# Policies and practices for adults learning mathematics: opportunities and risks

## Proceedings of the 9th International Conference of Adults Learning Mathematics (ALM9)

A Research Forum

**17 - 20 July 2002**

**Uxbridge, London, UK**

Compiled by
Jeff Evans, Pat Healy, David Kaye, Valerie Seabright and Alison Tomlin

Adults Learning Mathematics - A Research Forum
and
King's College London

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# About ALM

*Adults Learning Mathematics - A Research Forum* (ALM) was formally established at the Inaugural Conference (ALM - 1) in July 1994 as an international research forum with the following aim:

> To *promote the learning of mathematics by adults through an international forum which brings together those engaged and interested in research and developments in the field of adult mathematics learning and teaching.*
>
> Within ALM the term mathematics is understood to include numeracy.

**ALM and Charitable Status**

ALM is a Registered Charity (Charity Number 1079462) and a Company Limited by Guarantee (Company Number 3901346).

The company address is: c/o Sue Elliott, School of Education, Sheffield Hallam University, 36, Collegiate Crescent, Sheffield S10 2BP, U.K.

**Objects of ALM**

The Charity's objects are the advancement of education by the establishment and development of an international research forum in the life-long learning of mathematics and numeracy by adults by:

- encouraging research into adults learning mathematics at all levels and disseminating the results of this research for the public benefit;
- promoting and sharing knowledge, awareness and understanding of adults learning mathematics at all levels, to encourage the development of the teaching of mathematics to adults at all levels, for the public benefit.

**Working to Achieve These Objects**

ALM members work in a variety of educational environments to improve the learning of mathematics by adults. Currently many of our members are involved in the adult basic education programmes. Other members are involved in teaching mathematics at all levels in higher education, including initial teacher training and ongoing professional development of teachers.

ALM provides opportunities for teachers to bring successful practice from their own classrooms to a wider audience. This happens at the annual conference and throughout the year in the ALM newsletter and through the communication and networking encouraged by the forum. By reflecting on our own practice and the practice of others and by fostering

international links between teachers, we are able to encourage the transference of good practice in curriculum design, and in teaching and learning materials and methods, which have evolved in different countries. Innovative ideas are enhanced through critical appraisal by fellow participants, and pass into the public store of educational material when the Proceedings of conferences are published.

There is not enough information available about what mathematics is needed by adults in their daily and working lives, how adults learn mathematics, and what the most effective teaching and learning practices are. Our aim is to connect research with practice, by bringing the experience of practitioners and students to bear on the formulation of research questions and the conduct of research, and by making academic research accessible to teachers and therefore of benefit to their students.

The organisation does not support a single theoretical framework, or commission or conduct research. The presentation of papers at our annual conference provides an opportunity for discussion on research methods and findings, which constitutes an active and participative public peer review process and quality enhancement mechanism.

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**Prof. Dr. Juergen Maasz,** University of Linz, Linz, Austria

Chair of ALM

# Preface

The 9th Annual Conference of Adults Learning Mathematics was held over four days (17-20 July) in the Summer of 2002 at Uxbridge College, London, UK. About seventy people from ten countries gathered to continue or join the discussion around the theme of 'Policies and Practices for Adults Learning Mathematics: Opportunities and Risks'. This was seen as particularly relevant to the current UK context, where a major government initiative is providing financial opportunities to increase the provision and research of adult numeracy education (alongside similar developments for Literacy and English for Speakers of Other Languages). However, there are risks in the way the policy is being implemented, with control resting with a central strategy unit, experiments in coercion to attend courses and an emphasis on mathematical skills as universal and neutral. These opportunities and risks reflected the two approaches identified in the Preface to the ALM8 Proceedings, society's requirements of numeracy or adults' need for numeracy.

This conference sought to address both this particular UK context and to continue the international dialogue between researcher and practitioner that is the core of all ALM activity. These twin objectives were met by the contributions of thirty people who delivered between them 4 plenary sessions, 15 paper presentations, 11 workshops, 4 topic and discussion groups and 2 poster presentations.

One plenary session was delivered each day of the Conference, giving an opportunity for participants to gather together and to hear diverse views on the conference themes. These are presented at the beginning of these proceedings. The other contributions were presented in parallel sessions, producing the inevitable dilemma for participants to make impossible choices. These proceedings now give an opportunity to read all the sessions. They are presented under the three main themes that developed whilst planning the conference: Research Methods and Questions, Teaching Strategies and Methods, Policy and Curriculum Initiatives.

The continuing Topic Groups and one new discussion theme complete this record of ALM9. The Topic Groups form a conduit for ideas to flow from one ALM conference to another, and the discussion group provides an opportunity for new themes to be explored.

The success of the ALM9 conference was very largely built on the success of the conferences before. As our colleagues writing the preface to ALM7 proceedings said

> [these proceedings] serve as a vehicle that frames the emergent knowledge base and the current agenda of theory, practice, research and policy in the field of adults learning mathematics.

Acknowledgements

ALM would like to thank Uxbridge College, which provided the venue, teaching and catering facilities throughout the conference and in particular Jean Potter, Sheila Egan and the Principal, Rachel Davies. The organising committee owes a particular debt to Julie Wright, the Conference administrator. Finally we thank all those who participated in the conference.

**ALM9 Organising Committee**

Jeff Evans

Pat Healy

David Kaye

Valerie Seabright

Alison Tomlin

# Contents

## Plenary Lectures

Adult learners of mathematics:
A look at Issues of Class and Culture ..... 13
*Marta Civil*

What do we know and what do we need to know?
Researching adult numeracy ..... 24
*Diana Coben*

Mathematics or Numeracy: Does it really matter? ..... 34
*John O'Donoghue*

Using mathematics in the workplace: is the
'knowledge society' for real? ..... 44
*Alison Wolf*

## Topic & Discussion Groups

Topic group A: Developing a theoretical framework
on adult learning and teaching
*Convenors: Kathy Safford & Juergen Maasz*
*Tine Wedege* ..... *46*
*Juergen Maasz* ..... *48*
*Kathy Safford* ..... *51*

Topic group B: Mathematics education for the workplace
*Convenor: Lisbeth Lindberg* ..... *55*
*Jaine Chisholm-Caunt* ..... *57*

Topic group C: Affective factors in
adult mathematics learning
*Convenors: Wolfgang Schlöglmann & Jeff Evans*
*Wolfgang Schlöglmann* ..... *61*

Discussion group: Professional Development ..... 66
*Facilitators: Terry Maguire and Lena Lindenskov*

# Papers, Workshops & Poster Presentation

**Research Methods and Questions**

Adult problem solving and commonsense ..... 70
*Noel Colleran, John O'Donoghue & Eamonn Murphy*

Mathematics done by adults portrayed as
a cultural object in advertising and in film ..... 82
*Jeff Evans*

Algorithms and the 2002 National Baseline
Survey of Numeracy ..... 93
*John Gillespie*

Defining Numeracy ..... 102
*David Kaye*

Policies and pedagogies for lifelong numeracy (PPLN)
An International Collaborative Project ..... 107
*Terry Maguire, Betty Johnson & Keiko Yasukawa*

Self-System Processes and Affect in Learning Mathematics ..... 116
*Marja-Liisa Malmivuori*

Research-based Practices: A Summary of
Findings from American Doctoral Dissertations 1980-2002 ..... 124
*Kathy Safford*

Sharing Our Bibliographies: Books That Lead,
Push and Inspire Us to Better Practice ..... 139
*Kathy Safford*

Education in Mathematics for Adults Today ..... 143
*Wolfgang Schlöglmann*

**Teaching Strategies and Methods**

Pilot Research ..... 151
*Richards Angiama*

Art and Math ..... 159
*Eigil Peter Hansen*

Risks – Do the mathematical materials available
to our students enable learning? How could we
make them more effective? ..... 165
*Pat Healy*

Numeracy at the Workplace ..... 166
*Ben Hermeler*

Changing Faces of Adult Literacy, Numeracy and ESOL:
A Critical History of Policy and Practice 1970-2000 ..... 171
*Yvonne Hillier*

Modelling Workshop: Which is my Favourite Phone Tariff? ..... 174
*Juergen Maasz & Wolfgang Schlöglmann*

Communication & Power ..... 181
*Kate Newman*

Thinking and writing about maths activities:
a student's perspective ..... 189
*Caz Randall*

Sharing IT Experiences in the Delivery and
Support for Numeracy Practitioners ..... 190
*Valerie Seabright*

**Policy and Curriculum Initiatives**

The importance of adequate Teacher Training
for teachers of adult Numeracy ..... 193
*Tiggy Ayoub*

Consultation Research in Adult Numeracy ..... 195
*Ruth Polkinghorne*

Reflection on the New Adult Numeracy Curriculum England ..... 203
*Dhamma Colwell*

Why Teach Numeracy to Adults? ..... 204
*Lene Østergaard Johansen*

Opportunities and Risks in Exchange Across Borders ..... 214
*Lena Lindenskov & Ben Hermeler*

Lifelong Education an Organising Principle for
Policy Development – an Opportunity? ..... 221
*Terry Maguire & John O'Donoghue*

The differences between competence testing and
diagnosing the underlying reasons for the problems
some students have with mathematics ..... 230
*Jan Nankler*

The Education and the Final Examination Must
be a Single Coherent Unit..... 231
*Per Odergaard*

Is your college ready to provide a numeracy based
Human Rights Education Curriculum? ..... 235
*Tracy Part*

# Plenary Lectures

# Adult Learners of Mathematics: A Look at Issues of Class and Culture

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This paper draws on my work with parents and mathematics in working class, Hispanic communities in Tucson, Arizona. My goal is to show how this research on parents as adult learners can inform our work with adult learners in general. I first look at three bodies of research that have been very influential in my work with adult learners: a) 'funds of knowledge'; b) ethnomathematics; c) dialogical learning. I then use examples from my work with parents as learners of mathematics to illustrate some of the possible implications from these three bodies of research. In previous ALM presentations (Civil, 2000; 2001) I have discussed the dilemma of parents as parents (i.e., as learners for their children's sake) vs. parents as adult learners (i.e., as learners for themselves). This dual role that many adult learners (particularly women) are likely to experience is not unique to my work that focuses specifically on parents. Researchers such as Brew (2001; 2002) and FitzSimons (2002), while focusing primarily on adult learners in general, have recently highlighted the role that children play in mothers' decisions to undertake adult education. Thus, in this paper I revisit this dual role as parents and adult learners and also look at our more recent work, which adds one more role, parents as teachers. I use these three roles to suggest implications for mathematics learning experiences for adults.

## Uncovering the Community Knowledge

I have been working in Mexican / Mexican-American communities in Tucson, AZ for about 10 years now. There are certainly differences across these communities and even within one given neighborhood. Some families may be living in established neighborhoods and in fact may have been living there for many generations; others may be recent immigrants; some may speak English only, others Spanish only, and yet others may be bilingual (and with different levels of bilingualism). Some may have had quite a few years of formal schooling in their country of origin, but because of their lack of knowledge of English and other circumstances, they may be working at jobs that do not reflect their schooling (I have met quite a few college educated individuals working as custodians, classroom aids, restaurant helpers, and other jobs paying minimum wage or slightly above).

My interest in Adult Education is grounded on these initial experiences that I had with working-class families who are working hard at trying to make it and above all are trying to provide a 'better' living for their children.

In general terms, the children in these neighborhoods do not achieve academically as high as those in other wealthier parts of town. The typical rhetoric tends to blame families and communities for those failures. I have certainly witnessed comments along the lines of 'if we could only get these people to value education as much as [some other ethnic group] does;' or, 'let's face it, most of these students [at a high school in one of these working class, Latino neighborhoods] will not go into college,' or 'many of these kids are not college material, and

we do need people to do [some low-paying job].' Yet our conversations and more formal ethnographic work in these communities reveal a very different picture. It shows the richness that resides in these communities. Through ethnographic household visits and occupational interviews we have been able to document a wealth of 'funds of knowledge' in these communities we work in.

**What are Funds of Knowledge?**

A key theoretical concept in our work is that of funds of knowledge, which are 'the essential bodies of knowledge and information that households use to survive, to get ahead, or to thrive' (Moll, Vélez-Ibáñez, & Greenberg, et al., 1990, p. 2). Through our work we have gathered information on the labor and social history of language and ethnic 'minority' families as well as information on their views on education, and on the children's daily activities and chores. Many of these families have an extensive knowledge about construction, repairs, carpentry, household management, folk medicine, farming. Of particular interest for our educational goals is the fact that the children in these families participate in many of these activities, often learning about them through an apprenticeship model. Hence, these children come to school with knowledge about welding, construction, financial transactions, car repair, child care, and so on. Outside school, they are resourceful and creative problem-solvers. Inside school, often they have been exposed to what characterizes schooling for poor and minority children: basic skills, drill, rote-like learning. Although our work has focused on implications for the children's education, I have been intrigued by the implications for adult education. What would a Funds of Knowledge adult education program (in mathematics) look like? This question is addressed in what follows.

**Ethnomathematics**

My work with preservice teachers, and in particular with those 'non-traditional' students (i.e., mostly women returning for a college degree after having raised a family) made me notice that often, among those who claimed to be 'less successful', were those who tended to want to make sense of the problems and make connections to their everyday experiences.

On the other hand, the 'more successful' students were less likely to make use of informal methods, everyday type reasoning; they would rather use a formula, algebra, school-like methods. These students were regarded by the former as being smart, even though, in many cases they were not really all that successful with the formal approaches. To me it was interesting to note that those 'less successful' by school / formal standards, were actually much more creative and resourceful in their problem-solving approaches. Unfortunately, many of them did not value their own methods, dismissed them (cf. Coben, 1999, on 'just common sense') and asked to be shown the 'proper' way.

This led to my interest in the notion of beliefs about mathematics and in particular to studies on street / everyday math and school math (Lave, 1988; Nunes, Schliemann, & Carraher (1993); Saxe 1988). In fact it is this need to better understand the mathematics embedded in practices (e.g., Cox Hancock's (1994) study of seamstresses; Masingila's (1994) study of carpet layers; Millroy's (1992) work with carpenters; Hoyles, Noss, & Pozzi (2001) study of nurses; Smith's (2002) study of automobile workers) that led to our in-depth occupational interviews (e.g., with a seamstress, with a carpenter, etc.). I will return to the implications

from these interviews for adult education later in the paper. In this section my goal is to focus on the concept of ethnomathematics, and in particular on its relevance for adult education. To this end, I find Knijnik's work (1993; 1996) with adults extremely helpful. In particular, let's recall her concept of an ethnomathematical approach,

> *research* into the conceptions, traditions, and mathematical practices of a specific subordinated social group and *pedagogical work* involved in making the group members realize that:
>
> 1. they do have knowledge;
>
> 2. they can codify and interpret their knowledge;
>
> 3. they are capable of acquiring academic knowledge;
>
> 4. they are capable of establishing comparisons between these two different types of knowledge in order to choose the more suitable one when they have real problems to solve. (Knijnik, 1993:24)

Notice the parallels between this approach and our concepts behind Funds of Knowledge. The key message here is the recognition of knowledge and resources among the groups of people who have often been marginalized (whether it be by language, culture, gender, race, or social class issues). Many of our adult learners come from these groups. As Benn (1997) and Knijnik (1993) point out, though, I am certainly not advocating that in our work with certain groups who have been marginalized we focus primarily on their ethnomathematics.

In fact, the women I have been working with have expressed a clear interest in learning 'academic' mathematics. I agree with Knijnik (1993) when she says that 'merely glorifying popular knowledge does not contribute to the process of social change' (p. 25). As Benn (1997) points out, there are different forms of mathematics, each associated with a different discourse and set of values. Our task, I think, is to accept and value these different forms and bring them into the open for discussion. I think that the pedagogical approach embedded in dialogic learning (Flecha, 2000) enables us to do this.

**Dialogic Learning**

My initiation into my current work with working class women (most of whom are Mexican or of Mexican origin) took place several years ago with a small group of Mexican immigrant women who were part of a Literature Club in Tucson. In designing this Club, the facilitators moved away from the typical offerings to families that are often found in working class, minority communities. The emphasis of these offerings tends to be on the teaching of English as a second language, and in general on programs that focus on what families are seen to be lacking, reflecting a deficit orientation towards these families. In describing how the Literature Club functions, Andrade, González Le Denmat & Moll (2000) write,

> (1) It does not subscribe to the authority of the teacher; (2) the curriculum is created through collaboration with the participants; (3) all those in attendance are knowledgeable and literate; and (4) the content of the literature remains at a high intellectual level (p. 273).

And indeed the members of this Literature Club read key literary pieces, often by women and about women. Their discussions were guided by a basic rule: 'no one [this includes the facilitators] is better than anyone else in the group.' This rule is strikingly similar to the

principles behind dialogic learning in the literary circle described by Flecha (2000). In that literary circle in an adult education center in a working class neighborhood in Barcelona the group agrees on a book to read and discuss. Then,

> Each person chooses a passage to read aloud and explain why it was particularly meaningful to him or her. The dialogue constructed is then based on these contributions… No one determines the correct or incorrect reading based on his or her position of power. (Flecha, 2000:4)

A key concept in dialogic learning is the notion of an egalitarian dialogue, which as the excerpt above indicates, is a dialogue in which the validity of a contribution is NOT determined on the basis of who is giving the contribution, that is what his or her position of power is. The validity is determined through discussion in the group. What may this look like in a mathematics setting? Could we envision a 'mathematical circle' in which adults and facilitator(s) engage in dialogic learning about mathematics?

Flecha also brings in the sociocultural component, which as I presented earlier is key to our Funds of Knowledge orientation. So, in a sense, I have come full circle. I started this paper with the importance of Community Knowledge and a brief description of the concept of Funds of Knowledge. The notions behind Ethnomathematics, and in particular as they apply to adult learners, nicely complement the Funds of Knowledge orientation. Finally, Dialogic Learning provides a pedagogical framework that allows me to blend the principles behind Funds of Knowledge and Ethnomathematics. Figure 1 summarizes my proposed 'model.' In the rest of this paper I focus on specific examples from my work with adults and mathematics to address the challenges and rewards of trying to bring together these three bodies of research.

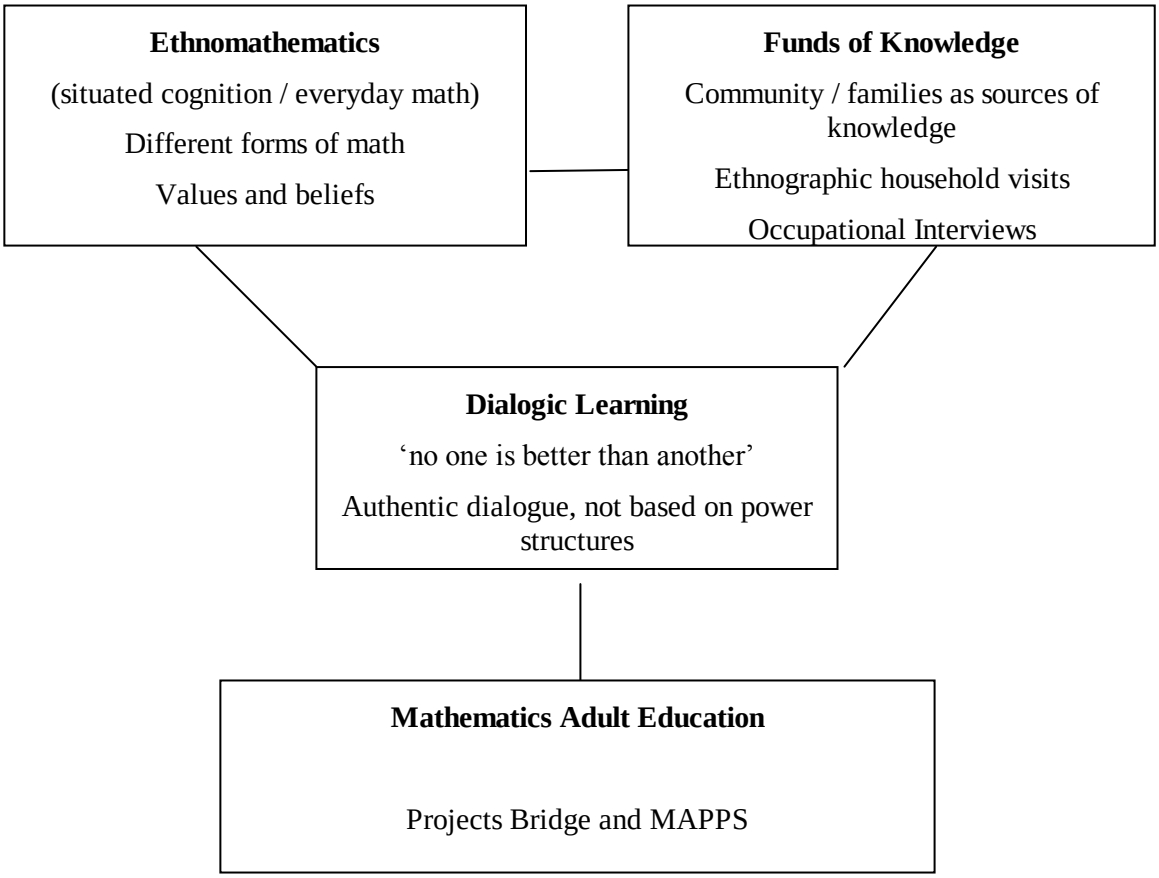


Figure 1. A proposed model for my work with adults and mathematics.

**Working with Parents as Adult Learners**

As I began my work with parents as learner of mathematics, I was drawn to the concept of parents as intellectual resources and to the possibility of creating opportunities for parents to explore mathematics as adult learners in order to promote their own development. We developed a series of mathematical workshops in which we engaged as a group in doing and discussing mathematics.

Yet, as I thought about what these explorations could look like, an array of questions came to my mind. The rest of this paper presents several of these questions and some examples from my work[1] to illustrate what I mean.

[1] I will be focusing on two projects. Project Bridge (Linking home and school: A bridge to the many faces of mathematics) is supported under the Educational Research and Development Centers Program, PR/Award Number R306A60001, as administered by the OERI (U.S. Department of Education). Project MAPPS (Math and Parent Partnerships in the Southwest) is funded by the National Science Foundation (NSF) under grant – ESI-99-01275. The views expressed here are those of the author and do not necessarily reflect the views of the funding agencies.

**What mathematics should we be discussing in these workshops?**

Project Bridge, where these initial workshops took place, is grounded on the Funds of Knowledge concept. My original idea was to somehow develop these workshops out of the mothers' uses and knowledge of mathematics in their everyday life. As I discussed in ALM 5 and 6 as well as in González, Andrade, Civil, & Moll (2001), the transformation of this everyday knowledge into mathematical knowledge to be used in school or in workshops for adults, proved to be quite challenging. One reason for the challenge was my own limitation: I was trained in formal mathematics and had little if any experience with many of the practices that we uncovered in our visits and occupational interviews. As Fasheh (1991), formally trained in mathematics, wrote about his mother's mathematics embedded in her practice of sewing, 'it struck me that the math she was using was beyond my comprehension. (...) Mathematics was integrated into her world as it never was into mine' (p. 59). Similarly, Millroy (1992) writes about what she considers to be a paradoxical situation in ethnomathematics work, 'how can anyone who is schooled in conventional Western mathematics 'see' any form of mathematics other than that which resembles the conventional mathematics with which she is familiar?' (p.11).

Our attempts to bridge these different forms of mathematics brings up questions around values: What are our values about mathematics? What do we count as being valid mathematics? My work is with women whose knowledge of mathematics (and their knowledge in general) has often been considered marginalized and of little value.

What can I do to change this, while keeping in mind Benn's (1997) pointed question 'is the use of contexts derived from women's traditional domains, say the home, reproductive or legitimising and hence emancipatory' (p. 178)? Furthermore, the women we work with, maybe because they first joined the workshops as parents (that is as learners for their children's sake), want to learn school (academic) mathematics. In this sense they are no different from most of our adult education students (Benn, 1997): they too want to learn academic mathematics.

In ALM 7, I presented an experience that allowed us to successfully combine these forms of mathematics, while focusing on academic mathematics. This was possible through the joint exploration of the Mexican craft of Papel Picado (punched paper). Using colorful paper one creates intricate designs by cutting out shapes in a careful and pre-planned fashion. Making 'papel picado' allows for an exploration of symmetry. We also took it in more artificial directions (but that tied in with our previous more school-like activities), such as finding areas and perimeters of the shapes being cut out. It eventually led to the need to find the area of circles, which took us to discuss $\pi$ (pi). An interesting aspect of this activity was that the mothers were guiding the practice, as I knew nothing about 'papel picado'. As we worked on cutting out shapes, I would pose 'innocent-sounding' questions, such as 'I wonder what the area of all this paper we are cutting out is?' Of course, the women knew how irrelevant the question is, but were eager to engage in the challenge of finding out. 'Papel Picado' provided us an arena for our joint exploration of academic mathematics, and although the mathematics was meaningless from the point of view of the practice, the practice and their teaching me how to do it were meaningful.

In the Bridge setting, we learned as a group. There were only a few mothers in this project, usually around five. It was very clear that the mothers had a say in what they wanted to learn (e.g., they directly asked me for algebra) and I tried to design activities that would address their needs while being true to my pedagogical beliefs, which are grounded in the notions of dialogic learning discussed earlier as well as with a strong belief in the fact that learners need to make sense out of the mathematics they are learning. Thus, although their request for algebra had to do with their wanting to learn how to manipulate meaningless symbols (in order to help their high school age children), I approached it from a conceptual understanding point of view. I know we did not get to the point in which they could solve equations and manipulate algebraic expressions like high school students are expected to. I also know that with more time, we would get there.

**What do parents value in terms of instructional approach?**

In my paper for ALM 8, I described three of the Math For Parents courses that we had taught so far as part of project MAPPS and the three different instructional approaches that each instructor used.

One was along the lines of dialogic learning, with parents and facilitators sharing into the dialogue, like a family; another course was more teacher-centered and the last course was more student-centered (but still quite under the control of the teacher). All of our courses make use of hands-on materials and group work (to a different extent, depending on the instructor).

The parents always comment on these characteristics as being very different from their own experience as children when they went to school (whether in Mexico or in the US). One challenge that we have encountered in trying to uncover what parents value in terms of both pedagogical approach and content is that most parents feel very positive about everything that takes place in our activities, or at least, so they say. Certainly one key characteristic in our programs is to work on the atmosphere: we want parents to feel comfortable doing mathematics and sharing their ideas. As research in Adult Education has shown, one of the biggest obstacles that adult learners (and thus their instructors) face is the fact that many of them return to study with not very good memories of mathematics in school (Evans, 2000; FitzSimons, 1994). Thus, for us it is imperative to work to counteract that. Furthermore, the lack of a clear terminal objective in our work with parents (do they take the courses for their own learning? to help their children?) and therefore the fact that there are no formal assessments associated with our activities, may help parents be more at ease. They do not necessarily feel they are under the spotlight.

