mathematics.

(2) Subject area:

The learner is the focus of the ALM studies, and her/his "numeracy" is understood as mathematics knowledge.

(3) Problem field:

Didactic questions are integrated with general adult education questions in ALM and the studies are interdisciplinary.

(4) Two perspectives:

The duality between the objective and subjective perspective is implicit, or explicit, in all ALM problematiques.

(5) Justification problem:

The general aim of ALM practice and research is "empowerment " of adults learning maths

(Wedege in Wedege, Benn, Maasz, 1998; Wedege, 2000).

ALM 7 Roseanne Benn

Active Citizenship Involves Numeracy

To suggest the content of an adult numeracy course, which would contribute to active citizenship, requires an examination of the citizenship situations where adults need numerical skills. Some examples are given below but there are many more.

Thorstad (1992) identified school governors as a prime example of citizens who work responsibly and without pay on behalf of the community. Some people are deterred from standing for governorship in the first place due to lack of knowledge or confidence in financial matters, and even those who are elected may be making decisions on shaky ground due to similar inadequacies. The numerical skills identified as being of most use to a governor were the ability to: follow an argument that includes (especially large) numbers; do a quick estimation; check other people's calculation; and calculate accurately with speed and agility but using a calculator. This is a mismatch with numeracy practice encouraged in many formal classrooms. As a result, adults were insecure with mathematical skills half-remembered from school or informally learnt as an adult or a confusion of the two. The result was that some non-specialist governors, including parents, did not take an active part in crucial debates or were being asked to rubber-stamp financial decisions made by the financial subcommittee.

Benn, R. (2001) All for One and One for All: Citizenship and Maths Education (in the proceedings of ALM7)

ALM 8 Inge Henningsen

The concept of numeracy has (at least) two sides: numeracy as a theoretical concept and numeracy as it is defined for instance in government programs for mathematics education and comprehensive assessment activities. This accounts both for the complexity and the attraction of the concept of numeracy, the latter to a great extent stemming from the short distance between theory and practice in current educational activities. This duality is, however, not unproblematic; since it has led to numeracy currently being used with two conflicting meanings. One is a research definition of numeracy that can be exemplified by Evans' definition:

Numeracy is the ability to process, interpret and communicate numerical, quantitative, spatial, statistical, even mathematical information, in ways that are appropriate for a variety of contexts, and that will enable a typical member of the culture or *subculture* (my italics) to participate effectively in activities that they value. (Evans, 2000:236)

This concept of numeracy obviously allows for a plurality of numeracies; and gender will almost inevitably enter into the delimitation of numeracy in various subcultures. The other can be exemplified by Organisation for Economic Co-operation and Development (OECD, 1996) stipulating that quantitative literacy on their level 3 is the minimum requirement to manage the complex demands from work and everyday life in the knowledge society. This represents a concept of a unified, common numeracy.

Henningsen, I (2002) Gender in ALM - Women and Men Learning Mathematics (in the proceedings of ALM8)

ALM 8 Lene Østergaard Johansen

I have argued that the concept of *Bildung* can contain the goals of numeracy teaching for adults who lack basic mathematical skills! As an example I have shown that active citizenship can be an ideal; active citizens are "the good people", who maintain and develop society. Depending on the context there will be different understanding of the term 'active citizen'. There will be a difference between what the government means when it talks about 'active citizens' and what for example the curriculum planner means. Another question to be raised is whether it is a right or a duty for people to be active citizens and/or to join numeracy classes.

Johansen, L Ø. (2002) Goals of Numeracy Teaching (in the proceedings of ALM8)

ALM 8 Roseanne Benn

The importance of this thinking is fundamental. It suggests that:
Mathematics is a social construct
It did not develop in a cultural or social vacuum
It is not a body of truth existing outside human experience
It is a construct or invention rather than a discovery
It is social in nature
It is value laden not value free
There are different mathematics in different societies reflecting the different needs of those societies.
(Benn, 1997)

Benn, R. (2002) Secret Knowledge: Indigenous Australians and Learning Mathematics (in the proceedings of ALM8)

ALM 8 Henning Salling Olesen

Looking into the literature I found a conception in line with and inspired by the Freirean position: 'Ethno-mathematics' (formulated in Brazil by e.g. D'Arnbrosio, quoted from Gelsa Knijnik in Coben *et al* 2000): Numeracy competencies are embedded in basic technologies and modes of social regulation (trade and organisation of production). The technological transfers and coercive changes caused by capitalist modernisation devalues old numeracy competencies and - primarily - introduces new ones. Abstract calculation and modelling are part of the division of labour, which is taking place with modernisation.