Most parents comment very positively on the opportunity to work in groups, not just from an affective point of view (they enjoy sharing and talking to their friends at the table), but cognitive (they appreciate seeing different approaches to a given task). They also value the opportunity to engage with other adults in discussions about an intellectual matter. In particular, several women who come in as friends enjoy this other twist to their friendship: they are no longer ‘just’ sharing stories about their children and in general about their everyday life; they are now talking about mathematics together. Although it would be hard to talk about a teaching philosophy that all project staff can agree upon, I would say that most of us had in mind an approach to adult education that gives them a voice in their

learning process. These adult learners appreciated being treated as equals:

> *For me the relationship with the instructor was very important. It was a relationship based on equality, I don't feel that because one is a teacher he should feel superior to us; this was a very positive relationship in which the teacher used his knowledge in a positive way, always treating us all as equals, and I always felt very comfortable. [MAPPS participant]*

**What is the role of our beliefs about mathematics and about its teaching and learning?**

This question has multiple implications, in particular when we look at parents as adult learners but also as parents. As adult learners, we may be encouraging parents to work in groups, to discuss mathematics, to explore different approaches to a problem.

Yet, is this the approach that their children are experiencing in their school mathematics? I briefly alluded to some of the dilemmas that my work with parents has posed for me (e.g., the group of mothers who wanted to learn algebra). Some times parents bring examples of rather dry homework questions that their children have been asked to solve, or they ask about a method that I may find completely procedural and devoid of meaning, yet that is what their children are being asked to use. Of course at other times, the teachers are the ones encouraging a more flexible, investigative approach, but then the testing comes into play. Generally speaking their experiences as adult learners in our programs are quite different from their experiences when they were in school and may in some cases (but I want to emphasize that not always) be different from what their children are experiencing. One possible consequence from engaging parents as learners of mathematics in a more freeing approach may be that they become supporters and even advocates of these approaches for their own children.

> *MAPPS has been very different from my previous experience (with math). I went through my whole life being told how things were not and not given any freedom to figure it out on my own.*

> *I'm amazed because [I see] something that I didn't see before, and it clicks in my mind and I understand why things are the way they are. I get excited because now I know , I'm not accepting it, now I know why that is the way it is.*

As parents themselves learn mathematics with an emphasis on understanding rather than rote memorization, they become quite vocal about the importance of understanding for their children's mathematics education.

As one mother very eloquently said, 'I don't want them [teachers] to teach to the test. You have to be versatile in many things. If you don't understand, what's the point?'

Underlying these experiences are the different players' beliefs. Parents come to these courses and workshops with often fairly well established ideas about what mathematics is and what its teaching and learning should look like. The authors of the Math for Parents materials also have their own beliefs that are reflected in the activities. The instructors of these course

bring in their own beliefs too, which may or may not be in agreement with those of the parents or authors. Sorting through all these different and sometimes conflicting beliefs is an important aspect of our research agenda.

**What is the potential behind parents (and more generally adult learners) as teachers?**

As part of our leadership development goal we have teams of teachers and parents delivering workshops to other parents. This aspect of our project has been a source of surprises for us. In the planning stages many of us were thinking that the teachers would be the main ones delivering the mathematics workshops and that the parents would take more of an assisting role. Well, due to different constraints on the arrangement of teams (e.g., some teams have only parents in them) and other reasons (some parents felt ready to take a leading role and wanted to do so),we now have a mixed model in which quite often parents are teachers to other parents. As one mother explained,

> *It was hard in the beginning to work with the teachers. 'They are the best.' They don't give you the opportunity that you may know more or bring other ideas. Now we are more equal. Before [with her hands she indicates parents in the team were at a lower level than teachers], but now [she indicates they are at the same level]. Now they rely on me, they check with me, they make you feel that you are important to them. One teacher once told me 'you just hand out papers' and I was upset. [Then she goes on to explain how in a more recent MAW [Math Awareness Workshop] she took the lead in the presentation.]*

Having parents as teachers has proved to be an extremely rich experience. It allows us to learn more about their understandings of mathematics, as well as about their beliefs about its teaching and learning. It has at some points been problematic (though often in the same ways as when teachers are presenting). But even with these possible problematic situations, I think that it is important to continue this approach given the enthusiasm with which the parents in the teams prepare for these workshops and how rewarding the experience seems to be for them. As these two mothers show in their reflection on what they pay attention to in their teaching, confidence, feeling comfortable, and equal contributions (again, a characteristic of dialogic learning) are key for them,

> *To give them confidence by telling them that I am also a mother like they are and that I may also have doubts and that we are ready to explain something again when they do not understand it. In conclusion, the important thing is to make them feel confident so that they will be encouraged to join this program.*

> *That parents know that I am teaching but they are teaching me too, not to make them feel like dummies. Let them contribute as much as I am contributing*.

The main goal in our projects is to engage parents as learners of mathematics. Thus, having parents teaching parents seems to make sense because as they have often told us and we see the evidence, they know how to connect to other parents. This is similar to having teachers teaching teachers in University-run professional development programs. The teachers in those programs are often very grateful to have teachers teaching because they understand their professional reality much better than university professors do.

In closing, as I said earlier, I came to this arena of adult learners through my work with parents. In several cases the parents in our projects have gone onto further adult education (along more formal lines). In this paper I have emphasized some general points that should be of interest to all of us who work with adult learners (whether parents or not). I would like to encourage adult educators to tap into the local schools for possible activities with parents as learners. It not only may encourage several of them to pursue further adult education, but I find it to be a very rewarding experience as it allows us to play a role at different levels including maybe children's experiences with school mathematics.

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# What do we know and what do we need to know?
# Researching adults learning mathematics – 10 years on

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Ten years ago the overwhelming response to my article, 'What do we need to know? Issues in numeracy research' (Coben, 1992), led to the founding of ALM. Ten years on, at our ninth international ALM conference, it seems a good time to review progress on research into adults learning mathematics, to ask again: what do we know and what do we need to know? In particular:

- what are the key issues and challenges in research into adults learning mathematics in 2002?
- what have we learned since 1992?
- where would we like to be in 2012 - and beyond?

Let's start by looking back over the past ten years.

## 1992-2002

In the decade since 1992, research in adult numeracy/mathematics education has undergone enormous change and development. ALM has played an important role in this development, one of which we can all be proud. So, here are some of my 'reasons to be cheerful'.

Opportunities for researchers and practitioners to meet and compare notes have mushroomed. To date these include: annual international ALM conferences; working groups on adult mathematics education at successive International Congresses on Mathematics Education (ICME8 and ICME9; ICME10 is planned for 2004 in Copenhagen, Denmark); in the UK, the London Language and Literacy Unit (LLLU) National Adult Numeracy Conferences; in Canada, the Summer Institute 2002 on 'Adult Numeracy and Basic Skills'; meetings of ANN (Adult Numeracy Network) in North America and of ALNARC (Adult Literacy and Numeracy Australian Research Consortium) in Australia. Other opportunities to meet stem from international groups for whom adult mathematics education is a major but not exclusive concern, such as Mathematics Education and Society (MES, formerly MEAS) and the International Study Group on Ethnomathematics (ISGEm).

Publications have proliferated, in the form of conference proceedings, books, articles and materials for teaching and for teacher education and websites (see list of URLs below). Conference proceedings include PDME (Political Dimensions of Mathematics Education; Kjaergård, Kvamme & Lindén, eds, 1996), MES/MEAS (Mathematics Education and Society; Gates, ed., 1998) and ALM Conference Proceedings (most recently, Østergaard & Wedege, eds, 2002) and the Proceedings of ICME (International Congress on Mathematical

Education) Working Groups on adult mathematics education (FitzSimons, ed., 1998; FitzSimons, O'Donoghue & Coben, eds, 2001). Edited collections giving an overview of the developing field of adult mathematics education include: *Perspectives on Adults Learning Mathematics* (Coben, O'Donoghue & FitzSimons, eds, 2000) and *Numeracy Development* (Gal, ed., 2000). Other edited collections span the adult/child divide (e.g., Tikly & Wolf, eds, 2000; Harris, ed., 1991). Roseanne Benn (1997) passionately argues that *Adults Count Too* and Jeff Evans (2000) considers *Adults' Mathematical Thinking and Emotions*. Mieke van Groenestijn (2002) builds a framework for what she calls Functional Numeracy Education (FNE) in her recent book. Gail FitzSimons' (1994) argues that the teaching of mathematics to adults returning to study could be enhanced by adopting a constructivist perspective.

Influential publications from related fields include Jean Lave's (1988) work on adults' problem solving strategies in their everyday lives (their 'situated cognition') which has influenced research by Evans (2000) and others (e.g., Watson, ed., 1998). Writers on ethnomathematics (the mathematics of social groups, embedded in their cultural activities and practices) draw on political theory and anthropology (Powell & Frankenstein, eds, 1997). Alan Bishop's (1988) identification of six 'pan-cultural' mathematical activities (counting, locating, measuring, designing, explaining and playing) has been applied as a basis for curriculum development in the workplace by Gail FitzSimons (2000). Similarly, Stieg Mellin-Olsen's (1987) description of 'folk mathematics' (i.e., mathematics mediated by artefacts and used by people in their everyday lives) led to his elaboration of Activity Theory in mathematics education, a theory that has proved to be a powerful framework in studies of mathematics used in the workplace (e.g., Kanes, 1997).

New curricula for adult learners, such as that in England (BSA, 2001) open up new possibilities, even as they arouse new concerns (Coben, 2001). Learning materials such as the CD Rom *The Numbers Disc* (CTAD, n.d.) and the ANAMOL (Adult Numeracy and Maths On-Line) Project (Marr, Johnston & Tout, 1999) show what can be achieved using new technology.

Such technological innovations exist alongside adult-focussed workbooks such as *The Numeracy Pack* (Coben & Black, 1998). In adult education undertaken as part of aid programmes in the developing world, REFLECT (an acronym of 'Regenerated Freirean Literacy Through Empowering Community Techniques') is unusual in placing aspects of mathematics (termed numeracy) at the heart of the educational enterprise (Foroni & Newman, 1998). In India, Anita Rampal and her colleagues also insist that *Numeracy Counts!* in their *Handbook for Literacy Activists and Resource Persons* (Rampal, Ramanujam & Saraswati, 1998).

Elsewhere, innovative work on assessment has been done, for example, in Ireland (Maguire & O'Donoghue, 2001) and The Netherlands (van Groenestijn, 2002:chapter 3). Developments in assessment have been usefully summarized, and suggestions for changes made, by Joy Cumming and Iddo Gal (2000). Schemes for teacher education, including *Adult Numeracy Teaching (ANT)* (Johnston & Tout, 1995) in Australia and the programme developed as part of *Skills for Life* in England (FENTO, 2002) aim to open up new horizons of professional development for adult mathematics teachers.

Centres for research and development have contributed to the increasing number of publications, including: in the USA, NCSALL (the National Center for the Study of Adult Learning and Literacy), NCAL (the National Center for Adult Literacy) and NIFL (the National Institute for Literacy); in Canada, NALD (the National Adult Literacy Database); and now, in England, the National Research and Development Centre for Adult Literacy and Numeracy (of which more below). All include the education of adults in mathematics (otherwise known as 'quantitative literacy' or 'numeracy') in their programmes, although in some literacy predominates. In The Netherlands, mathematics education has, since the 1970s, been greatly influenced by Realistic Mathematics Education (RME), which emphasises the importance of themes derived from the learner's context, learning as a social and constructive activity, and the integration of mathematics with other subjects (Freudenthal, 1991). Since 1990, the Freudenthal Institute in Utrecht has carried forward the development of RME, which (amongst other "ingredients", such as Freirean ideas, work on out-of-school learning, constructivism and Action Theory) has been influential in the work of adult mathematics educators, including Mieke van Groenestijn (2002:195).

Recent reviews of research include: Tout and Schmitt's (2002) review of the 'Inclusion of Numeracy in Adult Basic Education'; the review of research in adult basic skills by Greg Brooks and his colleagues, (Brooks, *et al*, 2000); Gail FitzSimons and Gail Godden's review of research on adults learning mathematics (2000) and Kathy Safford-Ramus' review of research on adult mathematics education in North America (Safford-Ramus, 2001).

These confirm that much remains to be done but also show a significant increase in activity since the publication of an earlier review (ALBSU, 1994).

As well as these positive developments, we face challenges. Ours is a diverse field with an identity crisis: 'numeracy' is a slippery concept, susceptible to various definitions. Adult numeracy remains the 'poor relation' of adult literacy and adult mathematics education is the poor relation of mathematics education in general. Despite recent developments, the field is still under-researched and under-developed, as the recent reviews of research, listed above, indicate. Meanwhile, adult 'innumeracy' is a big problem: 40% of adults in the UK have some problems with mathematics, 20% have 'very low' numeracy skills (DfEE, 1999). Moreover, there are problems in measuring these skills, as two members of the OECD's International Adult Literacy Survey (IALS) team (Houtkoop & Jones, 1999:33) point out. Clearly, further work is needed in order to gather reliable data at this level. In the OECD's latest survey, the Adult Literacy and Lifeskills Survey (ALL), the Numeracy Working Group is pioneering innovative approaches in this area, as participants at their session at ALM7 will remember (Manly, *et al*, 2001). Poor numeracy has a deleterious impact on people's lives, greater even than poor literacy (Bynner & Parsons, 1997) and adults' difficulties with mathematics may be compounded by difficulties in literacy and/or language. There is a shortage of experienced teachers, teacher trainers and researchers and an ageing, largely casualised teaching workforce – in England at least.

Against this background, in England provision for adults learning basic mathematics is currently undergoing radical change. High on the UK government policy agenda are:

- *L* ifelong learning
- *E* mpowerment
- *S* kills
- *S* ocial inclusion
- *S* ustainable development

Can *LESSS* mean more for adults learning mathematics? I hope it can and in England, at least, the signs are good. *Skills for Life* (DfEE, 2001) is the new national strategy for improving adult literacy and numeracy skills.

A key part of the *Skills for Life* strategy is the National Research and Development Centre for Adult Literacy and Numeracy (NRDC), established earlier this year.

The NRDC represents the chance of a lifetime: to redress the neglect of adults learning mathematics (at least at the level of basic mathematics), at a time when the importance of lifelong learning is widely acknowledged; to bring together research, theory and practice to inform policy; and to come in from the margins of educational research and provision and public concern.

The Centre aims to build a new discipline to support *Skills for Life* through the generation of knowledge and its transformation into practice. Further, it plans to become a rich resource in terms of research to inform development and policy; to help to forge a new identity for and with practitioners; to increase practitioners' contribution to and awareness of research and its implications for practice; to develop teacher education and continuing professional development; to build research and leadership capability; to develop appropriate research instruments; and to communicate with practitioners, researchers, policy-makers and providers.

With respect to adults learning mathematics/numeracy the Centre aims to:

- increase knowledge and understanding through a sustained programme of research and development designed to inform, identify and evaluate best practice in teaching, drawing on relevant national and international research;

- ensure that our work is meaningful and accessible to teachers, learners, policy-makers and providers by consulting widely in the field;

- integrate adult mathematics/numeracy in the Centre, both as a discrete area and linked with research and development in literacy, ESOL and specific learning difficulties and disabilities.

Centre projects include: surveys of adults' abilities and needs for literacy, numeracy and English for Speakers of Other Languages (ESOL) and the relationship of these abilities to wider social and economic factors; work on adult basic skills and information and communication technology (ICT); teaching of specific elements of mathematics; and teacher

education.

Work specifically on mathematics/numeracy under development in the Centre includes consultation with practitioners, policy-makers and researchers (including sessions at ALM9, reported on by Ruth Polkinghorne in the ALM9 Proceedings) and projects.

The latter include a review of research and projects on ways of making 'numeracy' meaningful to adult learners, investigating adults' 'sticking points' (e.g., teaching and learning fractions, decimals, percentages, ratio and proportion and measurement of length and area) and assessment in adult numeracy education. As this agenda develops, the new Centre should make a major contribution to work in this area in the coming years.

In the next and final section, I want to consider where would we like to be in 2012 – and beyond.

**2012 – and beyond**

First and foremost, I hope we shall all be alive and well and living in peace– and that we shall meet again at ALM19. I hope we shall continue to welcome new ideas and new ALM members, to develop new research agendas, share and refine research techniques and explore different aspects of adults learning mathematics. I hope our work will inform and influence policy makers, to good effect for adult learners. I hope we shall be better equipped to work with adults learning mathematics and better able to analyse adults' mathematical practices in different cultural, social and linguistic contexts. We still need to know a great deal more about how adults learn mathematics and how best to teach mathematics to adults. I endorse Dave Tout and Mary Jane Schmitt's statement in their discussion of the 'Inclusion of Numeracy in Adult Basic Education', in the belief that their suggestions apply to adults learning mathematics at any level:

> We need to develop a research culture. Research should focus on issues of cognition and attempt to ask questions about both the numeracy demands of society and the ways in which adults can develop numerate thinking to meet those demands. We need to know more about how adults think mathematically, what resources they bring to bear in approaching and solving problems, and what instructional interventions support the development of adult numerate thinking. Research also needs to be conducted about adult students' inherent attitudes toward math – about math anxiety and the effect it has on students' ability to learn. Research centers such as NCSALL, NCAL and NIFL should join with collaboratives such as the Adult Numeracy Network and Adults Learning Mathematics to develop a strategic research agenda that connects research with practice and policy. Practitioner research such as that described by Meader (2001) or that conducted by the Massachusetts ABE Math Team is a good model for moving forward in this respect. But other lines of research need to be developed as well. (Tout & Schmitt, 2002: 187-8)

Tout and Schmitt also point out that research on children's mathematics education has much to offer adult basic education, while echoing Alan Bishop's warning that research with adults is much more complex, since, with children:

> the learning situation is often concisely circumscribed, the goals are usually made explicit, it takes place in a specified location, the materials are usually publicly available, the teachers are certified and easily recognised, and the assessment results can often be readily accessed. (Bishop, 2000:xii).

In fact, the *Skills for Life* reforms of adult numeracy education in England, which include the introduction of National Standards (QCA, 2000), a Core Curriculum (BSA, 2001) and National Tests (see the QCA website for a sample test) and training and certification for adult numeracy teachers (FENTO, 2002), all mean that, in England, children's and adults' mathematics education are converging. It may be that research on children's mathematics education will become more relevant as a result, in England and wherever similar reforms may be tried.

So what would I add to Tout and Schmitt's list? Firstly, I would like to see adult mathematics education recognised as an essential part of mathematics education, no longer the 'poor relation' and no longer subsumed within adult literacy. Further work on conceptualising work in this field would help here. Better survey instruments are required in order to identify adults' strengths, as well as their weaknesses, in mathematics and to facilitate national and international comparisons. Stronger evidence of issues around adults learning mathematics is required if we are to have any chance of influencing policy-makers. I would like to see insights from psychology, sociology, political, cultural and gender studies, linguistics, neuroscience, children's mathematics education, adult learning generally, ethnomathematics, theories of capital, Activity Theory, and all the other disciplines and theories which may have much to contribute, becoming a more overt part of our discussions at ALM and informing the work of practitioners and researchers more directly. Practitioner-research is also important but practitioners need time and support to study and reflect on their work and to undertake research themselves, as we plan to enable them to do in the NRDC. In ALM, we need to continue to find ways to enable practitioners and researchers to learn from each other: ALM is a research *forum* precisely in order to enable that to happen. We already have the *ALM Newsletter* and the annual international conference; we are exploring other possibilities, including a journal and a re-vitalised e-list. We need to carry on the 'conversation between researchers and practitioners' that was the theme of ALM7 (Schmitt & Safford-Ramus, comps), and bring others into the conversation.

That means, as well as speaking and listening to each other, we need to speak and listen to researchers in related fields, to policy-makers, providers of adult mathematics education and others with a wider interest in adults learning mathematics. But above all, we need to observe, speak and listen to adults learning - and doing – mathematics.

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REFLECT, Regenerated Freirean Literacy Through Empowering Community Techniques. URL: http://www.reflect-action.org/

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# Mathematics or Numeracy: Does it really matter?

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## Abstract

Sometimes during the course of other assignments one is forced to clarify more carefully understandings held to that point. Recently when I was asked to undertake the routine task of writing a short informative paper on 'Mathematics and Numeracy' for the benefit of mathematician colleagues on the National Committee for Mathematics of the Royal Irish Academy, I accepted without any great trepidation. But I was more than mildly surprised when I found the task really challenging. While it was a relatively simple matter to finish my assignment I was left with a number of ideas and issues that called for extra consideration and analysis. In this presentation, I propose to explore some of these issues which can be flagged by use of pairs of words e.g. mathematics/numeracy, literacy/numeracy, adults/mathematics, adults/numeracy, numeracy/school mathematics.

## Introduction

At the outset I should like to thank David Kaye and other members of the organising committee for inviting me to give the final plenary session of ALM –9. When asked to suggest a title, I thought I would take the opportunity to explore and maybe resolve, at least to my own satisfaction, some issues that have been troubling me for a long time. Now with hindsight (I usually write my introductions after I have finished the paper!) I think 'resolution' was far too optimistic a target and 'clarification' more accurately defines the current state of my understanding. Before I move on, I should declare a bias – I come to this task and to ALM as a mathematics teacher educator, university mathematics teacher and mathematics education researcher.

This contribution is also motivated by the objects of ALM which include the following:

The Charity's objects are the advancement of education by the establishment and development of an international research forum in the life-long learning of mathematics and numeracy by adults by:

- encouraging research into adults learning mathematics at all levels and disseminating the results of this research for the public benefit;
- promoting and sharing knowledge, awareness and understanding of adults learning mathematics at all levels, to encourage the development of the teaching of mathematics to adults at all levels, for the public benefit.

This reminds us that adults' *mathematics* education and *numeracy* are vital concerns.

In this session, I propose to explore a number of relationships that arise in adult mathematics education that are influenced by policies and practices and where it makes good sense to assess the associated risks and opportunities. I am not suggesting that the list is exhaustive

but I do believe that it is comprehensive. I have adopted simple word pairs as a device to highlight relationships and as an organising principle.

These include:

- Literacy/numeracy
- Numeracy/Education
- Numeracy/school mathematics
- Numeracy/ indicators
- Adults/mathematics.

The thrust of the paper is clear – it answers the question in the title in the affirmative. It *really* does matter and it matters in a number of important ways! But first I would like to preface subsequent remarks with a short section on Economic/Education policy.

**Economic/education policy**

It is fair to say that economic policy and education policy no longer stand apart, if ever they did, in technologically advanced countries. Indeed it is clear now that education is purposefully articulated with economic policy, and in many ways is subservient to it, as countries pursue their economic development programmes.

The Higher Education (HE) sector has for a long time been an active partner in the national economic enterprise in many developed countries and is funded and resourced to meet the knowledge and manpower/skills needs of the economy e.g. Ireland. This is especially true of high-tech or knowledge-based economies where the impact on education is now being felt in all sectors from primary through to Higher Education. For example some conference participants will be quick to recognise evidence of this in the U.K. where there is now a National Numeracy Framework for primary and secondary schools. As an international association all of us are aware that lifelong learning/education is central to economic policy development internationally and this is clearly signalled in EU and OECD reports. Undoubtedly this impacts directly on adult literacy/numeracy education. Many of us also see a link between economic policy and equality issues.

It is true to say that all of us as we pursue our own agendas in adult mathematics education at local, regional or national levels increasingly feel the weight of economic policy in our day-to-day work and the effects are not always desirable or benign.

**Literacy/numeracy**

Like it or not, literacy and numeracy are bracketed together in the public consciousness and this is largely for historical reasons. Cockcroft (1982) identifies the source of the concept and the term numeracy as the Crowther Report (1959) and in his report advances a considered and now famous definition (Appendix). Crowther defined numeracy 'as the mirror image of literacy' (par. 398) and went on to elaborate his view (Appendix). Literacy and numeracy were seen as personal attributes that were needed to support the life-long aspirations of an educated person and that included communication between the so-called 'two cultures'. They were seen as overlapping complementary attributes.

Numeracy issues and provision are traditionally subsumed under literacy in many countries e.g. Ireland, U.K., Australia. Consequently, literacy has influenced the debate on numeracy as regards funding and provision with the lion's share of effort and resources going to literacy provision.

The concept of numeracy follows what may be described as an evolutionary trail that can be described roughly as follows:

1. Mirror image of literacy
2. Literacy (no explicit concern for numeracy except grassroots interest)
3. Literacy (concern for 3R's and basic mathematical skills)
4. Functional numeracy (detached from literacy)
5. Literacy (numeracy is recognised as an aspect e.g. quantitative literacy)
6. Types of literacy (e.g. mathematical literacy, scientific literacy, etc)
7. Numeracy (independent life skill detached from literacy/equally important).

If this evolutionary picture is a reasonable representation of the situation then there is reason to be grateful that numeracy was kept on the policy agenda allowing time for grassroots initiatives to increase general awareness and tutor expertise. Also as literacy evolved researchers had a ready source of analytical tools to shape research in numeracy and this association has already yielded a rich vein of research in adult numeracy that has had a big impact internationally on adult numeracy education and practice including tutor training (see Johnston and Tout, 1995).

**Numeracy/education**

Numeracy impacts on individuals across their life span from child to adult and has implications for their education and lifelong learning in schools, in the work place and in other non-traditional settings. A wide range of goals for numeracy can be identified in national and international reports and literature. In general it is fair to say that numeracy is perceived as 'contributing to the empowerment, effective functioning, economic status, and well being of citizens and their communities' (Gal, 2000:ix). Steen (1997: xxii) refers to a useful summary of these goals associated with five different dimensions of numeracy as follows:

> *practical*, for the immediate use in the routine tasks of life; *civic*, to understand

major public policy issues; *professional*, to provide skills necessary for employment; *recreational*, to appreciate games, sports, lotteries; and *cultural*, as part of the tapestry of civilization.

All of these implicate education at some level but other agencies are also implicated e.g. training agencies, trade unions. It is interesting to note that virtually all the definitions of literacy found in United Nations documents over 50 years include calculating or mathematics (Gal, 2000). However, it is not simply a matter of educational goals been driven by educational concerns but rather is it the case of strong economic and social policy pressures on education being marshalled to deliver aspects of government policy especially in the economic arena. It should be noted that the tension between education and training is still largely unresolved.

**Numeracy/school mathematics**

The relationship between numeracy and school mathematics is problematic not least because numeracy does not seem to be an automatic outcome for many after years of compulsory schooling.

It is clear that there is a universal expectation that the school mathematics experience should deliver numerate citizens. That it consistently fails to so for a significant percentage of the school-going population is matter of grave concern worldwide. This failure is due in part to a lack of clarity in the goals of mathematics education and a clear understanding of the meaning of numeracy. When we talk about numeracy what do we mean? In practice the term may signify any one of a number of things including, basic computational arithmetic, essential mathematics, social mathematics, survival skills for everyday life, quantitative literacy, mathematical literacy and an aspect of mathematical power. These descriptions span a spectrum of personal abilities from basic skills to high-level cognitive abilities such as problem solving and communication (see Tout, 2001).

There are many unresolved issues surrounding school mathematics as a preparation for adult life. How is numeracy different from school mathematics? How does one promote numeracy within the school mathematics context? What is the role of context and life experience in school mathematics and numeracy? How does school mathematics relate to adult mathematics education? How does school mathematics 'transfer' to adult life?

Responses to these and related issues take different forms in different countries. For example numeracy and literacy are prioritised in the Irish Primary School curriculum. While numeracy is not explicitly defined it is clear that there is a concern for basic mathematics as opposed to mere computational skills only (NCCA, 1999). The U.K. is pursuing a national strategy for numeracy through the school system. For many practitioners and researchers in the field, it seems numeracy should not be equated with less mathematics but more in terms of sense making, application and decision making.

The term numeracy is not generally applied to the secondary school mathematics curriculum except in the context of under-achievement and early school-leavers. Indeed, the goal of

secondary school mathematics in the U.S. is *mathematical literacy* (NCTM, 1989) which is interpreted as a good secondary mathematics education. This in turn is necessary for all who aspire to higher education and work in an Information Age. This goal outstrips what would normally be interpreted as numeracy in most other Western countries.

The concept of numeracy has some currency in higher education specifically in the context of the so-called 'numerate disciplines'. Traditionally, there has been concern for the mathematics education of engineers, scientists and technologists. For example, Le Roux (1979) in the spirit of Crowther interprets numeracy in a higher education context as developing the mathematical ability of non-mathematicians to interact effectively with mathematicians and communicate their needs. More recently this debate has widened to encompass issues such as service mathematics teaching, mathematical under-preparedness and entry standards (see IMA, 1995) learning support and more socially determined issues such as access, equality, disadvantage and the role of mathematics therein (see Benn, 1997).

**Numeracy/indicators**

What do we know about how numerate adults and others are? How do we measure numeracy in the population or elsewhere? There is no doubt that the first refuge of mathematicians confronted with the question of numeracy indicators is to point to school mathematics. In the first half of the 20th century elementary education based on the 3R's served as a guide to numeracy levels in the population. When compulsory education was extended to 15/16 years of age, lower secondary mathematics became implicated. In many countries the indirect indicators are, and have been, the mathematics results in State Examinations. The first reaction to falling standards in the 1980's in the U.S. and to a lesser degree in the U.K. was to advocate a 'return to basics' in mathematics, a misguided attempt to reform school mathematics that was widely resisted. Mathematical *literacy* is now the goal of school mathematics in the U.S. (NCTM, 1989).

In recent years there have been international studies in mathematics and science and literacy and these have been used as indicators although it is not always clear what these measure or indicate, or whether they apply to adults (see Kaiser et al, 1999). Some countries have been well served by national, regional or institutional studies e.g. U.K. Others such as Ireland must rely on participation in international studies for relevant data that is not always forthcoming in usable form. The point is illustrated for Ireland, a country that has participated in a number of such studies. Four of these are listed below:

- Second International Mathematics Study (SIMS, 1983-86)
- Third International Mathematics and Science Study (TIMSS, 1995)
- International Adult Literacy Study (IALS, 1995)
- Programme for International Student Assessment (PISA, 2000).

The main focus of SIMS was student achievement in mathematics and TIMSS measured achievement in mathematics and science. Tests/test items used spanned mathematics content in arithmetic, algebra, geometry, measurement, descriptive statistics and probability. Populations tested included 13 and 19 year olds (SIMS) and 9 and 13 year olds and students in final year secondary school (TIMSS). While these data shed light on performance in school mathematics, extrapolation to adults' numeracy levels must be tenuous.

The IALS was concerned with adult literacy and surveyed adults aged 16 –65 in 19 countries. This survey used three literacy scales; prose literacy, document literacy and quantitative literacy and these scales were used to identify five levels of literacy. Quantitative literacy was defined as the knowledge and skills needed to apply arithmetic to numbers incorporated in printed materials. Cleary this study is concerned with literacy and has very little to say about adult numeracy in the participating countries. Morgan et al (1997) present the results for Ireland.

PISA is different from the other studies in that it has a special focus on knowledge and skills needed for adult life. PISA acknowledges that students cannot learn all they need to know in school for successful participation as adults in society. Students must become life-long learners. It assesses skills in three domains – reading literacy, mathematical literacy and scientific literacy at the end of compulsory education (15 year olds). Mathematical literacy is defined as 'an individual's capacity to identify and understand the role mathematics plays in the world, to make well-founded mathematical judgements and to engage in mathematics, in ways that meet the needs of that individual's current and future life as a constructive, concerned and reflective citizen'. In a significant departure from practice, mathematics test items are not designed to reflect school mathematics but rather the extent to which school has prepared students for, *inter alia*, the mathematical demands of adult life. Such studies are likely to influence our thinking on adult numeracy and adult mathematics education generally and the next PISA (2003) survey when mathematical literacy is a major focus is eagerly awaited. A summary of results of initial survey for Ireland can be found in Shiel et al (2001).

Unfortunately, Ireland is not participating in the Adult Literacy and Life skills Survey (ALLS, 2002), the successor to IALS, which includes numeracy as an independent life skill, and is likely to be a very important study as regards adult numeracy. Colleagues in ALM have developed the numeracy dimension to this study and therefore we look forward to the results with special interest (see Manly and Tout, 2001).

**Adults/mathematics**

I have argued elsewhere (Coben et al, 2000) that mathematics education should not be defined exclusively in terms of school mathematics. School mathematics cannot be treated in isolation from adult domains such as 'everyday mathematics' and 'workplace mathematics'. It is equally clear that we have much to learn about the interaction between school mathematics and adults learning mathematics in out-of-school settings.

The school mathematics experience impacts directly on adult mathematics education in Further Education (FE) and Higher Education (HE). When we look at adults in these sectors the concern is mainly for *mathematics* as opposed to *numeracy* education although one could argue that there is some overlap depending on how one interprets numeracy e.g. Adult Basic Education (ABE) in Further Education. Further Education is generally concerned with developing workplace skills/training for employment and also providing second-chance education for post –16 year olds. This second-chance education usually links in to Higher Education through a series of steps or equivalences. Indeed, many countries have high school

equivalency diplomas that can be earned by adults part-time or at night. Unfortunately, very often the mathematics courses taught are identical to school certificate programmes and they are taught to adults in traditional ways that have already failed these same adults in school.

The normal cohort of undergraduate students in Higher Education institutions such as universities have traditionally been taught without any real emphasis on their adult status. Mature students (those aged 23 or 25 or more) had to fit in or leave since there was no attempt to adjust mathematics teaching to their special needs or circumstances. Thankfully this state of affairs is changing with universities in many countries making special provision for mature students by introducing foundation year, access programmes or other transition arrangements in tandem with learning support such as Mathematics Learning Centres and on-line support. But clearly these activities are viewed in Higher Education as *mathematics* teaching except perhaps when progression is targeted for disciplines in the Humanities when the term numeracy is applied. It should be said that universities did not rush to embrace such activities but yielded under pressure of social and economic policies and financial impact of fewer students due to demography.

**Discussion**

Adult mathematics education involves mathematics teaching and numeracy, and practitioners need to be clear what their goals are. Increasingly school mathematics goals include numeracy but numeracy education does not always include substantial mathematics. The tension between mathematics and numeracy in adult mathematics education needs to be acknowledged and the relationship should be clarified. For example, how does a numeracy curriculum for adults differ from a basic mathematics curriculum for adults? Mathematics and numeracy are not congruent. Nor is numeracy an accidental or automatic by-product of mathematics education at any level. When the goal is numeracy some mathematics will be involved but mathematical skills alone do not constitute numeracy.

Mathematics and numeracy are overlapping concerns in various sectors of national education systems including primary, secondary, Further Education and Higher Education and outside the formal education systems. Adult mathematics education generally is not well articulated throughout the various sectors nor is numeracy education. However, some definitions of numeracy e.g. Johnston (1994) offer an avenue for an integrated approach to numeracy education that may be viable at each level and also makes sense in an adult environment.

**Conclusion**

It is a matter of concern that the relationships discussed in this paper are not well understood in policy-making circles. It matters that the respective discourses e.g. economists, politicians, professional mathematicians, mathematics educators, adult educators may not be able or willing to accommodate issues affecting adults' mathematics education/numeracy. Clearly it is important that numeracy is seen as a pedagogical construct and not as an economic one!

It does matter that mathematics education is not distorted by undue pressure from economic policy that has the effect of atomising curricula into various skills that are measured incessantly. It matters that adults are trusted to study mathematics when that is what is needed and develop their numeracy when that is necessary. It affects tutors in their practice if

they are not trained to deliver the appropriate service and it matters to society if there is not sufficiency of individuals with appropriate skills in the workforce. Sometimes these requisites are described as literacy or literacy and numeracy or as multiple literacies e.g. reading literacy, scientific literacy, mathematical literacy. So long as we know what we are talking about then adults' mathematics education is more likely to prosper.

## Appendix
## Selected definitions of numeracy

**Crowther (1959: par 401):**

' 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 modern 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 categorization of mathematical behaviors into six major aspects:

- Data representation and interpretation
- Number and operation sense
- Measurement
- Variables and relations
- Geometric shapes and spatial visualization
- 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 (1991):**

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: *Suda (2001):5*

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## Using mathematics in the workplace: is the 'knowledge society' for real?

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The arrival of the 'knowledge society' has become a cliché, though one which permeates government policy documents and attitudes. It sits rather oddly alongside the government's own current emphasis on 'numeracy' rather than 'mathematics' in education policy for everyone post-16, whether young or adult. This address will report on recently completed research into how mathematics is actually being used in the modern workplace. Is the 'knowledge society' on its way? already here? and what are the implications for the teaching of adults?

# Topic & Discussion Groups

## Topic Group A
## Developing a Theoretical Framework for Adults Learning Mathematics

**Convenors: Juergen Maasz, University of Linz, Austria**
**and**
**Katherine Safford, Saint Peter's College, New Jersey, USA**

### Introduction

The topic group concerning the development of a theoretical framework for adults learning mathematics has met for six years, including 2002. Leadership of the discussion has been fluid, yet a thread of continuity prevails. This year, Tine Wedege opened the first session by tracing the history of the topic group and sharing some of the key themes and critical discussions from ALM-4 through ALM-8. Juergen Maasz followed Tine's presentation with a paper that pondered the different meanings of the terms theory and practice for ALM. At the second session of Topic Group A, Kathy Safford shared some of the research themes she has discovered while reviewing the abstracts of dissertations published in North America over the past two decades. She suggested other topics which appear to be under-researched and participants discussed those ideas and suggested other important but neglected themes.

### Chronology of the debate in the Topic Group "Developing a theoretical framework of ALM" (Tine Wedege)

At the last five ALM conferences, a growing group of participants has engaged in an ongoing exploration of the theoretical frameworks for adults learning mathematics.

At ALM9, I had promised to tell a little about the background of this topic group and tried to present the chronology of the debate.

This debate about the new research domain - 'Adults Learning Mathematics' as a community of practice and research – and about developing theoretical frameworks started at ALM4 in 1997 and continued through ALM5, ALM6, ALM7 and ALM8 in 2001. "Adults and mathematics" was - and still is - a new and uncultivated area of research. As Diana Coben has stated: "The field itself is ill-defined - or wide open, depending on one's point of view." This is the central reason for the work and debate in this topic group where different metaphors have been used to characterise the research area: I have used the metaphor *borderland* to illustrate that the area is situated between other scientific fields (mathematics education and adult education research). Roseanne Benn has used this metaphor *moorland* to illustrate that the area is wide open and uncultivated.

At the ALM4 conference in Limerick, Ireland, 1997, a group started the discussion on my paper entitled *Could there be a specific problematique for research in adult mathematics education?* By 'problematique' I mean a systematically linked problem field in which questions and answers about the subject field are formulated on the basis of a certain theoretical and/or methodological approach. It was a meta-discussion about the nature of the new research domain, and the debate at the conference showed that this is a very complex issue. From this debate, I have quotations from two former chairs and from the present chair of ALM:

John O'Donoghue:

> "We have a complex of problems. What constitutes our area? Is it a legitimate scientific activity? When we went to ICME last year, we made a choice. It was a hard decision: Is research in Adults Learning Mathematics a subfield of the field of Mathematics Education, or is it not?"

Diana Coben:

> "I see 'adults and mathematics' as a field where we can meet as researchers and practitioners with different backgrounds from different fields, i.e., adult education in general and mathematics education."

Jürgen Maasz:

> "When we talk about putting limits in the field of research, it should not mean 'putting someone outside'. We should talk about theories, not about membership of the ALM community."

(Wedege, 1998:215-16)

At ALM5 in Utrecht, Netherlands, 1998, we continued the debate in a workshop organised by Roseanne Benn, Jürgen Maasz and myself. In the debate a central question concerned the situation of our research and practice in the scientific landscape, and this time the perspective was *Adults learning mathematics as a community of practice and research*. We tried to characterise the ALM practice and research as situated between adult education and mathematics education research. It was a point that there are no clear boundaries in our domain. Some of the research questions in the field are sociological, some psychological, other questions are educational, philosophical or anthropological (Wedege, Benn, Maasz, 1999).

At ALM6 in Sheffield, United Kingdom, 1999, the reflective discussion was continued in a topic group. The conference organising team had proposed that *Developing a theoretical framework for adult mathematics learning and teaching* be a yearly recurring theme at the ALM conferences. Roseanne Benn, Juergen Maasz and Kathy Safford organised the debate, which was structured by three themes:

(1) The value of multiple theories and perspectives

(2) In Adults Learning Mathematics - should our emphasis be on the A, the L, or the M or on the relationship between the three?

(3) The value of ALM is that there is a dual emphasis on research and practice.

During the debate, it was concluded that the question for each of us is not whether we each have a theory. It is more, which is your theory, and can you name it? Can you describe it, and how does it affect your research and teaching practice? (Benn, Maasz, Safford, 2000)

At ALM7 Boston, United States of America, 2000, Roseanne Benn and I invited the participants to join us in examining a "critical incident" through different theoretical

frameworks and exploring the implications of these frameworks on our practice as adult educators and researchers. It was stated that different theories offer a larger perspective in practice and research and that interdisciplinarity is a must. Thus, we began to make explicit some of the possible theoretical and methodological choices, and how these choices affect our practice. (Benn & Wedege, 2001)

From the very beginning of the debate in 97, it has been stated that it is important to make this explicit: What do we mean by mathematics and mathematics education? In the constitution of the research forum ALM, it is stated that we understand the term mathematics to include numeracy.

Last year, at ALM8 in Roskilde, Denmark, the conference theme was "Numeracy for empowerment and democracy?" As organizers of the topic group, Roseanne and I decided to put the concept of numeracy on the agenda: *Developing a theoretical framework for adults learning mathematics: the case of numeracy.* 'Numeracy' is a central theoretical construction in research, practice and politics within the area of ALM. The term 'numeracy' was introduced in the United Kingdom in the late 1950s. There have been many different definitions generating a lively debate between educational planners and researchers in English speaking countries about the content and meaning of the concept of 'numeracy'. (Just to mention a few names: Roseanne Benn, Keiko Yasukawa & Betty Johnston, and Jeff Evans.) In recent years in Denmark, there has been an on-going conceptual and educational construction of numeracy, translated into Danish as 'numeralitet' (Lena Lindenskov & Tine Wedege).

Several studies examine numeracy in society. They represent, however, different approaches to the subject area, for example: an *objective perspective* (society's requirements of numeracy) *versus* a *subjective perspective* (adults' individual need for numeracy); or a *numerical skills approach* (numeracy as basic skills) *versus* a *numerate competence approach* (numeracy as an everyday competence).

In the on-going exploration of the theoretical frameworks for adults learning mathematics, we focused on concepts of numeracy in the topic group last year. (Benn & Wedege, 2002). Finally, we are back in the United Kingdom and the topic group organisers are Jürgen Maasz and Kathy Safford.

**Thinking about Theory and Practice in the Area of ALM (Juergen Maasz)**

When I prepared the Topic Group A "Developing a Theoretical Framework on Adult Learning and Teaching" in London I remembered some discussions in similar topic groups in earlier years. One aspect of many statements concerned the relation of theory and practice. I had the feeling that it was not always clear what the meaning of "theory" and "practice" was. There were different meanings and some misunderstandings. This is the reason for me to invite you to concentrate on some possible meanings of "theory" and "practice" in the area of ALM.

Theory is bad, practice is good, isn't it?

Sometime the concepts of "theory" and "practice" are combined with strong emotions. This was my feeling when I listened to sentences like this: "We are practitioners, we do not need any theory!" "What is the practical use of this theory?" "I do not believe your theory, my practice shows something different!" "What you are saying is only your personal experience. It is not founded by a theory!" "A good theory is the best tool for practice!" ...

My first association when I listened to such arguments were similar arguments in a course for adults I held for some years. For example when I taught algebraic formulas many participants said: "It has no practical use to learn this theory (calculating with variables)". Sometimes this argument was used like a metaphor: "This seems to be too difficult for us!" I will come back to this situation later.

The second and more important association is my time as a student of philosophy at the university. Sir Karl Popper wrote some important books about the theory of research and science. One of his theses is that practice and theory are always connected - it is impossible to do something like teaching without thinking about it. If this is correct - and I think so - it is not useful to talk about "theory" and "practice" as if there are contradictions or as if it would be possible to do one of them without the other part. They belong together.

Maybe the thinking about an activity like teaching is reduced or wrong or concentrated on only very few of the many important aspects of the situation. Maybe the actor does not know that there are a lot of elaborated theories about this type of situation. Maybe this is a reason for doing mistakes in some situations. But all these (and other) possibilities are good arguments for more reflected action, for better knowledge about existing theories or for the work for better thinking and better theories. There is no good argument for practice without theory or theory without practice: All theories about learning and teaching need empirical research as foundation.

Different types of theories and practices in mathematics courses for adults

One difficulty in the debate about "theory" and "practice" in the ALM area is that there are very different points of view. I try to explain this with an example. For several years I taught craftsmen (journeymen) who wanted to pass an examination to become more qualified: "Master Craftsmen" (foremen or master artisan). There typical vocational practice was handwork with metal. They worked for example as smith or as locksmith. They repaired machines or built tools needed for the function of industrial machines in an automated production line. What they called "theory" was the calculation of the geometry of metal objects, for example the volume or the weight of a T-beam or a T-girder. They always wanted to calculate with concrete numbers like 137 mm or 3.4 m and not with variables. I argued that it is much easier to use formulas with variables by giving a sequence of similar objects (for example only the length of a lot of T-beams was different).

Their "theory" is a simple example for the practical work of a machine building engineer. The mathematics department of the University of Linz has offered mathematics courses for engineers for about 20 years. The engineers learned, for example, to optimise constructions (minimal costs and sufficient stability or minimal use of energy and sufficient power and so on) with related mathematical methods. They modelled the situation and solved the

mathematical equations system with numerical methods (and computer programs) to find solutions for the best practical use. The proof of a numerical method (Why is it allowed to use this method in this situation?) was a not useful theory from the point of view of the engineers. They did not like any mathematical proof, even constructive proofs that show how and why an algorithm works.

To prove mathematical theorems is a part of the daily work of mathematicians. For many mathematicians at universities it is a practical action to find different proofs for a theorem. What is "theory" for them? Thinking about the philosophical questions of the foundation of the truth of mathematics and logic.

Another type of "far away" and boring theory for many engineers are many parts of physics like solid state physics or "laws" of mechanics, durability or stability of constructions etc… For scientists working at a physics department at the university the daily work of an engineer is a "far away" practical use of their theory.

All together we have something like a chain connecting handwork and physics or mathematics. If we have a look from one chain link somewhere in the middle to both directions we see that the meaning of "theory" and "practice" depends on the standpoint of the viewer. The same activity is theory for one group and practice for another group.

Let me add one remark: I do not think that the chain goes up or down: All chain links are important.

Pedagogical theory and practice

Now I proceed to the next step, from the content of mathematics courses for adults and the different views of it as theory or practice to the process of teaching and learning. Following Sir Karl Popper, these activities have theoretical and practical aspects, too. Here "theory" means a mathematics education, pedagogical, psychological or sociological theory about teaching and learning. A typical question is "Are there any differences if adults or younger students at school learn mathematics?" I think: "Yes, there is!" One argument for this "yes" is that adults have their own experience with the practice of what is taught, it is part of their daily work. For students this type of practice is something that perhaps could happen in future.

Practice is the daily work of teaching in courses. Some teachers have worked for many year and gained a lot of experience. One popular theory about teaching says that only the teacher himself is an expert in the area of his or her own classroom situation. Teaching teachers means, in the light of this theory, to communicate with them about a transfer of pedagogical theories or experiences of other teachers into their situation (and not simply to order that they should teach in different way).

What is a theory about pedagogy, psychology or sociology? I think of science theory or ethics or another part of philosophy. Typical questions are like this: "Is this theory proven?" "What could it mean to "prove" a pedagogical theory?" "Is this argumentation - for example

based on statistics, a questionnaire or interviews - correct?" "How does it relate to other results of pedagogical research?" Some of our colleagues from pedagogy, psychology or sociology really do not like these "theoretical" questions.

At least a third type of theory and practice should be mentioned here, concerning the everyday life. Each student, each adult learning mathematics and each of their teachers lives in the same world. This means that there is a very big common background that could be used to show the relation of mathematics to everyday life in mathematics courses. This is one very good possibility to answer the question "Why should we learn this?" There are a lot of theories about "good" ways to live and "good" ways to handle every day life situations concerning money, buying, health, building, housing, travelling and so on. Mathematics is one useful theory to understand such problems better and to find good solutions.

**Theories need a research base. What are researchers investigating? (Katherine Safford)**

For the past two years I have been analyzing the dissertation research on adults learning mathematics that has been published in North America since 1980. The premise for this project is a belief that research reported in dissertations should help us lay a foundation for our theories about what constitutes "good practice." Tine has quoted Diana Coben's remark that our field may be viewed as "wide open." The dissertations that I found provide small points of light in a night sky of need. 119 dissertations from 50 US states and Canada, spanning 22 years, provide shallow coverage of any one research question. They did not appear to be connected or to spring from a common research project. While a start has been made, there is still much work to be done.

As part of the analysis, abstracts from the dissertations were reviewed and certain themes emerged. These categories are far from definitive but do provide a means to determine whether researchers have explored or neglected specific areas. These are the themes as I have grouped them:

Adult Basic Education
Adult Development Theory
Classroom Methods and Materials
Effects of Student Age
Gender
Learning and Developmental Disabilities
Learning Styles
Math Anxiety
National Council of Teachers of Mathematics Reforms
Parent Education
Predictors of Success
Problem-Solving
Street Mathematics versus School Mathematics

Student Characteristics or Understanding
Technology
Workplace Numeracy

What then is missing? In North America, and I believe in many other industrialized nations, adults are studying mathematics in a wide variety of settings. Certainly there are entire populations whose needs are not being studied. The first to come to mind is adults for whom English is a second language. As a greater emphasis is placed on problem-solving, the ability to read takes on increased importance and language difficulties provide an additional hurdle for the ESL student. Are we introducing obstacles or are can we reinforce reading instruction by extending the tasks to include mathematical reading and word problems?

A second, growing, student population in adult education is high school dropouts. While the evidence is anecdotal at present, adult education programs are reporting a growing trend for high school students in the United States to leave the traditional high school and drop into adult high school or General Educational Development (GED) programs. This new breed of "adult" students is likely to have experienced primary and secondary mathematics education that is different from that of their older classmates. In addition, behavioral and motivational problems that may have led to their exodus from traditional high school can leave them ill-prepared for the workbook or computer-aided methodologies often used in adult mathematics education. Can this cohort be included in adult programs or will we need an intermediate level of education? Is it conceivable that the life-oriented problems posed in adult mathematics classes will provide the spark needed to ignite the interest of these adolescent-adult students?

How can the computer and video technology be utilized in providing distance learning for adult students? The rising tide of distance learning that occurred a few years ago seems to have ebbed, or at least leveled off. Yet it would seem logical that the ability to learn or practice mathematics outside of the classroom setting would appeal to adult students. This semester I have tried to marry onsite lectures with commercial instructional software in an algebra course for adult students. The results from this experiment have been disappointing yet I still believe that the two can be successfully blended. Research needs to be conducted to investigate ways to link the two methodologies as well as other technologies.

The incarcerated population in the United States is large and their educational level low. If jails are truly to become "correctional facilities" education should be a major goal of the justice system. How can we improve the mathematics skills of the imprisoned? Onsite instruction is not always possible. Could the research on technology also shed light on this question? Perhaps video-conferencing with questions phoned or e-mailed in could assist in this endeavor. The pool of qualified mathematics instructors is shrinking in the United States. Closed circuit television might be a vehicle for effective teaching at several sites simultaneously.

What ethical questions arise when we do ask adult students to participate in research projects? Even if we, the researchers, believe that a new methodology improves practice might we be wrong? Programs and/or the student responsibilities impose severe restrictions

on instructional contact hours. When we stray from familiar instructional methods, we risk wasting precious student time on unproven trials. On the other hand, we will never know if a particular method may prove effective unless we try it. The National Council of Teachers of Mathematics (NCTM) has been implementing reforms on the primary and secondary levels in North America for nearly two decades. Research is needed to determine where they are appropriate for adult students and how best to extend that research to adult education while minimizing the risk of ineffective instruction.

In the United States, the link between adult high school equivalency programs (GED) and tertiary education is not seamless. Research is needed to identify knowledge and skills that are needed for success in higher education and to examine effective ways to integrate these into GED programs that currently focus on completion of secondary level education rather than preparation for undergraduate work. If workplace qualifications and the personal goals of adult students include higher education, adult mathematics educators must address this reality when designing adult high school mathematics instruction.

This list is suggestive, not conclusive. Many, if not most, of our countries are struggling to provide mathematics education to immigrant students. As I write this, the economies of many nations are stagnant or facing recession. When times get tough, it is often adult education that feels the budget cuts first. We will be called on to provide the best education at the smallest cost. Quality research should help us move toward that goal.

## Concluding Remarks

The *Developing a Theoretical Framework* topic group has made much progress but the moorland is broad and provides extensive questions upon which we can graze. With each ALM conference, researchers and practitioners extend our knowledge base and help each other in our respective work. May such be true for many years to come.

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## Topic Group B: Mathematics Education for the Workplace

### Convenor: Lisbeth Lindberg, Göteborg University, Sweden

This Topic Group has met and discussed at two conferences. At ALM-8, we started by summing up the discussions from ALM 7. Some of the issues were the following:

- Mathematics in the vocational education setting is in a supportive role, thus mathematics should be more applied and work-related.
- Mathematics teachers must be more educated and interested in the vocational areas especially if they teach students from those areas.
- The teachers in the vocational areas have to be more educated in the modelling of mathematics.
- There might be a literacy issue, i.e. that the vocational students do not have the reading skills needed.
- There might be a need for more situated mathematics.
- Much of the discussion was about the conflicts between program goals and instructor hang-ups. Programs have goals, but instructors are not always tuned into or supportive to those goals.

The meeting last year at ALM 8 had addressed the following issues:

- Skills versus philosophy
- Pure mathematics versus relevant applications
- Literacy versus numeracy
- The tensions between directly used mathematical knowledge versus lifelong learning

**ALM9**

The discussion group focused on interesting issues that have arisen related to the topic during this year.