Olesen, H. S. (2002) Lifelong Learning - a political agenda! Also a research agenda? (in the proceedings of ALM8)

ALM 9 Selected definitions of numeracy from **John O'Donoghue**

Crowther (1959: par 40l):
'On the one hand is an understanding of the scientific approach to the study of phenomena - observation, hypothesis, experiment, verification. On the other hand is a need in the modem world to think quantitatively, to realise how far our problems are problems of degree even when they appear as problems of kind.'
Central Advisory Council for Education (England) (1959) A report of theCentral Advisory Council for Education (England), Crowther Report, London: HMSO

Cockcroft (1982: par 39):
'We would wish 'numerate' to imply the possession of two attributes. The first of these is an 'at-homeness' with numbers and an ability to make use of mathematical skills which enable an individual to cope with the practical mathematical demands of his everyday life. The second is ability to have some appreciation and understanding of information which is presented in mathematical terms, for instance in graphs, charts or tables or by reference to percentage increase or decrease.'
Cockcroft Committee (1982) Mathematics Counts: A Report into the Teaching of Mathematics in Schools. London: HMSO.

Steen (1997: xx):
'There appears to be reasonable consensus among individuals of widely differing perspectives on the natural growth of numeracy from the basic arithmetic of grade school through the more sophisticated numerical

reasoning of measurement, ratios, percentages, graphs, and exploratory data analysis that is now the centerpiece of middle school mathematics.'
Steen, L.A. (ed.) (1997) Why numbers count: quantitative literacy for tomorrow's America. New York: College Entrance Examination Board.

Dossey (1997: 173):
'To understand the meaning of quantitative literacy, a better model is one based on a categorisation of mathematical behaviours into six major aspects:

Data representation and interpretation

Number and operation sense

Measurement

Variables and relations

Geometric shapes and spatial visualisation

Chance

These aspects provide a broad basis for examining the ability to interpret and act in a wide variety of mathematics-related settings.'
Dossey, J A (1997) 'Defining and measuring quantitative literacy'. In L A Steen (Ed) Why Numbers count: quantative literacy for tomorrow's America (pp 173-186) New York: College Entrance Examination Board

Johnston (1994: 34):
'To be numerate is more than being able to manipulate numbers, or even being able to 'succeed' in school or university mathematics. Numeracy is a critical awareness, which builds bridges between mathematics and the real world, with all its diversity.'
... in this sense ... there is no particular 'level' of Mathematics associated with it: it is as important for an engineer to be numerate as it is for a primary school child, a parent, a car driver or gardener. The different contexts will require different Mathematics to be activated and engaged in...'
Johnston, B. (1994). Critical numeracy Fine Print, 16(4), 32-36.
O'Donoghue, J. (2003) Mathematics or Numeracy: Does it really matter? (in the proceedings of ALM9 2002)

Roseanne Benn
Numeracy makes a difference (Chapter 8)
Numeracy consists of being able to make an appropriate response to a wide range of personal, institutional or societal needs. To participate fully in everyday living, adults need the ability to understand broader contexts in which numerical demands are located, to make use of appropriate communication skills, to be able to collect, present and interpret information presented in a variety of mathematical ways and to judge according to the nature of the activity and the desired outcome. People learn best when they are personally involved in the learning experience since learning has to be discovered if it is to have personal significance or make a difference. Considerable research has shown that people do use mathematical concepts in their jobs; some has shown that the mathematics learned formally has not been used. Learning about mathematics is only meaningful if it is accompanied by a pedagogy that raises questions about how it is that students produce meaning and how they become engaged in particular learning situations. This can only be done through a critical pedagogy that illuminates the knowledge, needs and concerns of both individual and group learners. Here the knowledge of numeracy is seen as important, not just for utilitarian or abstract purposes, but as part of students' attempts to understand their own individual and collective lives and to make their lives meaningful.
Benn, R. (1997) Adults count too: Mathematics for empowerment. Leicester: NIACE