- Are there some interesting projects that we know of that might give ideas for future development?
- Has there been an attempt to give opportunities for collaboration between workplaces and schools?

Ben Hermeler gave a short version of his paper ‘Numeracy at the workplace’ (see Paper Presentations section of these *Proceedings*) at the conference. Jaine Chisholm-Caunt gave a paper on ‘The Workplace Basic Skills Network and professional development courses.

- What is still the *most* critical question?

How do we organise the content and should we deal with it in the schools or in a real job situation?

- Is there a need for more mathematics or less mathematics and something else?

The discussions will continue during the next ALM-conference.

In Sweden there is right now a big discussion about how to organise the vocational programmes and where and how to teach mathematics. The question is also about by whom. Furthermore, should the content focus on general mathematics or of vocational mathematics?

The book Education for Mathematics in the Workplace (Bessot & Ridgeway, 2000).has some very interesting aspects that we will continue to discuss.

The discussions in the topic group at ALM9 focused very much on the qualifications of the further education teachers´ education and qualifications. The group agreed upon contents for the teachers that included good knowledge in didactics of mathematics and ability to work with teachers from different vocational areas. The group named this education a 'richer teacher education'.

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**Workplace Basic Skills Network**

**Jaine Chisholm Caunt**

The workplace basic skills network is a membership organization funded by the Department for Education and Skills in order to increase the quantity and improve the quality of basic skills in the workplace. The network runs the only *accredited* professional development programmes in the UK to enable tutors to design and deliver successful customised programmes for workers.

**What is numeracy?**

Numeracy involves the functional, social and cultural dimensions of mathematics. Numeracy is the type of maths skills needed to function in everyday life, in the home, workplace, and community (Withnall, 1995).

Like literacy, numeracy is a set of cultural practices that reflect the particular values of the social, cultural and historical context.(Jorum, ,Resbick and Gabrele, 1994).

Critical numeracy means that learners empowered with functional skills can participate fully in civic life, and take political and social action (Kerka, 1995)

**What is Workplace Numeracy?**

It depends on what kind of workplaces we look into. Some examples from different areas:

- Filling in stock report forms
- Calculating metric conversions
- Entering data onto a computer
- Reading graphs and charts
- Measuring and weighing ingredients
- Calculating money and checking payslips
- Converting between 12 hour and 24 hour time
- Monitoring readings and temperatures
- Estimating wastage
- Calculating product output

**Further education versus workplace contexts**

Further education teachers tend to have fairly clearly defined roles (e.g. teacher, support assistant etc.) which reflect their curriculum subject area. Workplace tutors often have less well- defined roles. Are workplace tutors, "teachers" or "learning support assistants´? This can fuel controversy over whether they should have a level 3 or a level 4 qualification. Workplace basic skills tutors are rarely defined by their curriculum subject area: e.g. basic skills is often only an aspect of their work, rather than its focus. This can also mean that they

miss out on professional development which they don't identify as being relevant to their needs.

**Advantages of new teacher training qualification requirements**

Further education tutors will have parity with schools sector. There will be recognition of literacy and numeracy as core curriculum subjects, rather than defining them as "remedial" learning. This should enhance pay and status of basic skills teachers. This should also help to encourage new entrants to the profession. There will be a better deal for the learner. They will now be taught by qualified professionals, rather than by well-meaning volunteers.

**Disadvantages of new teacher training qualification requirements**

We need to upskill a large proportion of the existing workforce, as many have the new minimum levels of qualifications. Concern that many teachers (particularly those working in the non-further education sectors) will not have the new minimum levels of qualifications. There is a concern that many teachers will not want to engage in the process. There will be queries over the perceived need for the new requirements. There is a concern that the new requirements reflect the further education context, rather than the realities of these working in other sectors.

**Implications for workplace numeracy teachers**

Many (the majority?) of numeracy tutors, particularly those delivering in the workplace, only have a level 2 qualification in maths/numeracy. Will these people be "pushed out" of the profession? How do we upskill the very large numbers of teachers involved? Do workplace numeracy teachers *really* need a level 4 qualification? Are we confusing numeracy with maths?

Or do we need to develop a *closer link* with maths teaching, to encourage cross-pollination or subject expertise, and to discourage numeracy teaching from being seen as a "lesser" subject?

### Numeracy teaching outside the UK

What is the experience of other countries in trying to regulate and professionalise the teaching of numeracy, particularly in the context of the workplace? What can we learn from other nations' experience? How can ALM provide for discussion and raising awareness of the issues involved?

### Workplace basic skills network

For further details, visit the website for further details about our activities including details of our professional development programme courses, and "on line" enrolment forms: http://www.lancs.ac.uk/website

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## Topic Group C: Affective Factors in Adult Mathematics Learning

**Convenors: Jeff Evans, Middlesex University, London, UK**
**Wolfgang Schlöglmann, University of Linz, Austria**

This Topic Group held two well-attended meetings at ALM-9. At the first meeting, the twenty or so participants introduced themselves and their interests in affect related to mathematics, including maths anxiety, loving and hatred of maths, diffidence, attitudes, beliefs, and the relationships with mathematical thinking. The discussion then ranged over cultural differences, the qualities of ongoing gender differences, and the effect of mathematics competitions and international surveys.

Three ongoing issues had been proposed by the convenors:

- the relating of the work discussed at ALM to overviews of the research in this area (e.g. McLeod, 1992; Evans, 2000);
- bringing in the physiological dimension; and
- issues of methodology.

In the paper that follows, Wolfgang Schloeglmann addressed all three through an introduction to the use of neuro-physiological results in mathematics education research.

In the second session, participants discussed how to 'change the face of mathematics', since it is not always as human(e) as it might be. Some speakers emphasised the importance of teaching style, especially the experiences at the beginning of a course. Others discussed groups directly oriented to confronting maths aversion, such as the use of mathematical autobiographies. As with the first session, there were several telling anecdotes about the importance of affective aspects in the learning of mathematics by adults.

There was substantial support for a continuation of this workshop at future ALM conferences. Topics of interest that were suggested included:

- Cultural differences
- Crossing the mind-body divide
- Neuroscience and 'self systems'
- Affective and attitude results from the international surveys

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# Affect in mathematics education in light of neuroscientifical results

**Wolfgang Schlöglmann**

Research on the influence of affect in mathematics learning processes was increasing during the last decades. New concepts, partly borrowed from other subjects, was developed and stimulated research activities. In this paper I give only a summarizing description of the categories of affect (Goldin, 2001). For an overview about the different concepts I refer to Jeff Evans's book (Evans, 2000):

> ***(1) emotions (rapidly changing states of feeling, mild to very intense, that are usually local or embedded in context),***
>
> ***(2) attitudes (moderately stable predispositions toward ways of feeling in classes of situations, involving a balance of affect and cognition),***
>
> ***(3) beliefs (internal representations to which the holder attributes truth, validity, or applicability, usually stable and highly cognitive, may be highly structured).***
>
> (4) values, ethics, and morals (deeply-held preferences), possibly characterized as "personal truth," stable, highly affective as well as cognitive, may also be highly structured). (Goldin, 2001: 3)

If we look at the description of the categories of affect – emotions, attitudes, beliefs and values/ethics/morals – we recognize the terms 'stability" and 'intensity" are used for characterization. Jeff Evans summed up all these in a graphic form:

Range of Types of Affect (Evans, 2002)

**Beliefs** **Attitudes** **Emotions**

**Stability** **Intensity**

**Values** **Mood**

In the following results from neuroscience on affect ( in neuroscience research mostly called 'emotion") are used to get a better insight in affect as well in the descriptions as in reactions (Schlöglmann, 2002).

1) The brain is the organ in which is represented all the knowledge about the world outside but also about all processes inside of the body.

2) All systems of the brain are the result of evolution with the aim of helping the individual to survive. Emotion and cognition are also part of the brain system and therefore a result of evolution (Damasio, 1999; LeDoux, 1998; Roth, 2001).

3) A special brain system of an individual is a consequence of the evolution as well as of the ontogenetic development of the individual (Ciompi, 1999).

4) First of all we have to note that all processes on the neuronal level are unconscious. The course of a process is a consequence of the structure of the system and the stimuli. But some of these processes lead to conscious results. We are aware only of these conscious parts of the processes.

Emotion and cognition are both subsystems of the brain system. They are located in different parts of the brain (Damasio 1999; LeDoux 1998; Roth 2001) but there are connections between both systems which allow interactions. A very important consequence of these two different systems of concepts is the fact that we have to distinguish between "feeling" and "knowing that we have a "feeling" (Damasio, 1999: 26) or "emotional reactions" and "conscious emotional experience" (LeDoux, 1998: 296).

The emotion system has also connections to the arousal systems, therefore emotional reactions are often combined with "body reactions" (LeDoux, 1998). For this paper the interaction between affect and cognition are of particular interest:

The emotion system influences memory processes. On the one hand, the emotion system is involved in the storage process. The system works like an appraisal filter. On the other hand, the results of the retrieval process are emotionally related (Roth, 2001).

To understand the significance of the neuroscientifical results let us consider the research methods used in mathematics education. For investigating beliefs and attitudes the favorite methods are questionnaires and interviews. Both rely on the memory of the interviewees.

If we look at the results of neuroscience in relation to the memory, we have to distinguish between two memory systems with respect to emotions: the implicit emotional memory and the explicit memory about emotions (LeDoux, 1998). The implicit emotional memory operates unconsciously, is strongly connected to arousal systems and may often lead to bodily reactions.

The explicit memory about emotional situations contains all the conscious knowledge about emotional situations, emotional reactions to objects, persons and ideas etc.. The most important consequence is the fact that this memory system is part of the cognitive memory and there is no distinction between a remembrance of an emotion and a remembrance of a cognitive content (LeDoux, 1998).

The fact that the memory about emotions is a cognitive memory has some important consequences:

1) We have knowledge about our feelings and their origin. This knowledge is stored in memory systems as cognitive knowledge. Therefore we have the possibility of investigating knowledge about affect using cognition. Research methods used in cognition research (questionnaires and interviews) can help us to explore affect.
2) The memory about emotions is open for "rational" manipulations. That means we are able to think about our emotional remembrances. But we have to note all verbal statements are controlled by cognition.
3) A very important control authority to all verbal statements is the "feeling of one´s own worth". Therefore we try to give our emotional remembrances a meaning which doesn't destroy the feeling of one´s own worth. In this sense persons have in interviews a tendency to trivialize their own weaknesses. This trivialization can, for instance, take place by the expression of opinions that particular mathematical contents are unimportant if the person is unable to cope with these kinds of problems.
4) Research on emotion and memory suggests that humans "construct" their memories in a way that they are able to live with this memory. A part of this process is that we forget unpleasant facts more easily than pleasant ones. And our memory has suppression mechanisms to handle unpleasant remembrances (Roth, 2001).
5) Group processes have an important influence on verbal statements concerning contents which are emotionally coloured. Humans are able to "learn" emotions in group processes (Ciompi, 1999; Damasio, 1999). These processes can lead to common shared emotions concerning special contents. Especially, shared value systems can influence the contents of the memory. In this sense we have to see the habitus concept (Gates, 2001) or the socially constructed "feeling rules" (Ulich & Kapfhammer, 1991) (Feeling rules mean that the group says what a member of the group has to feel in a particular situation) .

Whereas research on beliefs and attitudes uses in the most cases the explicit memory as source of information the affective category 'emotions" (Goldin, 2001) refers to class room observations (often video taped) as the favorite research method. In these cases we are able to observe an activated emotional memory system. This activation can be observed by the researcher. The most well-known signs of an activation of the system are bodily reactions. To interpret bodily reactions is a qualification which is evolutionarily rooted in humans and therefore a valuable research method to evaluate emotional situations. These emotional reactions underlie only a weak control by the cognition (LeDoux, 1998) and are therefore especially valuable hints to the emotional state of an individual. Signs for these emotional state are expressions of the face, shaking of the hand, quavering of the voice, and so on. These signs of the body allow us also to recognize all changes of the emotional state.

It is important to note that informations about emotional situations are not only stored in the memory which contains the knowledge about feelings they are also stored in the implicit emotional memory and this memory influence further reactions to a special situation.

Reports on learning situations in adult education in mathematics tell of "learning blockades" (Lindenskov, 1996; Schlöglmann, 1999; Wedege, 1998). Such very dramatic emotional reactions which prevent learning on the cognitive level refer to a 'traumatic experiences". LeDoux describes the reactions to such experiences in the following way:

In traumatic situations, implicit and explicit systems function in parallel. Later, if you are exposed to stimuli, that where present during the trauma, both systems will most likely be reactivated.

(LeDoux, 1998: 202)

The specificity of such emotional reactions is that there is no chance to help on the cognitive level. Such problems are not to handle in classroom situations. The emotion floods the cognition and the whole cognitive system is blocked and not able to be reached by "rational" arguments. But in most cases adults are able to handle also unpleasant emotional situations by using their knowledge about emotions. A qualification which Goldin (2001) calls meta – affect.

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**Discussion Group**
**Professional Development**

**Facilitators: Lena Lindenskov (Denmark)**
**and**
**Terry Maguire (Ireland)**
**Countries represented;**
**Ireland, England, Sweden, Uganda, Denmark and also input from Australia**

The group was gathered for two sessions with the aim of initiating a discussion group on Professional Development for the first time at an ALM conference. The discussion group should provide an additional forum where researchers and practitioners can discuss emerging issues surrounding the professional development (PD) of those involved in adult numeracy/mathematics. Many countries have, or are in the process of, developing professional development programmes. Diverse approaches have been taken in different countries. The discussion group will allow these experiences and approaches to be shared and discussed, to learn what is happening in other countries, and to understand the central values that inform particular approaches to the professional development of tutors in adult mathematics education.

**Session 1**

The focus agreed for Session 1 was to try and get a picture of what was happening in terms of PD internationally and considered the following questions submitted by Betty Johnson (Australia).

1. What would a good numeracy teacher, who had undertaken our (fantasy) numeracy PD course, know, believe and be able to do after it.
2. What are the implications of this for a PD course (knowledge about maths, learning, teaching, skills, competencies, length of course, organisation, participant's(tutor) background etc).
3. What kinds of professional development are possible? (How can it be delivered?)
4. How might professional development need to be customised to address the different contexts in which professional development might be needed? (e.g. prisons, workplace, community)
5. What can we share about what we know or hope about professional development?

It was agreed that these questions would form a good basis for future detailed discussion in the group. Session 2 focused on discussing/brainstorming the first of the questions.

**Session 2**

As a start to the second session Lena Lindenskov (Denmark) suggested a possible answer to Question 1, and gave the following examples of how this answer is implemented in the new Danish programme:

- It is a goal in the new programme that the participating teachers enhance their knowledge of and engage in explorations and discussions of differences/similarities between school maths and everyday maths. That is why there are activities in the programme like

  I. visit a workplace and investigate `NUMERALITET´ there ;

  II. go for a walk in the city, take photos of numbers, diagrams, patterns and the like;

  III. analyse your findings and compare them with school maths.

- It is a goal to enhance knowledge and discussions of a variety of curricula by comparing `NUMERALITET´ in other educational programmes in Denmark and abroad

- It is a goal to enhance knowledge and discussions of target groups' needs and experienced difficulties through activities on adult learners' `NUMERALITET´ and difficulties; and by giving information on dyscalculia

- It is a goal to enhance knowledge and discussions on the actual curriculum and test-system by completing activities on this

- It is a goal to enhance knowledge and experiences of different kinds of materials and activities for adult learners through simulations – teachers try out materials and tasks and teaching ideas as if they were students at an adult mathematics/numeracy course, and reflect upon that.

During the subsequent brainstorming session it was difficult to specify according to Betty's terms ´to know, believe and do´. Our brainstorm resulted in these more general statements:

- Being familiar with curriculum
- Know about theory of curriculum development
- Know about teaching ideas
- Understand profoundly the subject
- Understand Adults as learners
- Understand Adults and mathematics
- Talk/cope with own emotions and values and internal conflicts
- See and internalise visions for the programme
- Understand – from illustrating examples - what is numeracy/mathematics and how it is relevant
- To be able to communicate in partnership
- Being aware of linguistic issues to help learners
- Recognise and come to live with the field as 'not fully understandable and rational'

- Feel pride in the profession as adult mathematics/numeracy teacher and tutor

I. Believe that teaching adults mathematics/numeracy is not teaching a lower level, but really a higher level because of the complexity of adult mathematics/numeracy

II. It was a vision in the group to involve teachers as researchers.

The Way Forward was discussed as the final issue of the session with the following conclusions:

1. The discussion group is included as a topic group for ALM10.
2. Each country represented gives a short description of the professional development opportunities that are available for tutors of mathematics/numeracy. The description will should include the issues that dominate in a particular country.
3. An e-mail group is set up (responsibility TMM and LL). This group will share information and keep in contact until ALM10. The group will be facilitated by TMM and LL until that time.
4. If possible, an article on Professional Development will be produced for the Newsletter during the year to keep all ALM members up to date about what is happening.

# Papers, Workshops & Poster Presentations

# Adult Problem Solving and Commonsense

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## Introduction

The authors have designed and evaluated an educational programme aimed at developing adult learners' quantitative problem-solving skills (Colleran, O'Donoghue and Murphy, 2001). That study identified a number of emergent issues that require further exploration. One of these issues concerns the role of commonsense in the formal adult learning context. The study found that normal, everyday commonsense (Lonergan, 1957) provides a confident basis on which adult learners began the quantitative problem-solving process. However, there are indications that commonsense not only provides a confident basis for learning but is a significant *resource* in the adult learning context.

A better understanding of commonsense and innate thinking skills, and their interaction during problem solving, may shed additional light on the traditional problem of learning transfer, an issue that has merited attention at previous ALM conferences and in the general educational/mathematical literature (e.g. Lave, 1988; Noss and Hoyles, 1996; Evans, 2000; McKenzie, 20001). The capacity to transfer commonsense and thinking skills is an issue that merits systematic and sustained exploration. This combination may provide another 'position' along what may be viewed as a spectrum of successful learning which has 'unproblematic transfer' at one end and 'situated cognition' at the other.

## A model for adult problem solving

The processes through which adults solve problems are not well understood or modelled. The mathematics education literature did not provide an appropriate framework for an adult-orientated educational programme. Consequently, one must draw on the contributing disciplines for additional insights e.g. philosophy, psychology and education. Lonergan (1957) offers a viable framework in his programme for life.

Lonergan believed that the process by which adults come to know and decide is the same for all normal adults. Not only is the process the same, it is activated and employed without direction on the part of the individual. Therefore, the cognitional structure is *invariant* in that it remains the same for each knower and it is *naturally innate* because it happens without direction or effort on the part of the knower.

The preliminary stage of Lonergan's programme is the uncovering of one's cognitional structure, i.e. the innate, invariant thinking process. This discovery process, Lonergan postulates, will lead to an improvement in problem-solving and decision-making skills of adults.

**Lonergan's programme unfolds on three levels of knowing:**

- **commonsense knowing,**
- **scientific knowing,**
- **critical knowing.**

*Commonsense knowing*, because it happens spontaneously in the concrete world, does not require the engagement of the problem-solving processes. *Scientific knowing* is employed when an individual engages a novel situation and the mental processes outlined in the cognitional structure (see Figure 1 below) move from the concrete to the abstract. However, Lonergan suggests that adults become effective problem solvers in two modes – the direct mode and the indirect mode. The *direct mode* of problem solving requires the individual to concentrate on achieving a solution to the problem at hand - problems are solved by engaging the mental processes of the cognitional structure. However, the *indirect mode* requires the individual to attend not only to the solution but also to the *process* – the mental operations engaged during the solution episode. Understanding the process by which solutions are found is known as *critical knowing*. In the context of our educational programme critical knowing enables learners not only to solve quantitative problems, it also provides the means by which they can engage with confidence the new quantitative situations that present themselves regularly and frequently in the ever-changing conditions of their daily lives.

Therefore, Lonergan's problem-solving and decision-making programme offers more than a structure for understanding, knowing and deciding. It offers a *developmental process* in which an adult learner can move from understanding, knowing and deciding at a commonsense level to a scientific level and finally at a critical level. It is also a *creative process* in which the individual struggles to spark new insights that may hold the key to a required solution. Lonergan's problem-solving and decision-making programme can therefore be visualised not as a two-dimensional cycle of mental activities but as a three-dimensional helix (see Figure 1) which dynamically connects concrete understanding at the lower, commonsense level to a deeper and more abstract understanding at the intermediate, scientific level and finally to an even deeper metacognitive understanding at the top of the helix. At each successive level the learner engages the cognitional structure and comes to know. Knowing at the concrete level provides the basis for scientific understanding and both commonsense and scientific understanding provide the basis for critical understanding. In this manner the learner builds understanding *from concrete understanding to abstract understanding to process understanding*. The loop structure enables the learner to back track if at any stage understanding becomes shaky. The loop also points to the relationship and the sequence of development of the three types of knowing.

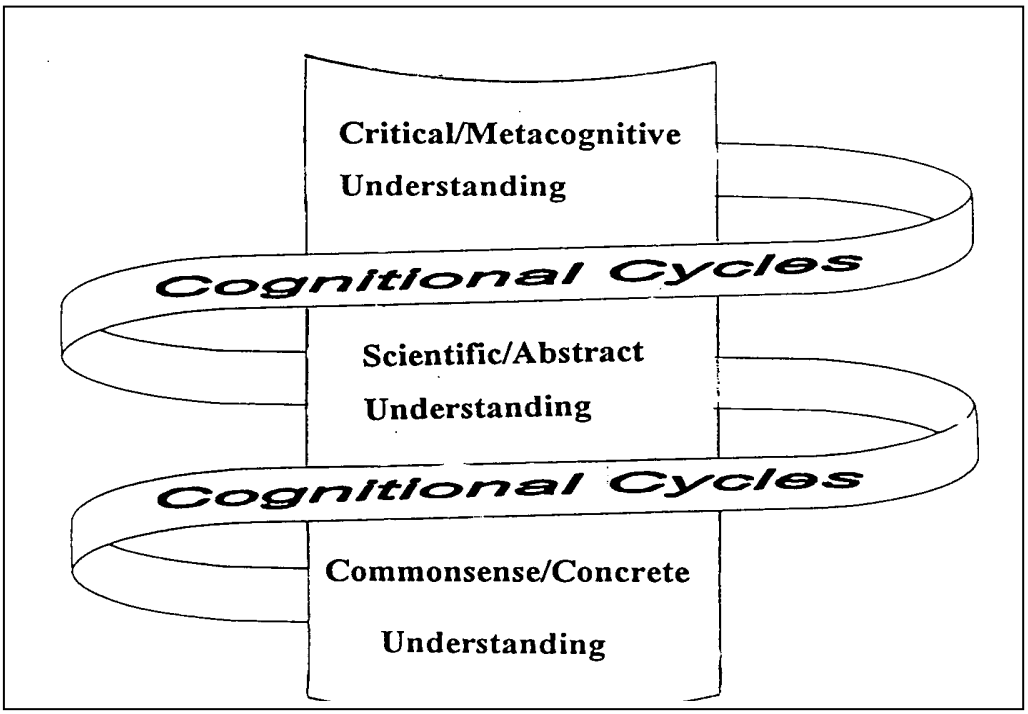


Figure 1. Helix illustrating Lonergan's dynamical and developmental process for understanding.

**The educational programme**

Lonergan's cognitional structure stands at the heart of this educational programme and provides the direction and the substance of the intellectual activities addressed throughout the programme. Two further elements; 'realistic' problems and an enabling social learning context, are combined to constitute the programmes theoretical structure (Colleran, O' Donoghue and Murphy, 2000).

Lonergan's (1957) 'programme for life' is transformed into a concrete educational programme through six carefully designed worksheets and problem-solving activities. Throughout the programme learners reflect on the solutions they generate to quantitative problems and complete worksheets, each with a particular focus on an individual stage of Lonergan's cognitional structure. The following issues are attended to in a sequential and developmental manner:

- experience,
- commonsense understanding,
- questions for intelligence,
- insight,
- formulation of insight,

- questions for reflection,
- scientific understanding,
- evaluation,
- decision,
- review (Colleran, O' Donoghue and Murphy, 2000)..
-

**Resources for problem solving**

While the literature on mathematical problem solving (Schoenfeld 1992; Mayer, 1982) suggests there are five resources that need to be addressed in the context of adult mathematical problem solving we believe that another resource i.e. commonsense, should also be considered as a significant resource:

1. domain specific knowledge,
2. heuristics,
3. metacognition,
4. beliefs,
5. context
6. commonsense.

Before we discuss the evidence from the evaluation phase of the study it is appropriate to establish a clear understanding of what commonsense is in the context of this programme i.e. Lonergan's (1957) understanding, and we reflect on other relevant research in this area, for example Coben (1997).

**Commonsense as a resource**

Commonsense, in the problem-solving context, provides a resource with three distinct elements:

1. An accumulation of practical understandings
2. A form of knowing
3. A basis for scientific understanding.

*An accumulation of practical understandings*

> Commonsense is a collection of insights accumulated by a community, or individuals within that community, in a socio-historic setting. The context within which it operates is quite specific. It is specialised in the concrete objects of everyday living in terms of their relationship, not to one another, but to the individual. It is bounded by the concerns of human living and by workable solutions to daily tasks. "[Common sense] ... clings to the immediate and the practical, the concrete and the particular. ... Rockets and space platforms are superfluous, if you intend to remain on this earth" (Lonergan, 1957:179).

*A form of knowing*

> Intelligence is met in every walk of life. It is this everyday, practical, concrete, intelligence that Lonergan (1957) calls common sense. However, even though it is called common sense, *it is not common to all people*. And while it may be accessible to all normal individuals there are no acknowledged specialists or experts (Coben, 1997). The intelligent person of common sense demonstrates a greater readiness "in catching on, in getting the point, ... in grasping implications, in acquiring know-how" (Lonergan, 1957:173).

Commonsense knowing can be identified by the following:

- Pragmatism
- Spontaneity
- Socially generated
- Temperamentality
- Taking things for granted
- No theoretical inclination.

In summary, common sense is confined to the particular, the experiential, and the concrete, where only non-technical, descriptive terms are used. It is the field of human interaction, where people operate during their everyday living. Common sense operates within a cultural context where it settles for a mode and measure of understanding that enable human activity and human interaction to operate intelligently.

*As a basis for scientific understanding*

However despite its limitations where would we be without it? There would be no place for

human temperament, spontaneity, practicality, intuition, aesthetic appreciation, love, hate and so on. In other words there would be no room for what makes us human, imperfect though that may be. However there is another type of understanding which tries to reduce the subjective 'drawbacks' to produce a more objective understanding i.e. scientific understanding. Lonergan tells us that the scientist is not the whole man or woman functioning "but the rest of the man subordinated to his intelligence. Like Thales so intent upon the stars that he tumbled into the well" (Lonergan Research Institute, 1996:113). While an individual requires commonsense understanding to survive effectively in this world, occasions may arise when scientific understanding is required. This is not to say that the subject is not intellectually engaged in the field of common sense. Common sense requires an equally intelligent subject; it is the context that determines the function to which the intelligence is directed. Therefore commonsense can be regarded as a sea within which arises here and there islands of conceptual, scientific understanding and knowledge (Tekippe, 1996). Without this sea or concrete world of commonsense understanding, science has no starting point. It is into this particular, concrete world that science attempts to introduce universal, theoretical understanding.

So, even though there are two fields of operation it does not imply that different people exclusively inhabit each field. A single human mind can and does operate effectively within both fields. When the individual is engaged with practical issues he or she is concerned with the development and growth of common sense of the particular place and time in which he or she operates. However, that same individual may need to develop scientific understanding in relation to their job or profession. This shift form commonsense to scientific understanding is similar to the developmental process described in Argyris and Schon, (1996). They describe a process that moves from routinised, tacit, commonsense understanding, which leads to no significant change of action, to a far deeper, scientific understanding, which brings about a change in the way the individual acts. The former is described as 'single-loop' learning while the latter is described as 'double-loop' learning. Until one attends to experiences in this reflective manner things will continue in the routine, however, with reflection the situation will become transformed from commonsense, single-loop learning to scientific thinking and double-loop learning. Again the basis for scientific understanding is the routine world and it is reflection and scientific thinking that leads to new understanding and knowledge.

Lonergan (1957) assures us that science does not have a monopoly when it comes to intellectual demands and ability. Common sense and science are equally intelligent and they have a functional complementarity. Without commonsense there is no starting point for scientific understanding. Both science and commonsense operate as partners in the development of human understanding. However, there is concern that scientific knowledge has become a "fetish used to alienate students (and teachers) from their own native ability to know the world" (di Norcia, 1975:27). Making sense of the experiential world is intellectually demanding and fundamental to everyday living and may provide an invaluable resource, particularly for adult learners when they are engaged in formal education.

## Practical quantitative problems and commonsense

### *'Invisible' Commonsense mathematics*

During the pilot study as well as the case study (Colleran, O' Donoghue and Murphy, 2002) evidence from the authors (NC) researcher journal indicated that learners were initially

unaware of the mathematical skills they used routinely and effectively in many everyday situations. These skills were 'invisible' (Coben, 1997; Harris, 1995). However, when learners were made aware of these skills by the tutors, learners called these skills or this competence 'commonsense'. As a result of their participation on this programme 'invisible' mathematics became 'visible' for learners. One learner [PI:L1a:LC] from the pilot study reported on a conversation he had with a learner-colleague, who was not participating in the programme, who had asked what was going on in this 'new programme'?:

> *We're doing maths that happens every day. And she said, well it doesn't happen to me. And I was saying to her, but sure if you're at home and you want lace for the windows, right? I mean you get out a tape and you say well it's about three feet, it's about seven feet… so you know you want at least three feet wide, you know it has to be at least seven feet long, and then you say to yourself but then you say to yourself but that could be dead flat, I want it fluffy. So what I'll do is I'll get four times as much going across. So they're after measuring it and then they're multiplying it by four and she said to me I'm doing that everyday but I don't realise I'm doing it. And then she said…I would have been interested in that if I knew that's what it was about.*

*Commonsense contributions to the problem-solving process*

Learners who participated in the pilot as well as the case study not only became aware of the 'commonsense' mathematics they used throughout their daily lives but also became aware of the important role commonsense, or prior experience, plays in the quantitative solution process. One learner [PI:L1a:LB] in the pilot study suggested that commonsense is:

> *…experience of what you already know in coming to a solution…*

In the case study when learners were engaged with the 'Stocks and Shares' problem they talked about the relevance of bad press and how this could affect share prices. This 'bad press' concept was something learners brought with them to the problem situation.

One of the problems addressed by learners during their participation on the learning programme was to 'Design a car park'. While attempting to come up with a solution to this problem learners discussed commonsense issues such as the average size of a family car, the size of a minibus, how much room is needed to open the door of a car and how to represent the size of the car park site on a sheet of paper using an appropriate scale.

While learners were addressing the problem 'What is the best way to heat your home this winter"? the discussion that followed resolved that there may be a fuel that is the most economical for heating a house but it may not be suitable for every house. Commonsense issues such as the age of people living in the house; the size of the house; the cheapest fuel may not be the most practical; safety; coal is messy; oil is cleaner; and so on. The learners did decide that the cheapest or most economical way can be worked out mathematically however this answer may not be suitable. For example oil may be the cheapest fuel but if the house does not have a heating system that uses oil then it would not be appropriate. All learners agreed that this situation cannot be generalised – each home and each situation has

to be examined individually. The decision on what fuel to use goes beyond the answer to what is the most economical – it's a matter of opinion and preference as well as the facilities one has available.

It is clear that learners' commonsense, i.e. their accumulated understandings and knowledge concerned with human living and workable solutions to daily tasks, was employed throughout the quantitative solution process.

*Commonsense as a basis for quantitative solutions.*

However commonsense was employed to the extent of its usefulness and then, particularly in the case study, the teacher intervened or was asked by learners to intervene when commonsense was no longer capable of progressing the problem any further. As the following quotations from learners in the case study illustrate the learners knew when their commonsense exhausted the tutor provided support.

> *The teacher's job here is only to help us with maths problem …[The tutor] will help us if we are stuck. [L10:L2J]*

> *…and as time is going on less interaction from the teacher. [L11:L2J]*

> *All the group are going to help one another out… The tutor is the last resort… I think it's good if we had no one to help us that we would be able to solve it as a group… working together helping one another to solve a problem and coming up with a solution… There is more communication and activity involved. [L2:L2J]*

The tutor became the bridge between the commonsense available to learners and the mathematical expertise required to solve the problems.

*Commonsense as a confident starting point*

Practical quantitative problems created a context in which learners were enabled and encouraged to draw on relevant personal experiences i.e. commonsense. Several learners, particularly in the case study developed sufficient confidence to bring this prior relevant knowledge to bear in an explicit way on the quantitative situation they were addressing, particularly in the "Stocks and Shares' and the 'Design a Car Park' problems. This prior knowledge or commonsense provided a confident foundation on which to build and support the solution process. Learners were encouraged to search their own knowledge resources as a starting point and as a point of reference throughout the problem-solving process.

In summary, as a result of the programme evaluation process it is clear that concrete understanding or commonsense, which most adults have in abundance, provided *a store* of concrete, practical understandings and experiences. Acknowledging and valuing commonsense encouraged adult learners to search their own knowledge resources as a *confident starting point* in the problem-solving process. The learners informal knowledge or

commonsense provided a *sound base* on which formal, scientific and mathematical understanding was built.

**An insight into the 'transfer' problem**

*Transfer in flux*

The 'learning transfer' issue ranges from unproblematic application of understandings from one context to another (e.g. Bruner, 1960, 1966) to situated cognition (e.g. Lave, 1988). Situated cognition argues understandings are not transferred but are newly generated by individuals in each new situation encountered. However there are a number of intermediate positions such as 'situated abstraction' (Noss and Hoyles, 1996) and 'translation' (Evans, 2000) where the boundaries between situations are lower and permeable.

Unproblematic transfer of understandings from one situation to another has come under sustained criticism over the past (Lave 1988, Evans, 2000). However, our research suggests that there is movement of learning resources i.e. commonsense and a generalisable problem-solving heuristic, from one situation to another. In the context of adults solving quantitative problems many learners in our study accessed relevant commonsense and employed their natural thinking processes to stimulate new insights and create new understandings i.e. to learn. Each learner in the case study, employed their commonsense or prior understandings as a basis for innovative and creative solutions. However, understandings are personal and unique and it must be recognised that insights based on one learner's commonsense will inevitably be different to another's. Therefore what is stimulated or 'signified' (Evans, 2000) by the problem will determine the commonsense employed. While recognising the individual and unique nature of each learner's life experiences and how that can impact not only intellectually but also emotionally and socially in the formal learning context, there may be a danger of individualising the formal learning experience to the extent that no generalsiations are possible.

So, while unproblematic transfer of learning is no longer widely accepted we believe that situated abstraction (Noss and Hoyles, 1996), translation (Evans, 2000) and a form situated cognition (Lave 1988) which does not overemphasise the discontinuities between contexts, are sympathetic with our study.

*Another view on the transfer issue?*

It is clear from our study that learners' prior understandings or commonsense, particularly among adult learners engaged in ABE, provides a problem-solving *resource* with three distinct elements:

1. A store of practical understandings and knowledge
2. A confident starting point on which to begin the problem-solving process
3. A base on which to build a formal solution.

Lonergan (1957) suggests that this store of commonsense understanding is generated through an innate thinking process i.e. Experience, Practical Insight and Judgement. However, this innate thinking process does not always conclude with practical, commonsense judgements; the process proceeds, when motivated by circumstance, to generate reflective, conceptual insights and judgements (see Figure 1 above). The innate availability of this thinking process

to all normal adults is by no means proven. (However, the notion of innate and similar cognitive skills is suggested in the field of language development by Chomsky, (2000). He suggests that all normal humans have innate and similar cognitive abilities to generate languages – the language learned is determined by the context or country in which the child develops). We have discovered strong indications, among a number of learners in the pilot study and among all learners in the case study, that they employ Lonergan's thinking process, not only while they are engaged in quantitative problem-solving situations but also in their daily lives outside the mathematics classroom (Colleran et al, 2002).

If, through further investigation, evidence grows of the innate availability of a universal thinking process among all normal adults (Lonergan 1957) we are perhaps looking at the construction of a problem for educators which de-emphasises 'transfer' of learning as the core problem. We are then moving from a mechanical metaphor, i.e. 'transfer', to more dynamically interconnected and complex intellectual, emotional and social metaphors such as 'motivating' learners to 'discover' the resource of commonsense and the innate thinking skills available to all normal adults and the 'creation' of new understandings, knowledge and solutions. This view requires no 'movement' of intellectual resources. It is the individual that moves from one context to the next and the intellect, guided by affective factors, 'activates' his/her innate thinking skills and 'accesses' relevant commonsense as the basis for a solution to a non-routine problem. The problem may then be framed in language such as:

How can we *motivate* adult learners to develop sufficient confidence to *discover and activate their innate thinking processes* and to *access the store of relevant knowledge* as they endeavour to make choices in a multitude of changing quantitative environments they engage throughout their lives?

There is something unstructured, non-systematic, post-modern, individual and above all emotional about this question. We seem to be moving from a hard, rationalistic, scientific and wholly intellectual framework for understanding the transfer of learning to a softer, emotionally charged and individualistic view. The modern scientific view that frames its models on measurable, observable, structured objectivity, which did not concern itself generally with the impact of human individuality and particularly emotions, seems to be broadening out to include the post-structural evaluation of the unique individuality and subjectivity of learners.

Finally, the contexts within which commonsense flourishes is always socially interactive, emotionally charged and practical, where individuals' actions are often confirmed by admiration and approval and sustained by respect and affection. We believe, while recognising the impact emotions play in the learning environment that *social interaction, admiration* and *respect* can provide the pillars on which to build and maintain an appropriate learning environment for ABE learners. Systematic and sustained research into commonsense as a resource may provide fruitful insights into individuality, emotions, creativity and learning in a variety of learning environments.

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# Mathematics done by adults portrayed as a cultural object in advertising and in film

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*In earlier work, I considered the increasingly widely-discussed role of affect and emotions in the learning and doing of mathematics by adults (Evans, 2000, 2002). In this paper, I argue that greater notice should be taken of the sources of attitudes and feelings towards mathematics which are produced in cultural products, such as advertisements and films. Taking a discursive approach, this paper analyses a sample of these products for what they propose about mathematics, and those who do it, and the sorts of emotions likely to be associated with the message. This format allows the addressing of several methodological questions (e.g. sampling, confounding) that are relevant to many types of 'qualitative' research.*

## Introduction

Much of the research done on mathematical affect assumes that feelings about mathematics originate in the experiences of the particular individual at school (e.g. Buxton, 1981), or in some form of 'cultural transmission' of attitudes from significant others in the person's life – parents, teachers, and peers (e.g. Fennema & Sherman, 1976). However, at the same time, I also want to consider the possible sources of attitudes and feelings towards maths, which are produced in cultural products, such as advertisements and films, and which we experience as adults.

There is clearly a wide choice of which cultural products to study: we could select from various *media*, including print (books and newspapers), radio, television and film, and from among the *document types* of stories / drama, articles / documentaries, and comedy / cartoons. I chose films and newspaper advertisements, on the grounds of their widespread visibility - and hence likely potency in promoting images of mathematics - and their accessibility for analysis. The adverts all mentioned mathematics, and the films all portrayed episodes in the lives of mathematicians, mathematics teachers, maths students, and/or examples of mathematical work. The two genres of work differ in that the adverts are relatively laconic and static, and may depend on intertextuality for some of their meaning. Films are dynamic (within boundaries), normally with many episodes.

With both types of document, I wanted to examine:

- How mathematics, and the people doing it, are portrayed, and the relationship between the two; and
- What sorts of emotions are portrayed or attributed to the characters, as a result of their involvement with mathematics.

In addition, I wanted to consider:

- Differences in the portrayal of mathematics and doers / users of it between the two media; and
- Changes in portrayal over time.

**Methodology**

There is no straightforward sampling frame available, from which to sample. To begin with, I have restricted myself to documents largely in English (including films with subtitles), produced since the mid-1980s. The adverts are few in number, seen in newspapers and magazines by friends or myself. The films are an initial selection from a growing set of recent films about mathematics and mathematicians. The sample considered is summarised in Table 1.

*Table 1* Sample of print advertisement and film documents considered.

| Document Type | Document | Aim / Content |
|---|---|---|
| Adverts (1985 – 1995) | Letts Study Aids (1986) *see Figure 1* | Sell study aids |
| | Sharp Home Computers (1987 ca.) *see Figure 3* | Sell PC software |
| | Mercury Telephone Network (1994 ca.) *see Figure 2* | Sell long-distance telephone subscriptions |
| Films (1995 – present) | *The Proof of Fermat's Last Theorem* (1996) | Documentary report of the successful efforts of British mathematician, Andrew Wiles, working in the USA, to find a solution to 'Fermat's Last Theorem', unproven for 300 years. |
| | *Good Will Hunting* (1998) | Story of a young working-class man, who, while working as a janitor at his local University, solves a number of problems intended by the top University Mathematics Professor (Fields medal winner) to be very challenging for the brightest mathematics students. |
| | *Enigma* (2000) | Story of the national collective effort at Bletchley Park during the Second World War, to 'break' the Germans' Enigma code. |

I aimed to make an initial reading of each of the sample documents, and to make comparisons within each document type. Then I formulated two provisional conjectures, that we might go on to test:

(1) More recent documents from the 1990s portray mathematics more positively than earlier ones from the 1980s; and
(2) Films in general portray mathematics more positively than adverts.

Some theoretical pointers came from Williamson (1978), and FitzSimons (2002) has some useful discussion on 'images of mathematics' (pp. 45ff). The first conjecture probably came to mind from 'anecdotal' evidence, especially the evident public fascination with the publishing of the proof of Fermat's Last Theorem, and then was supported by my initial reading of the data. The second conjecture might be derivable from the idea that films are trying to sell themselves, and thus their content, which must be attractive or satisfying in some sense; adverts are trying to sell something else. Thus, in some sense, 'advertisements *intend* to make us feel we are lacking' (Williamson, 1983: 8; author's emphasis).

**Analysis**

Since I aim to use a discursive approach, it is important to begin by clarifying the range of practices and discourses that are 'at play' in and around each document (Evans, 2000, 2002). Here these could include:

- research mathematicians' practice (M)
- school maths (SM) practices
- citizens' or everyday practices (ED)

Of course there are many overlaps or *multiple positionings*: virtually all citizens have engaged in school mathematics as young people, and all mathematicians are citizens.

Let us look more closely at two adverts and two films. First, the Letts advert (see Figure 1). The advert portrays an eleven-year old girl, who within her family is an older sister, and is growing up. She expresses some dislikes, or more precisely has several 'hatreds' *expressed on her behalf*, namely of brussels sprouts, lace-up shoes, and her brother. In school practice terms, we are told she is undergoing the 'difficult' move from primary to secondary, and that she 'hates' Maths. Now, 'hating' is usually considered a strong feeling – but this is rendered normal by her 'hating' of other things, as might be expected among eleven-year-old girls of the time (1986). So within positionings in family and in school, especially school maths, practices, the girl seems to experience fairly 'normal' emotional responses, at least according to the *writer* of the advert.

The *reader* of the advert is of course the parent. The parent is positioned here as 'aware of the pressures' on the child and as 'probably welcom(ing) a sensible means of providing some extra support at home'. The advert effects to be sympathetic about the likelihood that 'even the most concerned parent' may be 'uncomprehending' about current teaching methods. And, at the end, the parent is reminded (if necessary) of the importance for children to do

well at school, so as to 'do well in the competitive world beyond'. Thus the parent is positioned as 'aware' of the range of the child's difficulties – but as uncertain, and perhaps even anxious, about 'knowing' what help will 'best fit in with … the classroom'. This is the need or lack, for which the advert provides an 'answer'.

The picture of school mathematics here is rather limited; no particular content is suggested: it is something you might indeed *hate*, rather than simply being indifferent to it (compared with other subjects at school), or finding it sometimes difficult or frustrating, or not always enjoyable. Thus, as well as *creating 'needs'*, the advert (not necessarily intentionally) might be *creating feelings*, or at least 'helping' to categorise indifferent or mildly negative feelings as stronger ones.

We can compare the Mercury advert (see Figure 2). Here we need to take account of *intertextuality*, the ways in which the reading of a particular text (here, advert) or utterance depends on (an understanding of) prior texts and therefore can be seen as a response to them; it points to the inseparability of text and context (Fairclough, 1992: Ch.4). Here, the reader 'knows', from earlier adverts in this series, done in sepia brown on the television (to indicate something old-fashioned) that this family is somewhat backward and behind-the-times. But *even they* know some things….

The nephew announces his conclusion that Mercury is the cheapest, based on his slide rule calculations. But his uncle, positioned in the family as 'knowing' and as sometimes needing to 'straighten out' the younger members of the family, acknowledges the correctness of the maths, but indicates that it is unnecessary, and perhaps even distasteful, to calculate on this particular question, that is, to be a 'clever dick'. Thus the reader is allowed a feeling of *relief* that calculations are not need for *this* consumer decision, at least.

In reading this advert, from the mathematical point of view, the two discourses that appear to be juxtaposed are:

- everyday or consumer maths, or perhaps simple 'common sense', and
- engineering maths – or, more precisely, a backward version of it – signalled by the use of a slide rule, in the mid-1990s, some 15 to 20 years after the widespread availability of pocket calculators!

Here, mathematics is portrayed as the preserve of rather pompous 'clever dicks', who nevertheless don't even know that their methods are behind the times - *and further* are not even necessary for the question at hand. All you need for that is 'common sense', which is what the 'knowing' uncle possesses. The user of mathematics is distanced from us, the readers of this advert, and his outlandish 'otherness' is increased by it. Here the reader's assumed low level of mathematical facility, though it might be experienced as a 'lack' in other contexts, can be laughed away, since Mercury satisfies your need to find the cheapest phone calls, by being 'obviously' the best.

In both of these adverts, despite initial dissimilarities, mathematics is portrayed as hateful, or unnecessary (for everyday life), and mathematicians are seen as pompous and distasteful (the

silly nephew). These adverts seem to draw on the reader's supposed antipathy to mathematics – and may quite possibly increase it!

I now turn to films. Because the structure of films is much more involved than that of adverts, I choose two films for which I have videotaped versions to hand, and analyse one short excerpt that involves mathematics from each. At the beginning of *Good Will Hunting* (1998), we see the young hero, Will Hunting, driving around in the car with his mates, fighting with other local working class young men, and provoking the University (middle class) boys in front of their girlfriends – in this case, with his apparently superior knowledge of economic history. At the same time, within the University, we see the top Mathematics Professor (Fields medal winner) assigning problems to his students which frustrate them all, until one day, the problem set on a blackboard outside the lecture hall has a solution written under it, which is judged to be brilliant by the professor. The professor is eager to find the identity of the solver, and tries to entice him/her to reveal their identity at the next lecture:

> *Students running across campus, towards a domed building. The Professor walks into a full lecture hall ….*
>
> *Professor:* Is this just my imagination, or has my class grown considerably? … *Students' laughter*.... Well, by no stretch of my imagination do I believe you've all come here to hear me lecture – but, rather, to ascertain the identity of the mystery *math magician* … so without further ado, come forward, silent rogue, and receive thy prize……
>
> *Students turn slightly hesitantly to look, but no one comes forward.*
>
> Well, I'm sorry to disappoint my spectators, but it seems there will be no unmasking here today…. However, my colleagues and I have conferred , and there is a problem, on the board right now, that took us two years to prove ….
>
> So let this be said: the gauntlet has been thrown down – but the faculty have answered, and answered with vigour!

But, meanwhile, our hero, Will, has been arrested in a fight. He gets caught because he stays to keep beating his rival, when all of the others in his gang have fled. He seems not just deviant, but rather, it appears, a little bit mad. As the film progresses, he is taken on for counselling, by a friend of the Professor, who himself had to drop out of his mathematical career, when it became too much for him. The rest of the film has Will going on a journey, a metaphorical one, perhaps like a young knight of old. This involves facing his anger, his difference, his madness, with the help of an older man, the friend of the professor, who has himself chosen to give up trying to be a research mathematician, so as to become a counselling psychologist and to teach in a local college. Around the same time, Will meets again one of the young women from the University, courts her, and, with the help of his counsellor, ultimately wins her, so to begin a real journey with her, to California.

Mathematics as portrayed in several ways, in terms of its connection and use by the various characters in the film. The mathematics done by the professor is a domain or a tool of striving, of competition, that can be used to beat down your opponents, or even a student who may dare to 'throw down the gauntlet'. For the counselling psychologist, on the other hand, mathematics is *one of many* areas of striving, where the struggle is with oneself and the trials of life; mathematics can be set aside for other areas of striving. For Will, mathematics is only

one area of academic learning, one area that can be used to beat your opponents down (see above for his use of economic history). The film shows how mathematics is admirably suited for competitive purposes, because it can be formulated as problems or proofs to be solved – and success or failure are highly visible, for example on the blackboard of the film. However, Will ultimately sets mathematics aside, contrary to the Professor's hopes, in favour of his journey with the woman, and perhaps in favour of a more rounded, less mad, life.

In *Enigma* (2000), mathematics is much more essentially woven in with the story of the code-breakers. It is represented in material form, starting in the opening credits, as the spinning of the wheels in the code-breaking machine. In this story, there are lots of mathematicians around in the code-breaking blocks of Bletchley Park, and there are lots of women, mostly doing less demanding and less glamorous tasks. The hero, Tom Jericho, is brought back to the code-breaking operation in 1943, well into the war, after having had a breakdown earlier on because of the stress and overwork.

Earlier on, he had fallen in love with one of the many women working on the site. At one point in the story, he goes to the woman's house (rented and shared with another woman), and finds her not there. He cannot resist entering her room, and recollecting her image, as he smells her perfumes, and one particular earlier meeting with her:

> *Theme song in the background, they are sitting on a sofa.*
>
> *She:* Why are you a mathematician? Do you like sums?
>
> *He, holding a rose*: Because I like numbers – because, with numbers, truth and beauty are the same thing … you know you're getting somewhere, when the equations start looking … beautiful. *(He looks at her slightly appraisingly / appreciatively.)*
>
> Then you know the numbers are taking you closer to the secret of how things are. A rose is just plain text…
>
> *He hands her the rose; she takes it, but, as he passes it over, a thorn punctures his thumb and makes it bleed. She kisses his thumb; they embrace.*

Back in the present, Jericho notices that a previously loose floorboard is screwed down tight; underneath it, he finds a transcript of a coded German message, illicitly removed from the Bletchley Park compound; during this, he is surprised by the woman's house-mate, also employed at the Park. As his first love remains missing, he embarks on a quest with the house-mate to solve the mystery of the stolen transcript.

In *Enigma*, the mathematics is, in a sense, intertwined with the women. The Bletchley Park of the film is tingling with sexuality. At the individual level, the hero in the passage quoted above aligns the first woman's beauty with that of mathematics. The second woman partially undermines this simple alignment: her distinctive and non-mathematical insights and skills are crucial as she accompanies him on his quest to find the truth about the stolen transcript.

The picture of mathematics as related to various sorts of individual striving is, at least

partially, challenged by *Enigma*. The mathematics is here part of a clear division of labour, producing a collective genius, the basis of an effort that is crucial to national survival.

**Discussion and Methodological Reflections**

Looking at the adverts and films, first individually and then as separate categories, allows us to make instructive readings and to make comparisons within each type.

Then we can go on to make comparisons across types. The advertisements considered portray mathematics in a negative way, as hateful, pompous and generally distasteful. On the other hand, the films portray mathematics as the pinnacle of knowledge, perhaps the most powerful form of thought – at both individual and collective levels – and as therefore supporting a quest for the truth, and beautiful. But too much mathematics – or too much thinking? – can possibly be dangerous: it can be an expression of 'madness', or perhaps a trigger for madness. In this sense, these two films are not atypical of other films from this recent period (such as *A Beautiful Mind* (2001)).

This appears to provide some confirmation for a conjecture of the form:

| | | |
|---|---|---|
| Mathematics in advertisements | --- | negative |
| Mathematics in films | --- | (conditionally) positive |

However, this raises a number of methodological issues:
1. These conclusions are based on my readings of the films and the adverts. Although I have tried to be explicit and systematic about the conceptual bases on which I have produced these *readings*, they are just that: they are provisional and contestable, and could be done otherwise.

2. The conclusions will be based crucially on the sample of each type of document that I have selected for analysis / reading. Here the sample is determined by the documents of which I have been aware, and (in the case of films) by those of which I have access to a videotape copy.

3. The simple conclusion presented above privileges the difference adverts vs. films as determinant of the difference in quality of portrayal of mathematics, but there may be other differences that are *confounded* with that of type of document. For example, all of the adverts were produced in the period 1985-95, while the films are produced in the last ten years. Or it may be that the adverts were produced in the UK, and the films in a different culture, the USA. Either changes over time or national-cultural differences could be very interesting to follow up.

**Conclusions and further research**

What is required to deal with the three problems outlined in the previous section? First, the sample analysed must be extended in at least two ways: (i) by choosing further cases *within* each category of document, to test and develop my conjectures; and (ii) by *theoretical sampling* (Hammersley and Atkinson, 1983) to ensure that theoretically crucial intersections

of categories are represented; for example, here we must strive to include films from the earlier period 1985-95, and adverts from 1995-present.

Thus, for (ii), we might analyse in more detail films such as:

- *Stand and Deliver* (1989): the story of a struggle of pupils from the Latino ghetto in Los Angeles, who are challenged and encouraged by an outstanding teacher from their community to excel in a US national mathematics competition
- *Schuler Gerber* (1987), the story of a group of friends in an Austrian secondary school in the 1930s, who are persecuted by a teacher, who is a Nazi … and who also teaches mathematics!