Lena Lindenskov & Tine Wedege
Definition and Method
It is obvious that the kind of mathematics education that primarily consists of solving arithmetical problems is not sufficient for the development of the relevant competence in the participants. Nonetheless, it is obviously difficult to say constructively which math-containing competences are relevant, which competences people have and use, how they can be built up, strengthened and expressed, and to what extent the public debate makes room for their expression. In order to deal with such essential, but difficult questions, we must develop

the concept of numeracy in relation to adults' math-containing everyday competences, both from a social and a subjective point of view. We have developed a working model for numeracy as an everyday competence, and in the following we will describe how we have arrived at it and what it consists of, including examples of what it can be used for.
Our two-pronged general definition of *numeracy* describes a math-containing everyday competence that everyone, in principle, needs in any given society at any given time:
Numeracy consists of functional mathematical skills and understanding that in principle all people need to have.
Numeracy changes in time and space along with social change and technological development.
It is this "in principle" that makes possible a general evaluation (as in the big international surveys) and the developing of general courses in numeracy. All adults who participate in a numeracy course will, in fact, have their own perspectives (why am I here?), their own backgrounds and needs (what am I going to learn?) and their own strategies (what am I learning?)
The second part of the definition has to do with numeracy as historically and culturally determined. It may well seem banal, but we wish to emphasise that numeracy is different in the Denmark of today than the Denmark of just ten years ago. And that numeracy in Denmark today might be different to numeracy in Colombia today.
Lindenskov, L & Wedege, T (2001) 'Numeracy as an Analytical Tool in Mathematics Education and Research', Centre for Research in Learning Mathematics (Publication No. 31), Roskilde University, IMFUFA, Roskilde

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Diana Coben
Defining numeracy
Numeracy is a notoriously slippery concept (Withnall 1995, Evans 1989). There is no shortage of definitions but there is, crucially, a shortage of consensus, with the term meaning different things in different educational and political contexts (Coben 2000a) and in different surveys of need (Coben 2001). In the international Adult *Literacy and Lifieskills Survey* (ALL) numeracy is considered as:
the ability to interpret, apply, and communicate mathematical information (National Centre for Education Statistics 2002)
In England the meaning of numeracy is being set by the government's *Skills for Life* strategy (Department for Education and Skills [13fES1 200 1), which includes national standards (Qualification and Curriculum Authority [QCAJ, 200 1) and tests', an Adult Numeracy Core Curriculum (Basic Skills Agency [BSAI 200 1), and Subject Specifications for teachers' knowledge of numeracy (Further Education National Training Organisation [FENTO] 2001). In *SkilIs for Life,* numeracy and literacy are basic skills pertaining to the individual, in which levels are mapped across to the National Qualifications Framework:
the ability to read, write, and speak in English (or Welsh), and to use mathematics at a level necessary to function at work and in society in general. (BSA 2002)
In other words, adult numeracy education in *Skills for Life is* located firmly within Domain One in Kell's terms, on the basis of a definition of adult numeracy as a basic skill learned and practised by the individual, 'created through the standardising processes of fixing levels, writing unit standards and setting performance criteria' (Kell, 200 1: 100).
I want to emphasise the distinction between adult numeracy learning, adult numeracy as a skill, adult numeracy education and adult numeracy practice, because in lumping together practice, skill, learning and education in adult numeracy, as well as using the term to mean numeracy in the abstract, we risk adding to the confusion surrounding the term. Rather, adult numeracy practice may or may not involve learning and may or may not be skillful; adult numeracy learning may or may not involve practice; whatever the intention of teachers, adult numeracy education does not necessarily result in learning and it may bear little or no relationship to adult numeracy practice. My main focus here is on adult numeracy education, viewed in relation to practice. My contention is that adult numeracy education should aim to equip adults to use mathematics appropriately, confidently, meaningfully and effectively: appropriately, in relation to learners' own purposes for their learning; confidently, requiring that affective factors are given due consideration in the education process; meaningfully, in that mathematics without meaning is sterile; and effectively, because using mathematics ineffectively is a waste of anyone s time.
Coben , Diana (2002) Use Value and Exchange Value in Discursive Domains of Adult Numeracy Teaching in *Literacy and Numeracy studies – an international journal in the education and training of adults,* vol 11, no 2 pp25 – 35.