However, the fact that the former is about students excelling in a *school mathematics* competition differentiates it somewhat from the set of films about *mathematics* so far analysed. And the latter, an 'art-house' film made in Austria raises questions about whether it should be considered for inclusion in our sample. And for adverts we might consider analysing some such as:

- Givenchy π Fragrance for Men (2002) (see **Acknowledgements**), since it and many other contemporary adverts are available on the world wide web.

For (i), besides the results of one's own searches, the suggestions of colleagues are valuable (see **Acknowledgements**): for example, the film *Smilla's Feeling for Snow* (2000) allows us to assess the difference that having a female 'mathematician' as hero might make to the way mathematics is portrayed.

Second, we can seek and produce multiple readings of each document.

**Acknowledgements**

The current paper is an account of work in progress, and I would welcome comments on any part of it, as well as suggestions for further films and adverts that would be worth analysing. I would like to thank Pat Healy for bringing the Givenchy advert to my attention, and other participants at the workshop, who made a number of helpful suggestions, including the names of several films worth examining.

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**Appendix**

Figures 1, 2, 3.

**Figure 1 Letts advertisement**

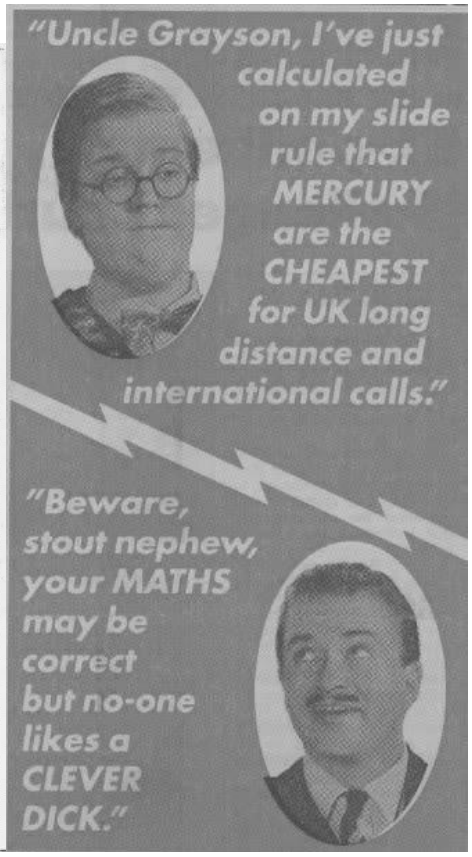


**Figure 2 Mercury advertisement**

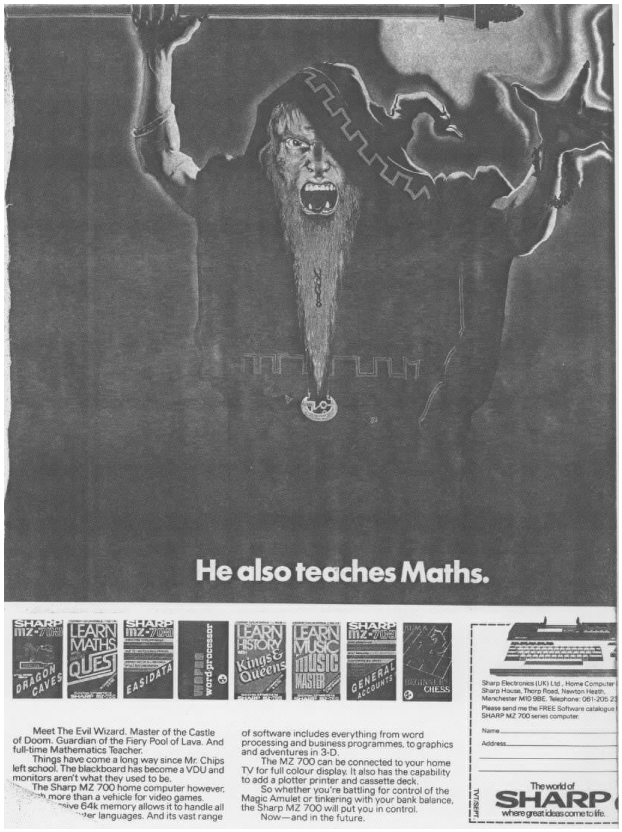


**Figure 3 Sharp advertisement**

# The National Basic Skills Survey of adults in England 2002-3
## The numeracy survey to date

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### Disclaimer
This paper presents the views of the author only.

### Introduction
The Adult Basic Skills Strategy Unit in the Department for Education and Skills commissioned CDELL to plan and devise two collections of assessment items to form the basis of the National Survey of literacy and numeracy. A profiled sample of 10000 adults aged 16 – 64 are being interviewed in their homes using laptops to present the survey items and store individuals' responses. The aim is to produce a national profile of adult literacy and numeracy competence over five broad levels of performance using multiple choice items, based on performance against the Adult Literacy and Numeracy Core Curriculum for England and Wales. It is hoped that the results of the survey will give new insights into the literacy and numeracy capabilities of adults in this country. This paper concerns the numeracy part of the survey. The author led the CDELL numeracy team.

### Partner organisations
The survey is being carried out by the British Market Research Bureau (BMRB). Associated software has been designed by Bradford Technology Limited (BTL). The numeracy and literacy items and the design of the two surveys are the responsibility of two teams from CDELL.

### The main aim of the survey
Much learning and teaching of numeracy with adults in England is now based on the Adult Numeracy Core Curriculum (Basic Skills Agency, 2001). This curriculum is presented in five levels – from lowest to highest these are Entry Levels 1, 2 and 3 and then Levels 1 and 2. Level 2 contains content corresponding to the Key Skills Application of Number level 2 specifications (QCA, 2000) that is broadly comparable in technical demand to aspects of Intermediate level GCSE mathematics, while Entry Level 1 contains content comparable to the curricula and attainment of many six and seven year olds.

A main aim of the survey is to produce national estimates, for the first time, of the proportions of the adult population of England currently at each of these levels, which could then be presented by age, sex, location and socio-economic grouping, so as to act as evidence for future comparisons and to inform future educational and training planning and interventions aimed at raising literacy and numeracy levels in England.

**Ongoing nature of the work**

The survey of a representative sample of approximately 10,000 adults in England commenced in July 2002. It is not likely to be concluded and the results presented by the Department for Education and Skills until the summer of 2003. Until then, individual items may not be made public, nor may any emerging results be published. However, aspects of the survey design, the considerations that led to them and other details of the survey process are not restricted; these form the subject of this paper.

**Considerations of the survey population**

In devising the numeracy survey, the team had several considerations in mind:

- The full range of numeracy ability was likely to be encountered - ranging from individuals who might have difficulty even with working with two digit numbers, up to those who were of degree standard in mathematics.

- Respondents would have no reason to co-operate with the survey apart from an altruistic one, personal interest and a modest complimentary payment on completion.

- For many respondents, their previous experience of working with mathematics might well have been unpleasant, making them reluctant to take part and likely to be easily discouraged by questions that were too demanding.

- In addition, experience from adult numeracy students suggested that many respondents would show a 'spiky profile' of competence – perhaps, for example. quite comfortable with arithmetic of money, but having difficulties with percentages, in interpreting graphs or working with metric units. The style of survey would need to be able to respond to such profiles.

- Finally, the time available to undertake the numeracy part of the survey was to be no more than 30 minutes. This meant that in fixing the extent of the survey, the team had in mind an average total time for the numeracy section of no more than 20 minutes.

**Initial design considerations and features**

The survey was to be carried out using multiple-choice items presented to respondents by lap-top computers.

The project team commenced work in December 2001, so that time to carry out item design, piloting and other research was very constrained. A specification for the numeracy items was drawn up in January 2002, with expert advice from Dr Diana Coben , Dr Jeff Evans, Professor Margaret Brown, Dr Alison Tomlin and others.

The items were designed by a team of three writers - all experienced in adult numeracy assessment. A proportion of the items at the upper two levels (Levels 1 and 2) were required to be closely based on items previously used in Adult Numeracy assessments, adapted to fit the survey requirements and screen layout. All items for the lower three levels (Entry levels 1, 2 and 3) were new. In designing the items, the authors took account of items used in other numeracy surveys of standing, including DfEE (1999), Elkinsmyth and Bynner (1994), IALS test items, van den Heuvel-Panhuizen, M. (1994 and 1996) and PISA - Programme for International Student Assessment (2001). In addition, ideas and approaches outlined in recent research into aspects of adult numeracy were referred to (Coben et al. 2000).

Piloting took place with groups of adult numeracy students and their tutors, enabling improvements to the wording and presentation of items to be carried out. Each item was then re-checked against the Core Curriculum statements for levels above and below the intended level of the item to ensure that the item best fitted its intended level.

Several innovative features have been included which the project team feel have contributed to the emerging success of the survey process. In particular, a series of algorithms was developed by the author to route the individual respondent to items at an appropriate level for that person, based on their previous responses, in the style of adaptive testing.

Respondents are presented with items in seven groups or 'steps'. Each of these seven steps targets different aspects of numeracy. In the first step, all respondents meet the same four items, two at Entry Level 1 and one each at Entry Levels 2 and 3. These were deliberately chosen so as to present familiar and straightforward tasks to all respondents. Based on their performance, respondents are then directed to one of three overlapping groups of five items, forming Step 2, with items ranging from Entry Level 1 to Level 2. Depending on their performance on these, the algorithm takes respondents to two items of an appropriate level in Step 3; these range from two at Entry Level 1 to two at the top level - Level 2. Again depending on their performance on these, the algorithm takes respondents to two appropriate items in Step 4. This is repeated up to Step 7 so that each respondent encounters 19 items in all, from a total of 48 items altogether.

Table 1 lists the 48 items analysed by general topic, step and level. An extract from the progression algorithm is shown in Figure A1 (see end of article). The numbers in boxes represent the items numbers and the arrows show progression routes depending on correct (C) and not correct (N) responses at each Step. The algorithm patterns for Steps 5, 6 and 7

are similar to those for Step 4.

**Table 1. Analysis of Levels and Steps of items.**

| Level<br><br>Step number and topic(s) | E1 | E2 | E3 | L1 | L2 | of which the respondent is presented with |
|---|---|---|---|---|---|---|
| Step 1<br>Basic money calculations | 11<br>12 | 13 | 14 | | | 4 |
| Step 2<br>Whole number calculations and time | 21<br>22 | 23<br>34 | 25<br>26 | 27<br>28 | 29 | 5 |
| Step 3<br>Measures and proportion | 31<br>32 | 33 | 34 | 35 | 36<br>37 | 2 |
| Step 4<br>Weight and scales | 41<br>42 | 43 | 44 | 45 | 46<br>47 | 2 |
| Step 5<br>Length and scaling | 51<br>52 | 53 | 54 | 55 | 56<br>57 | 2 |
| Step 6<br>Charts and data | 61<br>62 | 63 | 64 | 65 | 66<br>67 | 2 |
| Step 7<br>Money calculations | 71<br>72 | 73 | 74 | 75 | 76<br>77 | 2 |
| Total number of items at this level | 14 | 8 | 8 | 7 | 11 | |
| Total number of items | | | | | 48 | 19 |

Owing to cost considerations and requirements from DfES, not all the advisers' recommendations could be acted upon. Those not incorporated included that the items should have a voice-over option to assist with reading problems, and that calculators should be

permitted for some items. The former meant that the text and layout on the screen had to be as straightforward and easy to read as possible. There was concern that the reading requirement would exclude a small but significant group of potential respondents, but subsequent experience appears to indicate that very few respondents were actually so excluded.

**The conduct of the survey**

In the survey, the numeracy items are presented to respondents by trained BMRB interviewers. The interviewer typically sits alongside the respondent so that they can both see the lap-top screen. Before the first survey item is shown, two pre-survey items are presented to respondents to show them the styles of item they will be meeting and to enable the interviewer to explain what will be happening. The first survey item is then shown. The respondent reads the item, then selects from typically four alternative answers. The interviewer then inputs this choice into the lap-top: the next item is then selected automatically according to the algorithm and displayed. The interviewer's role is to input the respondents' choices correctly: the interviewer may not read out a question or provide hints of any sort.

The sequence of items shown and the respondents' response choices and times are recorded automatically.

**Opportunities presented by the use of lap-top computers**

Personal observation confirmed the reports from interviewers from the first batch of surveys that respondents reacted well to the use of lap-tops. Typically, the lap-top was seen as a neutral question-setter with the interviewer being viewed as 'on the same side' as the respondent, rather than as a question-setter or expert. Partly because respondents are not required to operate the lap-top themselves, the fact that many respondents have no personal experience of working from computers in this way has not been a barrier. If anything the modern image portrayed by the use of the computer is welcomed and appears to raise the status of the whole activity, distancing it from previous learning experiences.

Crucially, the adaptive design has meant that respondents are presented with items by and large appropriate to their levels of numeracy ability, while also reacting to individual respondents' areas of facility or difficulty.

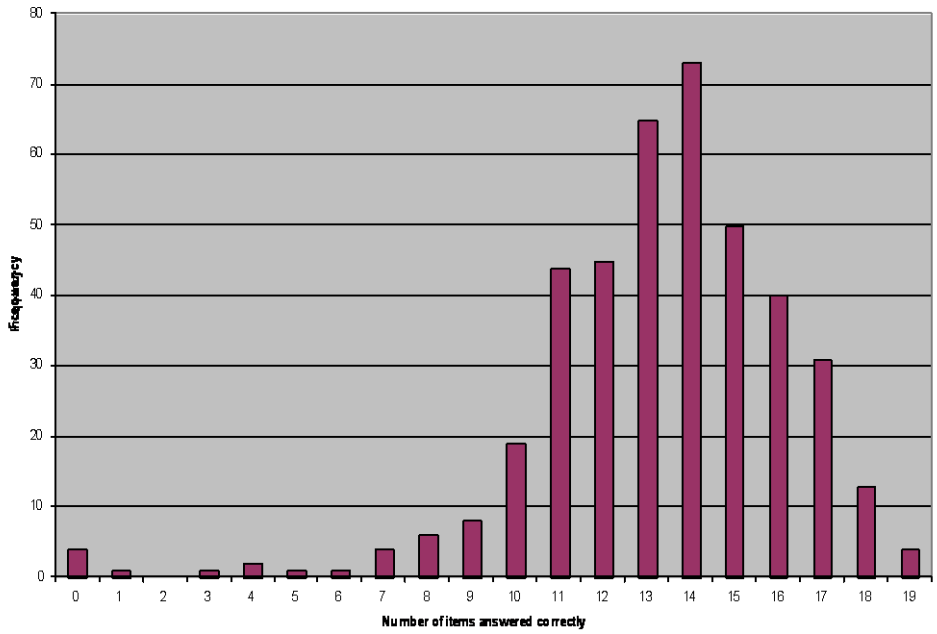
**Success rates for individuals - drop-out rates**

A main design objective was to base the estimates of level on what respondents could do, rather than what they couldn't. A subsidiary objective was to encourage and motivate respondents through their positive reactions to the survey experience, bearing in mind the negative feelings that some respondents might reasonably have been expected to have regarding exposing their numeracy skills. Indications to date are that both objectives have been substantially satisfied.

Figure 1 shows the frequencies of different numbers of correct answers from the first 412 respondents. The mean number of correct responses was 13.3 while over 90% of all respondents selected ten or more correct answers from the possible 19.

In addition, to date less than 2% of respondents have failed to address the full set of 19 items they were presented with. We believe that the adaptive nature of the survey was a major contributor to these gratifying results.

**Figure 1 Distribution of number of items answered correctly**



**Scoring and assessing**

The survey is designed to estimate the proportion of respondents at each of five levels:

- at or below Entry Level 1
- at Entry Level 2
- at Entry Level 3
- at Level 1
- at or above Level 2

Individuals would be likely to have performed at different levels of competence on different topic areas. Thus, many respondents' performance records would show a series of correct responses to a set of items set at different levels. What would be the most appropriate method to converting individual performance records into estimates of overall level? Would overall level be best measured by the level of the final two items successfully tackled - that is by the level of successful performance at Step 7? Or should it be based on mean or median performance on the final ten items from Steps 3 to 7? Or should it be based on summing overall performance (scoring 1 for a correct EL1 response up to 5 for a correct L2 response)? In all, five alternative schemes for setting overall level were trialled and these were compared against detailed analysis of individuals' performances from the first 189 respondents' results.

The method finally chosen was to sum overall performance, as this took into account all aspects of the respondent's performance. This led to the setting of threshold scores for minimum scores to achieve a particular level. These thresholds were carefully chosen after scrutiny of individual performances from the first 412 respondents and of the performance of individual items. Thus the few items which turned out to have very low or very high facility levels could be allowed for, while final decisions on thresholds for the five levels of performance could be deferred until after the data collection had been completed.

To confirm this method of estimating level, levels were then re-calculated using level estimates based on performance on the 'final ten' and 'final eight' items. Overall proportions using the three methods were found to be very close to each other.

**Likely publication of results**

It is unlikely that the data collection will be completed before late spring 2003. It is therefore most unlikely that results will be made public by DfES until the summer of 2003. It is hoped that it will be possible to present further details of the survey at the ALM-10 conference.

In addition to the proportions at each of the five levels, some measure of relative difficulty of different topic areas - and hence of spiky profiles - may be obtainable. Certainly such spiky profiles are evident in individuals' performances to date. In general terms, there appear to be three categories of respondent, - the very small proportion of respondents who remained at or

below Entry Level 1, the much larger group who were at Level 1 or 2 throughout, and the majority who found some topics hard and others much easier. Measures of relative difficulty of different topics may possibly be made, but these are compounded by questions to do with the facility of individual items and too much significance should probably not be given to them.

## Further research

Although the multiple-choice style of presentation enabled the survey to be adaptive and greatly facilitated the collection and future analysis of the resulting data, the style will only produce limited information concerning individuals' numeracy capabilities, personal techniques and understandings.

Several possible further research projects immediately suggest themselves. These include presenting the items as short response items to a much smaller sample of adults, then recording and analysing the responses in order to gain insight into methods used to tackle individual items, and then to make comparisons with the multiple choice versions of the items. The same multiple-choice stems could also be re-used, but with alternative distractors.

## Acknowledgements

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# Defining Numeracy

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## The Poster Display

The poster displayed at the ALM9 conference presented to the participants a wide range of uses of the terms numeracy and mathematics. Most of the quotations were taken from papers published in the proceedings of previous ALM conferences. There were 22 quotations from previous proceedings and three statements from current ALM members. In addition statements from three other organisations were also presented. The full list of references is given at the end of this paper and the full text of the quotations can be viewed on the ALM website www.alm-online.org; click on 'ALM Discussion List' to find the quotations.

## The Discussion

I work as a numeracy lecturer in Further Education in the UK, but I am very often described as the 'maths teacher', as that is a far more familiar term – especially to the students. Yet, it has become important to some of us who teach this subject to use the term 'numeracy' to describe the content of our teaching.

The quotations I used at ALM 9 gave a very wide range of views. Some specifically defined the term 'numeracy', others used it in contexts that implied a working definition. I also included some quotations that did not use the word 'numeracy' – but discussed 'mathematics'. This was to present a comparison with the use of 'numeracy': the use of 'mathematics' often implies a meaning similar to that given to 'numeracy'.

There are however different purposes served by using the term 'mathematics'. Look for example at this quotation from 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, R. (2002)

In presenting these definitions Roseanne Benn is making a political statement. I think the

meaning of these statements is changed if one replaces 'mathematics' with 'numeracy'. For example 'numeracy is a social construct'; 'numeracy is a construct or invention rather than a discovery'; or 'numeracy is value laden not value free'. The main reaction I have to this re-wording is that whereas the statement about 'mathematics' is challenging and controversial, similar statements about 'numeracy' seem to be merely definitions. For these reasons, I think exploring the use of the term 'numeracy' is worthwhile and helps to explore the process of adults learning mathematics.

## Further Developments

Presenting the poster aroused a lot of interest, and provided comment on other examples and sources of defining numeracy. One important omission at ALM9 was the work done by Lena Lindenskov and Tine Wedege in Denmark. Their article, 'Numeracy as an Analytical Tool in Mathematics Education and Research' (2001) itself reviews the concept and definitions of 'numeracy' and refers to the new Danish word for numeracy: *numeralitet.*

The work on the concept, uses and definitions of numeracy continues to be of importance to ALM, and I hope this work will be developed further in future editions of ALM conference proceedings.

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# Polices And Pedagogies For Lifelong Numeracy (PPLN)
# An international collaborative project

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## Abstract

This paper will report on the process and results of an international collaborative project "Policies and Pedagogies for Lifelong Numeracy" which grew out of a shared research interest between ALNARC NSW (Australia) and CAMET (Ireland). The paper will discuss how international collaboration for numeracy research can provide opportunities for researchers to share resources and increase the understanding of policy and practice both nationally and internationally.

Using a large-scale electronic survey, literature review and interviews with numeracy practitioners and researchers, the current status of adult numeracy internationally was investigated. The paper provides a brief outline ('snapshot') of aspects of adult numeracy from the perspective of local practitioners in a number of countries. The results from the survey are by no means comprehensive, but act as an initial sketch, which can be further, developed as information is collected. A number of the countries included have had limited voice at previous ALM conferences, for example, Nepal, Sudan, South Africa and Spain. The presentation concludes with a more detailed discussion of interesting initiatives focusing on professional development that were selected from the responses to the initial survey for their possible relevance to policy in the researchers' own countries.

## Introduction

The annual conference of Adults Learning Mathematics - A Research Forum has often provided the platform for international collaboration between researchers ALM8 was no exception. The Australian team and the Irish team met during the conference and it emerged from discussion that both teams were embarking on similar research projects on different sides of the world. The teams agreed on a joint research project that allowed them to work in partnership and to share resources. This synergistic arrangement allowed the teams to share data and to refer to the wider project in their subsequent researches. *'Polices And Pedagogies For* ***Lifelong Numeracy (PPLN)' An International collaborative Project. (International snapshot of adult numeracy (including adults learning maths)*** was developed.

The overall purpose of this project was to provide a brief account of international adult

numeracy policy, pedagogy and provision and case study initiatives in a number of countries. In particular the project was to focus on what is happening in countries other than those that usually come to ALM. The research was qualitative rather than quantitative and built on previous research in the field (Suda,. 2001). The research had three identifiable strands.

The first strand of the research was a detailed investigation of adult numeracy – pedagogy, practice, policy and practice over the last ten to twenty years in Australia and Ireland.

The second strand of the project involved developing snapshots of adult numeracy in a number of other countries, from the perspective of several practitioners in the field of adult numeracy in each of those countries. The snapshot format was designed to include general information about policy, funding, provision, and research in adult numeracy, and to identify any interesting or significant initiatives (S&Is) in each country studied.

The third strand of the research involved the compilation of detailed case studies of the interesting and significant initiatives that emerged from the first and second strands.

**Methodology**

Strand 1: Working from an agreed list of research questions each team completed this strand independently. In Australia, data for this section was obtained where possible from curriculum documents, face-to-face interviews with practitioners, and telephone interviews using a structured questionnaire In Ireland, a similar approach was taken that incorporated a comprehensive literature review, critique of policy documents, a survey of service providers which built on a national survey of tutors of adult numeracy/mathematics in Ireland carried out in 2001 by the Irish research team (Maguire and O Donoghue 2002).

Strand 2: This strand centred on the use of information communications technology (ICT) to access a very wide audience of those involved in numeracy internationally. Existing members of ALM were contacted by e-mail and were asked to contribute and spread the word of the project within their own country. In addition 'a call for help' was sent out on International and National numeracy discussion lists asking for members to identify any interesting or significant initiatives in their country.

Strand 3: During this phase (still ongoing) more detailed case studies of S&I initiatives that were highlighted during strands 1& 2 and the concurrent literature review and discussions are being carried out. The case studies chosen reflect an innovative and potentially useful application to the developing numeracy/mathematics provision for adults. Case studies completed to date use in depth semi structured telephone interviews. The initiatives selected had two central themes: Professional Development and Pedagogy.

The project was very well supported, in all over 600 E-mails were sent out and received from more than 30 different countries including:, Argentina, Australia, Austria, Belgium, Botswana, Brazil, Canada, Denmark, Finland, France, German, Greece, Iceland, Indonesia, Ireland, Italy, Nepal, Netherlands, New Zealand, Norway, Portugal, Singapore, South Africa, Spain, sub-Saharan Africa, Sudan, Sweden, Ukraine, United Kingdom, USA.

**Snapshots**

The first strand of the research has resulted in in-depth case-studies of adult numeracy in Ireland and Australia. For this paper, we are omitting these, since you are probably fairly familiar with some of what is happening in those countries. We thought we would move straight into the second strand of the research, and give you a glimpse of what is happening in three countries that are not so strongly represented at ALM: in this case Nepal, sub-Saharan Africa and Spain.

It has been difficult to obtain comprehensive and representative information, and at times we were tempted to put aside countries for which we did not have "all" the information. However, we ourselves have been stimulated by the pictures that are beginning to emerge, and we decided that even the partial pictures make a valuable contribution to our understanding of what adult numeracy is on a world stage.

***Nepal***

The Nepal picture focuses on a single initiative, involving however more than 12000 women. Helen Sherpa and Malati Lacoul of World Education wrote to us and described the work they are currently doing:

> The Women's Economic Empowerment and Literacy Project (WEEL) is an integrated micro-finance and literacy program for women, which is being implemented by World Education in Nepal. Numeracy is the biggest challenge groups face in their savings and credit groups and in managing their livelihoods. The lack of maths discourages them from adding new members as the math gets more complex for calculating interest and for deciding on loans proportionate to savings. ….Most literacy practitioners also shy away from math.

Several strategies were identified to address the situation. The facilitators are providing extra training to the literacy teachers to increase their confidence in teaching maths. This training incorporates a very hands-on approach, using tailored games and exercises, and manipulatives such as fake money. Unsurprisingly, the literacy teachers emphasise an initial 'verbal' approach to explaining the four operations, following it up with practice on real examples.

The facilitators have resisted the temptation to give a calculator to the treasurers of the savings and credit groups,. They make an interesting point:

> Calculators may still be needed though Inflation in many developing countries is making math a nightmare. As the value of currency decreases the number of place values needed rises in daily life. For our groups as their savings grow they find themselves adding Rupees 10 to Rs.2,00,948. It gets harder by the year and defeats even many cheap calculators.

The facilitators conclude:

> We see a lot of improvement in the way we teach math to adults but still feel there are a lot of challenges. We remain alert for ideas and suggestions as to how we can help adults learn math skills and how we can encourage other organizations to recognise the need for more math/numeracy in adult education programs.

***Sub-Saharan Africa***

Nepal is not alone. Adult literacy and numeracy have a strong presence in developing countries. Numeracy is often interpreted as basic functional skills - arithmetic and calculation. In some instances the term numeracy is associated with money, finance and business development. Literacy may refer to very different levels of competency and may or may not include numeracy. There are programmes where effective literacy acquisition takes the lead and others where empowerment and social and relational aspects predominate (Torres, 2002).

Most of the programmes are conceived and implemented by local and international NGOs. While they may have the support of the governments most rely on private funding much of it from international sources. The following programmes are responses, in different contexts, to some of the same questions that developed countries are trying to address as they come to grips with what the reality of lifelong learning might be.

ADRA (Functional Adult learning Program)

The project enrols 100,000 people, 90% of whom are women. Initially this programme did not teach literacy and numeracy but life skills. However it soon became evident that without literacy and numeracy, the development of such skills was restricted. Now the course is offered in three stages ADRA asks the learning groups to recruit their own instructors from the community:

> *Stage 1* - learning to read, write and calculate with a particular emphasis on calculating accurately. Standard literacy tests are used with added exercises to help learners understand what is involved in the processes of buying and selling.
>
> *Stage 2* - learning how to assess the feasibility of a project, and money management.
>
> *Stage 3* - sets up solidarity groups.

Other examples of courses that are run in this way include: The Bangladesh Saptagram and the Philippine Women's Enterprise Development Program which offer training in a range of skills that enable women to improve their livelihood skills and income. Others like the Women's Enterprise Development (Ethiopia) find that the participants seem to resist literacy/numeracy that is not directly connected with livelihood training.

SODEFITEX (Senegal)

Literacy and numeracy is also delivered associated with a specific vocational area as for example in Senegal where SODEFITEX (Society for the development of textile fibres) combined technical with literacy training.

The SODEFITEX package starts with improving livelihood then empowers people to 'democratise' and take more control over local affairs. The SODEFITEX programme has a 20% drop out rate. A further 10% refused to take an end of programme's test, and of those that did 80% received a pass mark or better. (Interestingly, higher proportions of women are more reluctant to attempt the test, but those that do are almost certain to succeed. Higher

proportions of men are willing to brave the test but lower proportions succeed at it – a result that mirrors research results on gender differences in developed countries.)

In other programmes different organisations share the delivery of training. Organisations that support literacy instructors tend to specialise in general education and to possess insufficient technical capacity to support livelihood training. Alternatively a particular approach to training is used for e.g. the Reflect approach to adult learning and social change is used by more than 350 organisations in over 60 countries. Originally work with Reflect focused on literacy and empowerment but more recently there has been more focus on the numeracy side, drawing on the ideas of 'ethno-mathematics' and 'critical mathematics'.

***Spain***

In Spain, the central government establishes the general direction of education policies, which are then developed and made concrete by the governments of the autonomous regions. As part of the World Year in Mathematics (2000) Spain established mathematics teaching as a priority, using government policy to back up the initiative. Adult numeracy is included in this policy.

Adult numeracy classes are offered in formal learning contexts, but also in non-formal ones (such as in the dialogical mathematics groups in the School at La Verneda-Sant Martí). Of course, adult numeracy also develops, as in all countries, in informal everyday contexts.

The formal adult system is currently undergoing change, and the new system will be in place by September 2002. It seems that the teaching of mathematics for both beginners and secondary level students will not differ significantly from the teaching which is currently given in schools.

The proposed format for the new plan relating to adult teaching is daily attendance for 3 hours a day. There is no doubt that this will be prejudicial to some adults since it will only be available to those few who can find the time necessary to fulfil the requirements of attendance.

The adult program includes four areas of study: Spanish, Society, Nature and Mathematics. In relation to mathematics, experience in the education of adults tells us that they need to understand reasons for what they are doing if their learning is to be significant. However the program and the contents of the accompanying texts are basically material used in schools. Most of the texts rely on rules, procedures, and formulae, and are popular with teachers, it would seem, because of their familiarity from their own school days. The very few texts which try to develop a closer link with the daily reality of the students are not widely used, are often hard to access and sometimes expensive to obtain.

The small budget available for the education of adults has several implications, including:

The absence of official infrastructure, an assumption that volunteers can supply all the teaching needs for the programs and a lack of commitment to the preparation of specialist educators. Although the recent White Paper on adult education showed that adult educators

are convinced of the need for more specific training, very little has been done in relation to the training of teachers in adult education.

The project also identified a number of initiatives that warrant a more detailed investigation. Two central themes have been chosen - professional Development and pedagogy. This strand of the research is in the early stages but we decided to give a flavour (brief) of some of the initiatives we identified in relation to professional development.

***Case Study 1 Making Math Real Institute (USA)***

This institute is a Professional Development Institute for Adult Math Practitioners Funded by the Bureau of Adult Basic and Literacy Education in Pennsylvania. Ellen McDevitt outlines why the institute was needed:

> 'We have large numbers of small programs that rely on tutors. Most of those programs do not teach math and if they do, focus on the real basics. This is mostly because they rely on volunteers--as my program did--and it's hard to get volunteers to, well, volunteer, to teach math' .

The Institute to have practitioners demonstrate their understanding of four principles:

- Mathematics is everywhere - Classroom math cannot be taught in a vacuum and knowledge cannot be evaluated in isolation using artificial examples.
- Instructors and tutors cannot teach as they were taught - Our adult literacy students are with us today, in part, because they couldn't get it the way they were taught.
- Practitioners need to adapt the problem-solving methodology to their own environments. - The cookie-cutter workbooks and tests that we knew in school do not serve our population well.
- Everyone can do math - There is no room for the artificial distinction of "I'm a math person" and "I'm not a math person" if we are to participate as workers in a global economy, help our children function mathematically, and contribute as members of a democratic society.

Tutors of the institute meets over two days, working together to solve problems, seeing and doing maths encouraging the development and sharing of resources. At the same time workshops are organised which allow with expertise to be share to stimulate new ideas and new ways forward.

Ellen McDevitt sums up the success of the institute

> It's been enormously exciting. What we have seen is that participants are beginning to think differently about how to teach math to adults--and the adults are responding. ……. By all accounts, we have been successful beyond our hope.

***Case Study 2 Teagasc Ireland***

Teagasc provides integrated research, advisory and training services for the agriculture and food industry in Ireland. TEAGASC provides a wide range of courses for new entrants and adults in agriculture and rural development. Since 1999 Teagasc has carried out a survey of the literacy and numeracy levels of the trainees entering their training programmes using the

Basic Skills Agency (UK) Initial Assessment. Based on this test, on average19% of trainees annually have a reading level, below level 1. 16% of students have numeracy skills below level 1. Teagasc decided to tackle the problem by providing in-service for their tutors. The in-service provision focused on how to integrate literacy and numeracy. No tutor is forced into doing in-service. All that participate volunteer for training. The fact that the course was accredited by University was also an incentive especially for those that may not have had any formal Higher Education qualification. The biggest problem identified by the organisation was the need for an attitudinal change among the tutors that they could make a difference. Many tutors firmly believed that the students coming to them had spent at lest 12 years in the formal educational system and if the 'professionals' could do nothing with them then they has very little chance in the 18 months that they were with Teagasc.

Some excerpts from one of the tutors tells how the course influenced him

> My big thing from the course was first of all awareness of the problem, ….. When you have 40 in front of you all heads are down and they are working away and you don't see the problem cases. And we don't get time to do much individual one to one here.

The opportunity to talk to other Teagasc tutors was beneficial

> One of the best things was that the people on the course were from Teagasc. Sometimes we mightn't have learnt a lot during the day but we learnt a lot during the coffee breaks from talking to other teachers.

The project is still ongoing. It is taking a long time to wade through all the data that has and is still being collected. However some interesting issues and questions are emerging:

- Success of places like La Verneda Sant Marti demonstrates that the environment of learning for 'the excluded' needs not to replicate the school environment which participants have already abandoned
- Importance of manipulatives and concrete materials in basic financial numeracy programs, in establishing understanding
- Possibility that much maths can be learnt through words and talking initially – is this what both the Nepal project and 'dialogic numeracy' might be saying?
- Programs are more likely to be successful if the outcomes are related to participants' life plans e.g. La Verneda and community participation, ADRA and livelihood skills
- Teachers are more likely to be successful if they have a strong knowledge of relevant livelihood skills
- Could there be a use for Reflect methodologies in developed countries? If so how could they be incorporated into existing numeracy provision.Professional development works better when it is tailored to the needs of the tutor
- The attitude a tutor has about what they think they can achieve and what can really be achieved with students can be changed
- Gains can be made if tutors have similar backgrounds and can relate to each other during training
- Tutors are there own greatest resource and need to be opportunities for discourse and collaboration.

These issues need to be explored further as we examine the data we already have and are continuing to collect. The project makes available contribution to our understanding of adult numeracy on a world stage but the data is, as yet, incomplete. Sometimes the information we have obtained is from a government and policy level only; sometimes it is at the other extreme and is the story of one particular initiative. We are always open to information that would fill out any of these pictures.

This is a copy of the paper prepared for the conference. At the conference the individual case studies were not included in the presentation. Instead some time was given to discussing how ALM could build on this project and how new members from countries that are not currently part of ALM could be encouraged to share their experiences with us.

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# Self-System Processes and Affect in Learning Mathematics

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*After showing passionate interest in human cognition and cognitive processes, educational research paradigms have created new opportunities for and even laid emphasis on studies of student affective factors. Constructivism, together with applied socio-cognitive, cultural and contextual views of learning and education, has enriched our knowledge of affect in mathematics education research, as well. This article first discusses some features and problems of studies of affect in education research. After this, a dynamic view of important aspects of students' affect in their personal and unique situational mathematics learning processes is presented within a theoretical framework of self-systems and self-system processes.*

## 1. Introduction

Traditionally, the abstractness and the difficulty of mathematics have been suggested as reasons for the appearance of negative views, attitudes, or affect regarding mathematics, and the effects of these reactions are most commonly considered negative in nature and related to differences in students' achievement and participation in mathematics. Viewing mathematics as a difficult and demanding subject has caused it to be highly regarded, and ability in it has frequently been used to measure academic ability in general. Today, the increased complexity of everyday life has increased the significance of mathematics for all citizens, at least in well-developed countries. The increased significance of mathematics in society and the recent fundamental changes taking place in mathematics instruction (e.g., non-routine problems, open-ended problems) create new challenges to all students' performances and mathematics learning contexts, and it is here where affect is playing a significant role.

In mathematics education studies, affective factors have been traditionally considered as minor components in explaining the differences in mathematics achievements between males and females, between low- and high-ability students, or between students with a low or high socio-economic status or with dissimilar ethnic backgrounds (Aiken, 1970; Ma & Kishor, 1997; Reyes, 1984). Today, affect instead of acting as a less significant personal mediator of mathematical outcomes, has become a focus of attention for its own sake. This change of perspective is reflected in recent mathematics education studies of and emphasis on affective factors (Evans, 2000; Goldin, 2000; Malmivuori, 2001; McLeod, 1994; Schlöglmann, 2002), as well as in increased interest in affective components in general educational psychology and in cognitive science (see, e.g., Collis & Messick, 2001; Oatley & Nundy, 1996). The new emphasis on affect has also produced more unambiguous conceptualizations with affective variables, as well as efforts to link affective qualities more closely to cognitive, social, and contextual aspects of mathematics learning and performance. In this article, we continue the theoretical efforts to understand the role and functioning of affect in personal mathematics learning processes.

## 2. The affective domain of personality

Lack of detailed specifications for the usually-applied affective terms or concepts and of consistency in the definitions has hampered a systematic consideration of the affective domain. The reasons for this inconsistency can be found in three different areas. One relates to the low traditional interest in a detailed and serious study of affective variables, at least in the scientific field of education (e.g., Oatley & Nundy, 1996). This leads to another important factor: the complicated and diversified nature of phenomena that are intertwined with human affect. The third reason can be traced to the diversity in the theoretical starting-points or paradigms behind the studies of human affect, ranging from behaviorist to psychoanalytic views, and from biological to cognitive or socio-cognitive views of human nature and behavior, together with the diversity of the methods used in studying affect. In addition to the term 'affective domain,' such concepts or terms as 'affective development of a personality,' 'affective learning,' or 'affective educational objectives' have also been applied in educational scientific fields. They are used to explain the perceived individual differences in students' academic achievements, and education researchers often join them with the generic psychological term 'affect'. Generally, both education and mathematics education researchers are of the opinion that the affective domain refers to factors that 'differ from pure cognition,' or that 'cannot be classified as cognitive or psychomotor objectives of learning,' or that 'in some way or another are connected with feelings and emotions' (Martin & Briggs, 1986; McLeod, 1989; Reyes, 1984).

A very typical way to define affective domain or affective educational objectives is merely to list certain significant affective terms, reactions and to develop specific affective taxonomies for educational objectives. However, the terms used to denominate affective factors may consider outcomes of learning, the means for learning or the processes involved in affective learning. For example, Fontana (1990, p. 981) believes that the affective part of the personality points to 'emotions and feelings, the process by which we actually experience ourselves,' whereas 'cognitive' refers to mental abilities and the process by which we classify and make sense of the world. On the other hand, Eraut (1989) views the objectives in the affective domain to be linked to the norms and values of the educators, including socializing with general school norms and values, moral and social education, and feelings and sensitivities. Taxonomies of affective human characteristics are designed also to express hierarchical structures. Krathwohl et al.'s (1964) early taxonomy of affective educational objectives distinguishes between different stages involved in the internalization of an affective construct. In turn, taxonomies of affective mathematics learning objectives may depend on Wilson's (1971) division between attitudes, interests, motivation, anxiety, and self-concept and, on the other hand, external, internal, and operational values. Today, these taxonomies often differentiate between mathematical beliefs, attitudes, and emotions (Hart, 1989; McLeod, 1989).

One option in recent education research is to deal with affect as the equivalent of or manifestation of different kinds of emotions. For example, Anderson's (1981) perspective on affective characteristics includes 'qualities which present people's typical ways of feeling or expressing their emotions' (p. 3). These qualities are said to have three properties: intensity, direction, and target. This view is reflected especially in cognitive approaches to affect, as in G. Mandler´s (1989) attempts to describe emotions as varying in intensity, direction, and magnitude. McLeod (1989), in turn, makes even more general comparisons along with the intensity, direction, and magnitude of affect that distinguish between students' beliefs,

attitudes, and emotions. Another approach to the affective domain is expressed, for example, by Beatty (1976), who connects affect in education simply with experiences of positive or negative feelings and the awareness of pleasantness or unpleasantness, which is caused by self-perceptions and closely related to motivation. A similar view has been expressed by Sonnier et al. (1989), for whom affective learning outcomes are associated with the question of whether or not students enjoy their learning. In this, three possibilities are distinguished: students' positive feeling of themselves and their experience, neutral, or negative feelings about themselves and their experience. More generally, these definitions relate to the so-called self-concept theories of learning or of motivation that deal with learning outcomes as the consequences of students' self-concept, self-esteem, or self-confidence (e.g., Borkowski et al., 1990; Wylie, 1974). These approaches have significant relations to our theoretical model of affect and of the core interplay between students' affect and cognition in their personal learning processes.

Even though some attention has been given to such specific affective reactions as mathematics anxiety since the 1970s, attitudes have dominated the research on affect in mathematics education (Aiken, 1970; McLeod, 1994). Rather than speaking about mathematics attitudes, later studies have made an effort to bring their forms of approach and affective concepts in line with those in use within mathematical problem-solving research, cognitive science, socio-cognitive perspectives, or socio-cultural studies. In particular, the concepts of beliefs and emotions have entered into mathematics education studies. However, research on affect may also deal with such constructs as self-efficacy, causal attributions of success or failure in mathematics, expectations of success, esthetic experiences, metacognition, and autonomy or independence. All these constructs have significant connections to student cognition and behavior, both theoretically and in related empirical studies.

### 3. Co-existence of affect and cognition

Deficiencies, restrictions, or variation in the theoretical models, definitions, or levels of abstraction applied, together with the complexity or inaccessible nature of the mental processes that underlie affective responses, can be viewed to be related to the traditionally accepted gap between affective and cognitive domains of personality (cf., Lazarus, 1991; Leventhal, 1982; Ma & Kishor, 1997; Wozniak, 1986). However, the well-known cognitive psychologist, Piaget (1981) believed that the affective domain plays an essential part in human mental processes and that it forms an 'energizing' context for personal knowledge construction. Today, many cognitive theorists consider that affect interacts with cognitive actions in important ways, even that it may dominate and direct one's cognitive resources and processes or the development of aptitudes in learning (e.g., Bearison & Zimiles, 1986). In contrast to active, deliberate, or conscious cognitive processes, important mental processes involving affect take place at unconscious or preconscious levels. These are also referred to as automatic or inexperienced mental processes that are associated with low levels of behavioral control (Lazarus, 1991; Mandler, 1989; McLeod, 1990; Schlöglmann, 2002).

We view students' affective experiences to be closely linked to their personal mental constructions, structures, and processes, but more particularly, to their personal and situational self-perceptions, efforts, goals, and self-regulation in the social and contextual mathematics learning environment. This kind of approach is reflected, for example, in the

perspective given by Hatfield (1991) who has linked high quality mathematical experiences to emotional states (feeling) and enquiry states (thinking) in which the emotional elements involve a sense of purpose, self-perception of potential for success, and a willingness and capacity to monitor and control the effects of one's feelings. We consider the arousal and development of students' highly influential affective responses (especially emotions) to mathematics to be intertwined with their situational or learned habitual beliefs, perceptions, and appraisals of the self in mathematics learning contexts and social environments. The willingness and capacity to monitor and control affect, in turn, relate to students' self-regulatory processes, which most often are called metacognition or higher-order cognitive processes. Furthermore, the varying levels of consciousness or awareness in the appraisals, as well as in the affective responses and their regulation, offer an unconstrained path from cognition to affect and vice versa. Like Lazarus (1991), we may then interpret appraisals, as well as self-regulation, with affective responses to represent different degrees of abstraction in mental processes or cognition.

Consistently with the current emphasis on process-based views of learning, we emphasize the dynamic aspects of the interplay of affect and cognition. Examination of unique situational aspects and processes of personal learning and affect will offer better opportunities for going beyond the traditional static and/or inaccurate affective concepts and restricted personality domains, and for understanding students' personal involvement with their affect and their processes of self-regulation. This examination will also make it possible to consider the multiplicity and concerted functioning of affect in mathematics learning processes, and thus challenge the image of simple causal relations between affect and cognition or behavior. In referring to the constantly operating mind and flow of affective mental processes and states, we indicate that different appraisals and processing activities can coexist at different levels of consciousness or self-awareness, and cause several (continuously flowing or changing and perhaps conflicting) affective experiences or self-states that are influential in students' mathematics learning processes. We may call the scene of these mental operations a student's contextual consciousness, in which his or her mental co-constructions, referred to by Wozniak (1986, p. 41) as experience, symbolic discourse, and action (i.e., affect, cognition, and action), will be manifested in unique ways in mathematics learning situations, and also conditioned by the various external features of a particular socio-cultural mathematics learning context. Within this scene, affective responses serve students as a significant source of information about their own mental content and ongoing processing activities, of their action conditions, and of their self-states with respect to mathematics in a learning situation (cf., Leventhal, 1982). Accordingly, affective responses constitute the essential attributions of students' learning mathematics, as well as the means by which they regulate their personal mathematics learning processes.

## 4. Self-systems and self-system processes

Students as historical and social individuals or selves constantly constitute, evaluate, develop, and regulate themselves and their own affective experiences and learning processes in relation to mathematics. The significant relationship between the self and affect is acknowledged in the classical theories of self (e.g., by James, 1980; Rogers, 1983/1969). Today, this relationship is reflected in recent phenomenological notions and developments with self-system structures or processes in the general education research domain. More traditionally it appears in the close relationship between students' self-concept and their highly intense responses, such as anxiety. We call these kinds of highly intense responses or

emotions 'self-affects'. They are connected with students' experiences of self-esteem, self-worth, and/or personal control with respect to mathematics, which can be described as the aspect of 'how one feels about one's worth' (cf., Harter, 1985). Mathematics education research has found that these kind of affective responses often appear to be negative and inhibiting in nature, resulting in disturbance of students' personal mathematics learning processes, performances, and achievements.

We view self-beliefs, self-perceptions and self-appraisals as the primary agents or factors in the arousal and development of students' mathematical self-affects (e.g., anxiety, fear). In this, both the stable constructions or self-systems (especially self-beliefs) and the functional aspects of their selves are important, but essential arguments are also given for such unique situational and constantly ongoing self-system processes as self-appraisals and self-judgments. These appraisals or judgments and, therefore, self-affects are influenced not only by personal but also by unique contextual and socio-cultural features of mathematics and mathematics learning. Thus, influential self-appraisals mediate not only the effects of students' past mathematical history (e.g., beliefs), but also those of the fundamental socio-cultural and contextual features of mathematics learning on their affective responses to mathematics (cf., Eccles et al., 1983; Malmivuori, 1996; Marsh et al., 1988). In this individual environmental interaction, the characteristics of an actual mathematics learning context, or unexpected, new, or rapidly changing occurrences in this context, represent more direct environmental influences on students' self-appraisals and on such self-affects as anxiety or test anxiety. Less direct environmental influences on students' self-appraisals and affect are again linked to particular kinds of socio-cultural beliefs about mathematics and mathematics learning or about performance situations that are reflected by students as well as by the larger social environment (e.g., perceptions of the difficulty of mathematics, attributions for mathematical successes or failures, Eccles et al., 1983).

In a more general form, self-regulation processes represent the central combining feature, the upper level of our dynamic considerations and self-system processes intertwined with affect. In addition to self-appraisals and self-judgments, these higher order or metalevel mental processes involve students' self-directive constructions, self-control and self-regulatory actions. More specifically, we relate the qualities of self-experiences and self-regulation processes with affect to the degree of students' self-awareness and emergence or to their lack of personal agency. Students' unique situational affective experiences as well as the development of their more stable affective responses toward mathematics are related here to their personal possibilities and development of self-knowledge, self-determination and self-control (i.e., personal agency) with respect to their own mental contents, responses or arousals, and actions in mathematical situations. These significant aspects of personal agency and self-regulated learning then have a strong influence on the sources, variation, sustenance, as well as on the role that students' affective responses play in determining the qualities of their personal mathematics learning processes and performances. They are the key features of students' contextual consciousness in any mathematics learning situation. We can summarize our dynamic viewpoint on affect in the following basic statements:

> a) Arousals, experiences and effects of affective responses always emerge and develop in relationship to students' personal systems, processes and states, which are uniquely activated in mathematics learning situations, contexts and socio-cultural environments.

b) Significant affective experiences with mathematics are closely and deeply involved in the activation and development of students' beliefs and perceptions of their personal capability, agency and control in respect to mathematics and mathematics learning situations.

c) Unique situational self-perceptions, self-appraisals and self-experiences constitute central occasions for the dynamic interplay of students' cognition and affect in learning mathematics. The other significant aspect of this interplay is represented by their self-regulatory actions and constructions, filled with or directed toward their affective responses.

d) The degree and development of self-knowledge, self-awareness and personal agency ultimately determine the role and effects of affective responses on the qualities and development of students' self-regulatory processes and, consequently, of their personal mathematics learning processes.

## 5. Epilogue

Newly rediscovered and less restricted terms or theoretical constructs, such as metacognition, consciousness, and self-regulation, afford opportunities to consider cognition as more closely linked to affect and behavior in learning and education. Moreover, application and more thorough understanding of various aspects of and viewpoints on affect, together with extensive empirical research on human information-processing, brain structures or neuroscientific systems, will increase our holistic understanding of the nature, functioning, and development of affective factors. In this article, we emphasize the role of personal constructive and self-regulatory aspects of affective responses in social, contextual and situational environments. More generally, we connect these aspects closely to the functioning, qualities and development of students' self-systems and self-system processes in respect to learning mathematics. The findings of mathematics education research on affect are complemented here by recent general cognitive, socio-cognitive, constructivist and phenomenological perspectives on learning. But, we place the greatest stress on the importance of understanding the co-constructive and dynamic nature of affect and cognition, in which the qualities and functioning of students' significant self-system processes and the emergence and development of their personal agency ultimately determine whether affect or cognition is dominant and identifiable in their personal mathematics learning processes.

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# Dissertation Research From North America 1980-2002

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## Introduction

In North America, research on the teaching to and learning of mathematics by adult populations is reported in dissertations, journals, and government reports. This project studied the first and largest repository, doctoral dissertations. It began in 2000 with an analysis and categorization of the dissertations published between the years 1980 to 2000. Since that time, dissertations continue to be identified and analyzed. In 2002, the author began to build a database about the dissertations. This will be amplified over the next two years and the database rendered accessible to other researchers via the Internet.

## History of Project

Research concerning adults learning mathematics is scarce and the reporting documents sometimes difficult to acquire. Digitization of sources in recent years has improved that situation somewhat but early documents continue to be available at limited locations. The project reported in this paper concentrates on doctoral dissertations indexed and abstracted in the databases of *Dissertation Abstracts International (DAI)*, a central source for most, but not all, North American dissertations. These databases are indexed in a variety of ways: author, university, and year of publication to name a few. Libraries, primarily university and college, subscribe to a service that allows patrons to search by specific criteria and to download the abstracts for dissertations that meet them. In addition, dissertations published since 1997 can be electronically mailed as a PDF document to an individual's account.

Dissertations reported here were selected from the DAI databases using a Boolean search for "Adult AND Mathematics AND Education" in the *descriptor* field. Abstracts of the qualifying dissertations were downloaded to a diskette, edited for format, and printed, one per page. They were then reviewed for validity as adult research. Several were culled for a variety of reasons. Some had been classified as adult yet reported research conducted with adolescent subjects. Others were concerned with in-service programs for professional development of teachers. In the end, 113 dissertations survived the cut and were deemed to be genuinely concerned with adult mathematics education.

The abstracts of these 113 dissertations were then analyzed qualitatively. Themes emerged from this analysis and a paper reporting the findings was presented at ALM-7 in Boston, Massachusetts (Safford-Ramus, 2001). In the intervening two years, the identification and analysis process has been repeated at six-month intervals. Six additional dissertations have been identified as a result of this cyclical process. Thus, the abstracts of 119 dissertations fed into this current phase of the research project.

**Current Project**

In the summer of 2002, I scrutinized the 119 abstracts and designed a database that stores pertinent information about the dissertations and permits searching and sorting by several criteria. Microsoft Access™ was the database software used to create it. Fields in the database are primary category, secondary category, author, title, institution, advisor, DAI number, year, research subjects, research questions and research findings.

From the abstracts I have been able to fill in the category fields, the author, title, DAI number, year, and research subjects. Abstracts since 1990 usually contain the name of the institution and the doctoral advisor. Some interesting sidelights appeared. A few dissertations had a genealogy—an earlier author appears later as a doctoral advisor for another candidate. Certain institutions appear to support research in adult mathematics education—they are represented several times in the institution list. Other institutions favor specific categories. For example, Grambling State granted two degrees to researchers studying the use of technology.

A separate Microsoft Word™ document file is also under construction. This file will summarize the conclusions proffered by the authors. It is organized by category and should be useful to researchers who want to investigate a particular theme. I chose a document file because Access™ limits fields to 256 characters and some of the conclusions were wordy. A sample page is shown in Figure 1. Both the database and document files will eventually be accessible through my web page at Saint Peter's College.

To date I have downloaded the PDF version of 75 percent of those dissertations published since 1997. I have also re-visited the dissertation abstracts and added an alternate categorization according to the following topics:

1. Adult Education In The United States
2. Human Learning Theory
3. Adult Learning Theory
4. Mathematics Education Theory
5. Perspectives On Learning And Teaching
6. Effective Numeracy Practice

These six reflect chapters in a book that I am writing for instructors of adults studying mathematics. They will not appear in the general database as they are personally useful but not of universal interest.