Mieke van Groenestijn

Numeracy, a dynamic Concept

The essence of all definitions is that numeracy is about *"mathematics embedded in a situation*" in a very broad sense. Second, math is a *'functional"* part of real life situations that adults *"have to manage"*. In addition to these main topics, issues are mentioned as *'feeling confident with numbers",* being able to *"communicate"* about mathematical topics, math as a tool for *"describing and analyzing our world*", math for *"effective functioning in one's group and community"*, math for "*critica*l *and effective participation in a wide range of life roles"* and the capacity to *'further one's own development"*.

These descriptions tell us that numeracy:

- includes functional mathematics
- is more than the traditional mathematics learned in school
- is always embedded in a real life situation
- includes managing a mathematical situation
- includes interpretation of and critical reflection on mathematical information
- includes communication and reasoning about mathematical information
- may differ per person, depending on one's situation
- is the basis for further learning

Numeracy encompasses the knowledge and skills required to effectively manage mathematical demands in personal, societal and work situations, in combination with the ability to accommodate and adjust flexibly to new demands in a continuously rapidly changing society that is highly dominated by quantitative information and technology.

The essence of numeracy is that it has its own content for every individual person - it depends on his or her personal and societal life and real life experiences - and that it is only a part of the person's total knowledge and skills. Everybody carries a backpack filled with a mix of real-life experiences and school knowledge and skills, built upon a variety of language, mathematical, cultural, social and emotional aspects. We would argue that these aspects should not be seen as loose elements but as an *entity*. They can be distinguished but not separated from each other. It is only possible to stress a specific part of this entity in a specific situation. Numeracy must always be seen as part of this broader set of knowledge, skills and feelings.

Groenestijn, Mieke van (2002) *A Gateway to Numeracy – a Study of Numeracy in Adult Basic Education* (section 2.3),

Utrecht CD β Press, Centrum voor Didactiek van Wiskunde, Universiteit Utrecht (CD-β wetenschappelijke bibliotheek, nr. 40) - ISBN 90-73346-47-9

Adult Numeracy Core Curriculum (UK)

Numeracy

Mathematics equips pupils with a uniquely powerful set of tools to understand and change the world' (The National Curriculum, (QCA). Changing the world may not be the immediate goal of adult learners, but being numerate - acquainted with the basic principles of mathematics is essential to functioning independently within the world. In everyday life we are confronted with numbers, from getting on the right bus or putting coins in a parking meter, to choosing the best deal on a mobile phone or a pension plan. Increasingly, we are bombarded with charts and statistics to inform us, persuade us, impress us, convince us - without some understanding of how to interpret data it is difficult to see how we can be independent citizens and consumers. And, in employment, research has indicated that numeracy, even more than literacy, has a powerful effect on earnings.

It is important that as well as developing skills in manipulating numbers, learners understand and make connections between different areas of mathematics so that they are able to apply skills to solving problems in a range of contexts. In the process, they may also begin to discover the joy and power of mathematics.

Basic Skills Agency (2001) *Adult Basic Skills Core Curriculum*. London: Basic Skills Agency

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National Curriculum (Primary) (UK)

What is numeracy?

Numeracy is a proficiency, which involves confidence and competence with numbers and measures. It requires an understanding of the number system, a repertoire of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands practical understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables.

Your pupils should:

have a sense of the size of a number and where it fits into the number system;

know by heart number facts such as number bonds, multiplication tables, doubles and halves;

use what they know by heart to figure out answers mentally;

calculate accurately and efficiently, both mentally and with pencil and paper, drawing on a range of calculation strategies;

recognise when it is appropriate to use a calculator, and be able to do so effectively;

make sense of number problems, including non-routine problems, and recognise the operations needed to solve them;

explain their methods and reasoning using correct mathematical terms;

judge whether their answers are reasonable and have strategies for checking them where necessary;

suggest suitable units for measuring, and make sensible estimates of measurements; and

explain and make predictions from the numbers in graphs, diagrams, charts and tables.

Department for Education and Employment (1999) *The National Numeracy Strategy - Framework for Teaching Mathematics from Reception to Year 6. London: DfEE*

British Dyslexia Association Maths Index

2. What do we mean by "mathematics"?

People often have difficulty with aspects of numeracy, for example, learning times tables facts, yet they can be successful in mathematics. Mathematics is made up of many varied topics such as shape and space. It is not just numeracy.

Unfortunately mathematics begins with numeracy and it is these early experiences of numbers that can be so influential in setting the attitudes to learning mathematics. If these initial problems can be addressed then there are no reasons why a dyslexic pupil cannot achieve good grades in GCSE and beyond.

3. Why should there be difficulties in numeracy?

It is not surprising that those who have difficulty in deciphering written words and learning patterns involving symbols should also have difficulty in learning the various facts, notations and symbols which are used in mathematics. If teachers are aware of the potential learning barriers and if they can present the work in ways, which minimise these effects, then the dyslexic pupil can succeed in numeracy.

The Numeracy Strategy will have some benefits for dyslexic pupils, for example, it encourages pupils to extend known facts as with deriving 4 x facts by doubling 2 x facts. The structure allows for frequent returns to topics thus allowing revision opportunities. There are also areas and approaches, which will be less 'dyslexia friendly' such as the emphasis on rote learning basic facts and the general pace at which the Strategy moves along.

4. Mathematics or Numeracy?

What do we mean by mathematics?

Mathematics comprises many varied topics such as shape and space. It is not just numeracy.

Unfortunately mathematics begins with numeracy and it is these early experiences of numbers that can, be so influential in setting the attitudes to learning mathematics. It should be remembered that most people do not use any more than basic arithmetic beyond school.

Today being poor at maths is socially acceptable, therefore is not seen as being as serious a life skills problem as it really is.

Problems in basic arithmetic can cause difficulty in everyday situations and may cause embarrassment. If these initial problems can be addressed then there are no reasons why a dyslexic pupil cannot achieve good grades in GCSE and beyond.

British Dyslexia Association (2001) *Maths Index: Dyslexia and Mathematics.* London: BDA

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ALM3 [1996]

Coben, D. (comp)(1997) *Adults Learning Mathematics - 3* (Proceedings of ALM3 the Third International Conference of Adults Learning Maths - A Research Forum) London: Goldsmiths College, University of London in association with ALM

ALM4 [1997]

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Johansen, L Ø. & Wedege, T. (comps)(2002) *Numeracy for Empowerment and Democracy* (Proceedings of ALM8 the Eighth International Conference of Adults Learning Mathematics - A Research Forum) Roskilde: Centre for Research in Learning Mathematics, Roskilde University in association with ALM.

Selected definitions of numeracy

Crowther (1959: par 40l):

'On the one hand is an understanding of the scientific approach to the study of phenomena - observation, hypothesis, experiment, verification. On the other hand is a need in the modem world to think quantitatively, to realise how far our problems are problems of degree even when they appear as problems of kind.'

Cockcroft (1982: par 39):

'We would wish 'numerate' to imply the possession of two attributes. The first of these is an 'at-homeness' with numbers and an ability to make use of mathematical skills which enable an individual to cope with the practical mathematical demands of his everyday life. The second is ability to have some appreciation and understanding of information which is presented in mathematical terms, for instance in graphs, charts or tables or by reference to percentage increase or decrease.'

Steen (1997: xx):

'There appears to be reasonable consensus among individuals of widely differing perspectives on the natural growth of numeracy from the basic arithmetic of grade school through the more sophisticated numerical reasoning of measurement, ratios, percentages, graphs, and exploratory data analysis that is now the centerpiece of middle school mathematics.'

Dossey (1997: 173):

'To understand the meaning of quantitative literacy, a better model is one based on a categorisation of mathematical behaviours into six major aspects:

Data representation and interpretation

Number and operation sense

Measurement

Variables and relations

Geometric shapes and spatial visualisation

Chance

These aspects provide a broad basis for examining the ability to interpret and act in a wide variety of mathematics-related settings.'

Johnston (1994: 34):

'To be numerate is more than being able to manipulate numbers, or even being able to 'succeed' in school or university mathematics. Numeracy is a critical awareness, which builds bridges between mathematics and the real world, with all its diversity.'

... in this sense ... there is no particular 'level' of Mathematics associated with it: it is as important for an engineer to be numerate as it is for a primary school child, a parent, a car driver or gardener. The different contexts will require different Mathematics to be activated and engaged in...'

Australian Council of Adult Literacy (199l):

Literacy involves the integration of listening, speaking, reading, writing and critical thinking; it incorporates numeracy. It includes the cultural knowledge, which enables a speaker, writer or reader to recognise and use language appropriate to different social situations. For an advanced technological society such as Australia, the goal is an active literacy, which allows people to use language to enhance their capacity to think, create and question, in order to participate effectively in society.

From: Policies and Pedagogies for Lifelong Literacy: International Perspectives for the 20 Century, 2001,p. 5.

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