**Future Plans**

Where will the project go from here? The next phase requires access to the dissertations themselves. The remaining 25 percent published since 1997 must be downloaded. Next I will need to triage the abstracts, determining which must be acquired and read before I complete my book, those that might contribute to the book, and, finally, those that are unlikely to contribute useful material for the book but still must be reviewed for inclusion in the database. This is a daunting task since the majority of the pre-1997 dissertations are only available to me as microfiche files maintained at the Library of Congress in Washington, DC. As each dissertation is reviewed, the questions and findings will be entered in the database and the conclusions summarized in the document file.

## COGNITIVE LEARNING STYLES

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| Czarnecki, Karen Gordon (1980) | A relatively field dependent cognitive style might have a negative effect on a GED candidate's ability to respond successfully to questions that were particularly challenging due to their high reading comprehensibility. Differing adult cognitive styles should be approached by a variety of question types so that no one learning style would be favored.<br><br>GED preparation teaching methodologies should include the field dependent adult so that this learner would not be penalized by a cognitive style that might inhibit full reflection of attained competencies.<br><br>Adult educators must give more consideration to adults' cognitive learning styles not only when preparing tests to measure their learning achievement but also when preparing classroom instruction. |
| Hoffer, Sharon Marie (1986) | Adults possess a dominant sensory modality through which they learn more effectively across subject matter.<br><br>Multimodal instruction is not as beneficial for adult learners as instruction presented in their dominant learning modes.<br><br>Auditahm and visitahm learners are two distinct types of tactual-kinesthetic learners. |
| Altieri, Gaetan (1987) | Anxiety was clearly the dominant learning problem.<br><br>Students reporting anxiety as a major learning problem showed higher concrete experience and lower abstract conceptualization modes of cognition than the less anxious cohort. |
| Marsh, Joan Czaja (1992) | Successful visual, auditory, mixed modality students had high correlation between their identified modality strengths and matching study strategies in class and in private study.<br><br>By incorporating a variety of modality based teaching methods, instructors of mathematics will provide a learning environment in which students can construct their own learning of mathematics. |
| Beauford, Judith Elaine Mitchell (1996) | Students preferred individual activities outside of class and group activities in class. |

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| Cook, Roberta Parrino (1997) | Math anxiety level was significantly correlated to one or more learning styles and to gender but not to age or math performance.<br><br>Females has a significant positive correlation between math anxiety level and audio or tactile/kinesthetic learning styles.<br><br>While the math anxiety of females was significantly higher than those of the males their course grades were as well. The females were significantly older and had a significantly higher preference for the visual learning style than the males. |
| Le, Xuan (1997) | Students in the study attended class regularly, took notes of everything on the board, asked questions of the instructor, completed all assigned work, and sought assistant from others when needed. They still did poorly in the course. The source of their difficulty was a mismatch between their expectations coming into College Algebra. They expected the class to be similar to their previous developmental math courses and believed they could succeed in this course if they studied in the same way. The discovery that this was not the case resulted in much confusion and frustration. In their struggle to deal with the difficulties they employed various positive coping strategies that allowed them to release some of the pressure they felt in their learning. They were persistent and not easily discouraged when encountering failure in their work. |

Figure 1. Sample Page from Category Document File.

(Adapted from individual dissertation abstracts contained in the *Dissertation Abstracts International* files)

Earlier I remarked that the *DAI* files contained most, but not all, of the dissertations published in North America. Once these have been reviewed and recorded, an effort must be made to locate and review appropriate dissertations for non-participating institutions. This may not be feasible but at the moment I do not know the extent of that effort. I believe that Harvard, an institute that has a long history of educational research, does not submit abstracts to *DAI*. They may be alone or there may be dozens of institutions absent.

Next, I may re-visit abstracts initially rejected as inappropriate, for instance the professional development abstracts, obtain the dissertations and re-consider their inclusion in the database. It may be that the abstract is misleading and they should be included. In addition, a few of the dissertations were not included because the research reported had been conducted outside of North America. These would be acceptable if the scope of the database was extended beyond the present definition.

Such an extension opens the door to entries from around the globe. At the ALM-9 session where this work was presented, several attendees volunteered to identify appropriate dissertations from their home countries and forward information about them to me for inclusion in the database. This will require some fine-tuning of the database. At the very least, a "county-of-origin" field will be needed. In addition, a column for native language title will need to be added and the title translated into English. Globalization will also necessitate a third file containing an entry form that can be downloaded, completed, and

returned to me for inclusion in the master database.

The database and document files will never be finished. Personal discipline will be needed so that, on a regular basis, new dissertations are identified, analyzed, and added to the files. The ability to download the dissertation as well as the abstract will make that work a local project and therefore more likely to be done.

## Conclusion

When presented at ALM-9, this database project was received enthusiastically by attendees of the session. The research reported was qualitative and subject to interpretation by the researcher. Verification of the categorizations by a second reader would be helpful but unlikely given the time that task entails. My hope is that, even in its imperfect form, the project results will be useful to colleagues interested in research findings about adults learning mathematics.

## References

Altieri, G. (1987). *The Problems and Cognitive Styles of Adult Learners.* Unpublished doctoral dissertation.

Beauford, J. E. M. (1996). *A Case Study of Adult Learners' Metacognitive Strategies in Factoring Polynomials Over the Integers.* Unpublished doctoral dissertation.

Cook, R. P. (1997). *An Exploration of the Relationship between Mathematics Anxiety Level and Perceptual Learning Style of Adult Learners in a Community College Setting.* Unpublished doctoral dissertation.

Cxarnecki, K. G. (1980). *Adult Performance on the Test of General Educational Development as a Function of Field Dependent-Independent Cognitive Style.* Unpublished doctoral dissertation.

Hoffer, S. M. (1986). *Adult Learning Styles: Auditory, Visual, and Tactual-Kinesthetic Sensory Modalities.* Unpublished doctoral dissertation.

Le, X. (1997). *An Investigation of Learning Approaches of Nontraditional Students in Mathematics.* Unpublished doctoral dissertation.

Marsh, J. C. (1992). *Achievement of Differentially Prepared, Nontraditional Students in Developmental Mathematics at a Community College: A Study of Modality.* Unpublished doctoral dissertation.

Safford-Ramus, K. (2001) 'A review and summary of research on adult mathematics education in North America'. In: M. J. Schmitt & K. Safford-Ramus (comps), pp 39-44.

## Appendix

### North American Dissertations 1980-2002

| *Category* | *Author* | *Title* |
|---|---|---|
| ABE Classroom Environment | Ehring, Howard A. | Implications of High School Dropouts Perceptions of Adult Basic Education Programs for the Improvement of Instruction |
| ABE Classroom Environment | Ross, Kenneth Scott | A Status Study of Mathematics Education in Adult Basic Education |
| ABE Classroom Environment | Tobing, Asmara Raphy Uli Lumban | Andragogy and ABE/ESL Classroom Practice |
| ABE Classroom | Nesbit, Tom | An Analysis of Teaching Processes in |

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| Environment | | Mathematics Education for Adults |
| Adult Development Theory | Dugan, Patricia Ann | Nontraditional and Traditional Student Learning Characteristics Relating to Class Size at the University Level |
| Adult Development Theory | Moss, Lester Lavahn | GED Total and Subtest Scores and Their Relationships to Cross' Life Cycle Phases at a Rural Mississippi GED Testing Center |
| Adult Development Theory | Mayta, Fabian Esteban | The Relationship of Mathematics Computation with Concrete Reasoning Ability, Math Attitude and Four Demographic Variable of English and Spanish-Speaking incarcerated Males |
| Adult Development Theory | Pace, John Patrick | A Model for Teaching Area and Perimeter Concepts from a Constructivist Perspective to Adult Community College Students Through Applied Problem-Solving and Activity-Based Instruction |
| Adult Development Theory | Bockbrader, Barbara Ellen Berger | Characteristics of Adult Rational Number Understanding |
| Adult Development Theory | Dias, Ana Lucia Braz | Theorizing the Practice of Mathematics Education in a Freirean Adult Literacy Program |
| Classroom Materials | Willing, Delight Carter | A Key to the General Educational Development (GED) Program: A Guide for Preparing Students to Take the New Tests |
| Classroom Materials | Grout, Don Hall | Evaluation of LOGO Lessons as a Method for Teaching Algebra with Nontraditional Adult Students |
| Classroom Materials | Defence, Astrid | The Readability of the Mathematics Textbook: With Special Reference to the Mature Student |
| Classroom Materials | Newman, Glenn Austin Robert | The Development of a Study Guide for Adult Students to Learn Statistics |
| Classroom Materials | Martelly, Diana I. | Effects of Using Manipulative Materials to Teach Remedial Algebra to Community College Students on Achievement and Attitudes towards Mathematics |
| Classroom Methods | Jain, Barbara Jean | An Exploratory Study of Directedness of Instruction in an Adult Basic Education Setting |
| Classroom Methods | Jones, Martha Jane Everman | The Effects of Teaching Modes on the Academic Gain of Central Steam Secondary Migrant Students of Texas |
| Classroom Methods | Munyofu, Paul Malima | The Effects on Achievement, Retention |

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| | | and Attitude of Using Expository and Discovery Approaches in Teaching Factoring to Adult Slow Learners |
| Classroom Methods | Gould, Lillian Joyce Venable | Evaluation of an Intensive General Mathematics Course as to Effecting Changes in Adults' Attitudes Toward, and Confidence in Learning, Mathematics |
| Classroom Methods | Reid, Margie N. Barron | A Comparative Study of Three Teaching Methods Used in Adult Basic Education and General Educational Development Mathematics Programs |
| Classroom Methods | Farr, Charlotte Webb | Effects of Inferencing Training on Verbal Abilities and Mathematics Problem-Solving among Adult Basic Education Students |
| Classroom Methods | Basinski, Ida Rockwood | Comparison of Cognitive and Affective Gains Between Participants and Non-Participants in an Affective Learning Experience |
| Classroom Methods | Skane, Marie Elizabeth | Utilizing a Conceptual Change Model with College Precalculus Students: Amending Misconceptions about the Distributive Law |
| Classroom Methods | Greenwood, William Franklyn | A Study of the Final Pre-Algebra Grades of Tutored and Untutored Learning Disabled Students at a Florida Community College |
| Classroom Methods | Berry, Andrew Johnathan | The Effects of Peer Tutoring on Adult Students in Remedial Algebra at an Urban Community College |
| Classroom Methods | Gunasekera, Thilak Wijenayaka | Effects of Pretest Sensitization Associated with Cooperative Learning Strategies of the Achievement Level of Adult Mathematics Students |
| Classroom Methods | Bryant, Debra Deon | A Comparison of Success Rates in Grade Maintenance in R/D Mathematics Through Level 1 Mathematics of TTU Students and Transfer Students to TTU from Other State Postsecondary Institutions from Fall 1994 Through Spring 1996 |
| Classroom Methods | Moussavi, Massoud | Mathematics, Modeling, and Modular Curriculum in Engineering Retraining Programs |
| Classroom Methods | Roberts, Rosemary | What Makes an Explanation a Good Explanation? Adult Learners' Criteria for Acceptance of a Good Explanation |
| Classroom Methods | Steig, Mary Jo | Factors Related to Community College |

Students Choice Between Three College Algebra Learning Environments

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|---|---|---|
| Classroom Methods | Smith, Pamela Dawn | The Utilization-Focused Evaluation of a Modularized Math Program |
| Classroom Methods | Hornor, Ni Z. | The Effectiveness of an Application of Some Concepts from Andragogical Instruction as Compared with Traditional Instruction in an Introductory College algebra course |
| Classroom Methods | Zielke, Ronald Eugene | The Making of a Champ: The Modification of Mathematical Self-Efficacy Beliefs of Non-Traditional College Algebra Students Using Techniques Adapted from Sports and Sports Psychology |
| Effect of Student Age | Porter, Albert H. | Analysis of Gender and Age Based Disparities in Basic Skills Proficiencies of Community College Freshmen and in Longitudinal Outcomes for Those Remediated in English and Mathematics |
| Effect of Student Age | Galloway, Linda Jean Lowrey | Individual and Teacher-Related Factors Which Influence Academic Help-Seeking of the Developmental Studies Mathematics Students |
| Effect of Student Age | Richardson, Samuel | A Comparative Study of Mathematics Attitudes Before and After Remediation |
| Effect of Student Age | Johnson, Rayneld Rolak | An Analysis of Learner Variables Related to Achievement in an Introductory Graduate Statistics Course |
| Effect of Student Age | Selman, Rae V. Cuerington | Noncognitive Indicators of Academic success of Nontraditional Older Students: Toward Equal Access to Higher Education |
| Effects of Student Age | Carabin, Robert Jerome | An Analysis of Adult Learning and Placement in Community College Entry Level Mathematics Courses |
| Gender | Nettles, Harriet | Motivational Factors Related to Performance in College-Level Mathematics Classes: An Investigation of Gender Differences |
| Gender | Riegle-Crumb, Catherine Casilla | International Gender Inequity in Math and Science Education: The Importance of Gender Stratification across Generations |
| Learning Disabled Students | Walsh, Velma Joy | A Study of the Incidence of Learning Disabilities among Soldiers in the U.S. Army's Basic Skills Education Program |

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| Learning Styles | Czarnecki, Karen Gordon | Adult Performance on the Test of General Educational Development as a Function of Field Dependent-Independent Cognitive Style |
| Learning Styles | Hoffer, Sharon Marie | Adult Learning Styles: Auditory, Visual, and Tactual-Kinesthetic Sensory Modalities |
| Learning Styles | Altieri, Gaetan | The Problems and Cognitive Styles of Adult Learners |
| Learning Styles | Marsh, Joan Czaja | Achievement of Differentially Prepared, Nontraditional Students in Developmental Mathematics at a Community College: A Study of Modality |
| Learning Styles | Beauford, Judith Elaine Mitchell | A Case Study of Adult Learners' Metacognitive Strategies in Factoring Polynomials Over the Integers |
| Learning Styles | Cook, Roberta Parrino | An Exploration of the Relationship between Mathematics Anxiety Level and Perceptual Learning Style of Adult Learners in a Community College Setting |
| Learning Styles | Le, Xuan | An Investigation of Learning Approaches of Nontraditional Students in Mathematics |
| Math Anxiety | Parker, Sheila Latralle Blackston | Overcoming Math Anxiety: Formerly Math-Anxious Adults Share Their Solutions |
| Math Anxiety | Zopp, Marilyn Ann | Math Anxiety, the adult student, and the Community College |
| Miscellaneous | Friedman, Susan O. | A Comparison of the Natural Science Curricula in an External Degree Program and Conventional Programs |
| Miscellaneous | Brown, Angela Denise Humphrey | Making the Invisible Visible by Challenging the Myth of the Universal Teacher: African-American Women Postsecondary Mathematics Teachers |
| Miscellaneous | Millette-McGuire, Beverly | The Role of Applied Mathematics and Algebra in Postsecondary Educational and Occupational Choices by Rural Students |
| Miscellaneous | Barlatt, Godfrey R. | Developmental Education and Teaching Processes: An Exploration of Ethical Dilemmas |
| NCTM Standards | Bartlett, Lucy E. | The Evaluation, Improvement, and Dissemination of a Guided Discovery Method for Teaching Developmental |

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| | | Mathematics |
| NCTM Standards | Ramus, Katherine Safford | How the Mathematics Education Reforms Pertain to Undergraduate Curriculum: An Introductory Study of an Experimental Developmental Algebra Course for Adults |
| Parent Education | Craig, Elizabeth L. | The Administration of a Parent-as-home-tutor Education Program and its Effects on Parent Attitudes, Parent Participation, and Student Mathematics Achievement |
| Parent Education | Doering, William George | The Effects of a Parent Education Program on Fourth-Grade Student Academic Achievement, Homework, Attitude, and Attendance |
| Predictors of Success | Mullinix, Patricia M. | An Investigation of The Entry Level Skills of Adult Learners as Predictors of Time Requirements and Expected Growth in the PLATO Basic Skills Learning System |
| Predictors of Success | Travis, Thomas Riley, Jr. | A Study of Selected Factors Contributing to Reading and Mathematics Achievement of Adults Enrolled in an ABE/GED Program |
| Predictors of Success | Grady, Donna Katherine | The Academic Performance of General Educational Development Entrants Compared with High School Diploma Entrants to Broward Community College, 1980-1983 |
| Predictors of Success | Huntimer, Linda Carol | An Investigation of the Characteristics of the Adult Learning Disability Programs at the Community College Level in California |
| Predictors of Success | Miller, Kathleen Noble | The Effect of the Individualized Manpower Training System Instruction Program in Basic Math Skills of the Achievement Level and Dropout and Failure Rate of Mathematics of Business Students at Daytona Beach CC |
| Predictors of Success | Lehmann, Christine Elyse Heinecke | Patterns of Adult Mathematics Learners' Causal Attributions of Success and Failure at Mathematics Tasks |
| Predictors of Success | Massey, Frances Ann | The Effects of Using Algebra Notecards on Algebra Achievement of College Students |
| Predictors of Success | Puchon, Charles Anthony, Jr. | The Relationship of Specified CLEP General Examinations and Other Selected Factors as Predictors in |

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| | | Information Systems Staff Officer Training |
| Predictors of Success | Stewart, Barbara Martin | An Analysis of Perceived Factors Impacting on Student Attrition in a Federally Funded Practical Nursing Program |
| Predictors of Success | Romero, John Edward | The Relationship of Placement Examination Scores to the Academic Achievement of Nontraditional Students |
| Predictors of Success | Banner, Doris Vance | The Tests of General Educational Development as Predictors of Student Performance in Five Programs at Asheville-Buncombe Technical Community College for the Years 1982-1988 |
| Predictors of Success | Leitsch, Patricia Kearns | Relationship Between Selected Academic and Demographic Variables and Success in Licensed Practical Nursing Programs |
| Predictors of Success | Meeks, Kay Irene | A Comparison of Adult Versus Traditional Age Mathematics Students and the Development of Equations for the Prediction of Student Success in Developmental Mathematics at the University of Tenness-Chattanooga |
| Predictors of Success | Cunningham, Donna Davidson | The Self-Concept, Basic Skills, and Work Values of Pregnant Youth or Young Mothers, 14-21 |
| Predictors of Success | Munn, Anne Hodgkins | Predictive Effects of Computational Ability, Mathematics Anxiety, and Spatial Visualization Ability of Achievement in Developmental Algebra |
| Predictors of Success | Oliver, Richard Thomas | Predicting Success in Mathematics for Adult Learners Based on Arithmetic Skills Test Scores |
| Predictors of Success | Refsland, Lucie Tuckwiller | The Use of Attitudinal Variables to Reduce Potential Prediction Bias of ACT Mathematics Test Scores for Nontraditional-age students |
| Predictors of Success | Trutna, Kevin Wayne | Characteristics of Adult Students in Introductory Calculus |
| Predictors of Success | Barker, John Lewis | Selected Factors Related to Academic Achievement of Developmental Introductory Algebra Students at the Two-Year College Level |
| Predictors of Success | Harper, Linda C. | The Re-Entry Female Student in Mathematics: A Study of Affective |

Variables that Contribute to
Persistence and Success

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| Predictors of Success | Kestner, Sandra Fey Shelley | A Study of Selected Programmatic and Personal Factors Associated with Reading and Math Achievement Scores of Adult Basic Education Students in Kentucky |
| Predictors of Success | MacLeod, Susan H. | Views of Mathematics of Women Restarting Their Education: Looking for Safety in Numbers |
| Predictors of Success | Smith, Joseph Garratt | An Evaluation of an Algebra Placement Procedure Consisting of Reinforcement Examples and Measures of Mathematics Anxiety and Locus of Control |
| Predictors of Success | Jost, Oliver R. | Computer Anxiety, Mathematics Anxiety and Achievement in an Adult Basic Mathematics Course |
| Predictors of Success | Szanto, Gabriella | Arithmetic Disability of Adults |
| Predictors of Success | Alford, Linda Gale | The Effect of Age, Ethnicity, ASSET scores, and Courses in High School Mathematics and Accounting on Final Scores of Students Enrolled in Postsecondary Accounting |
| Predictors of Success | Lang, Edith Tucker | The Impact of Developmental Courses on the Academic Performance of Community College Students |
| Predictors of Success | Zachai, Judith | Adult Learners' Math Self-Concept as a Barrier to Passing California State University's Entry Level Mathematics (ELM) Test |
| Problem-Solving | Ungson-Devito, Maria Teresa | Development of a Self-Instructional Booklet for the Teaching of Problem-Solving Strategies to Adult Students |
| Problem-Solving | Fazzari, Alan Joseph | Attributional Retraining Among Optimists/Pessimists Solving Math Problems in a Corporate Environment |
| Problem-Solving | Sneller, Lowell Lee | Training for Understanding: A Model for Mediating Abstract Statistical Concepts |
| Retarded Adults | Robinson, Donna Regina | A Criterion Referenced Instrument of Functional Mathematics Skills in Moderately and Severely Retarded Adults |
| Retarded Adults | Borakove, Larry Steven | An Examination of Developmentally Sequenced Mathematical Prerequisites for Teaching Coin Summation to Mentally Retarded Adults |

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| Street Mathematics | Holloway, G. Yvonne | Skill Qualification Test (SQT) Performance of Army Personnel as Related to Basic Academic Skills and Preparational Review Procedures |
| Street Mathematics | Owings, Maria Facchina | Environmental Influences on the Development of Vocabulary and Mathematics Abilities during Early Adulthood |
| Street Mathematics | Carey, Karen Waite | Changes in Mathematical Ability of BEREA College Graduates: A Twenty-four Year Longitudinal Study |
| Street Mathematics | Masingila, Joanna O. | Mathematics Practice and Apprenticeship in Carpet Laying: Suggestions for Mathematics Education |
| Street Mathematics | Crittenden, Alexandra Humphrey | A Case Study of the Perception of the Development and Transfer of Work-Related Mathematical Concepts to Personal Finance Management for Women in a Remedial Mathematics Class |
| Student Characteristics | Arnold, Carol Palmer | Remedial/Developmental Classes and Self concept Changes in the Non-Traditional Adult Student |
| Student Characteristics | McCarthy, William Francis | The Self-Directedness and Attitude Toward Mathematics of Younger and Older Undergraduate Mathematics Students |
| Student Characteristics | Miller, Nancy Carol Sanders | Perceptions of motivation in Developmental Mathematics Students: I Would Rather Drill my Own Teeth |
| Student Understanding | Khoury, Hani Qustandi | Exploring Perspectives about Mathematics Within the Cultural Context of a College Algebra Class at a Community College |
| Technology | Boysen, Vicki Allen | Interaction of Field Dependence-Independence with Type of Feedback Used in Computer-Assisted Equation Solving |
| Technology | Barnett, Thelma L. | A Comparative Analysis of the PLATO Computer-Assisted Instructional Delivery System and the Traditional Individualized Instructional Program in Two Juvenile Correctional Facilities Owned by the Commonwealth of Pennsylvania |

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| Technology | Burnham, Paul Thomas | A Field Test of a Structured Television Curriculum on the Mathematics Achievement of Incarcerated High School Equivalency Learners |
| Technology | Wilson, Shirley Anne | The Construction of Computer-Assisted Instruction: An Application to Remedial College Algebra |
| Technology | Robichaud, Kathleen Kienzle | The Use of Computer Assisted Instruction with Adult Basic Education Students: A Comparative Study |
| Technology | Wilson, Odell D. | An Automated Diagnostic Test and Tutorial Package for Basic Skills of Mathematics in Post Secondary Vocational Education of Kentucky Construction and Validation |
| Technology | Wheeler, Elizabeth (B.J.) Johanna | The Use of Dense Items, Constructed Using Cognitive Error Analysis, in a Computerized Diagnostic Program in Mathematics |
| Technology | Hsiek, Feng-Jui | Effects of Animation and Manipulation on Adult Learning of Mathematical Concepts |
| Technology | Wilder, Margaret Ramsey | The Effects of a Simulation Test Model of the General Education Development Program as Compared to the Effects of a Drill and Practice, Both Computer-Based and Workbook-Based on GED Mathematics Scores, Retention, and Time |
| Technology | Burton, Beatrice Spencer | The Effects of a Computer-Assisted Instruction and Other Selected Variables on the Academic Performance of Adult Students in Mathematics and Reading |
| Technology | Wardlaw, Roosevelt | Effect of Computer Assisted Instruction on Achievement Outcomes of Adults in developmental Education Programs: A Comparative Study |
| Technology | Lou, Yiping | The Role of Social Context when Learning with Computer Technology: A series of meta-analyses |
| Technology | Ruffin, Ellick Leonard | Computer-assisted Instruction: Demographic Variables and Student Attitudes |
| Workplace | Hollobaugh, Patricia Susan | Attitudes of Industrial Workers Toward Work Force Continuing Education Programs |

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| Workplace | Immergut, Brita | Assessment of Basic Skills in Mathematics and Attitude Towards Mathematics in Working People |
| Workplace | Vanis, Mary Irene | Workplace Literacy: Basic Skills Requirements of Entry-Level Workers in an Electronics Industry |
| Workplace | Blair, Judith Dee | Development of a General Industrial Mathematics Curriculum for Arkansas Industry |
| Workplace | Stephens, Geralyn Esther | An Assessment of the Basic Skills Competencies of Employees Within an Industrial Enterprise |

# Sharing Our Bibliographies: Books That Lead, Push, And Inspire Up To Better Practice

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## Introduction

Often a book opens a reader's eyes and mind to situations and theories s/he has never encountered or considered and, in doing so, alters the path of his/her research and practice. This workshop provided the opportunity for participants to talk about books that have proven valuable in their work. The facilitator offered a brief discussion of some texts that have helped her to research adult mathematics education and to construct a theory of good practice for use in her work. Attendees were then encouraged to suggest other books and state the ways in which the book affected their thinking and/or their classroom practice. At the end of the session, contributors were asked to write a brief review of the books they had recommended. Only one person submitted a review but the other suggestions that were made during the session are listed at the end of the paper.

## Reviews

*Knowing and Reasoning in College: Gender-Related Patterns in Students' Intellectual Development, Marcia B. Baxter Magolda (1992), San Francisco: Jossey-Bass.*

This book draws on and extends work by earlier researchers about student perspectives concerning the nature of knowledge and the process of learning. Data was gathered through interviews with students during, and immediately after, their college careers. Baxter Magolda discovered a progression from an objective, "teacher-as-source of knowledge" to a subjective, "student-as-constructer of knowledge" conviction. While the stages revealed gender variance, the progression was parallel.

For the past ten years my research has explored ways to apply studies about math histories and math anxiety as well as the reforms in mathematics education to courses that I design and teach. Despite this, in my work with traditional and non-traditional age students I am often frustrated by students' reluctance to value their own ability to tackle problems and/or to reflect on classroom and homework experience to build or expand their mathematical knowledge base. The material in this book offered valuable insights and possible explanations for my classroom experiences. It has caused me to seek ways to meet students at their perception levels and to provide experiences that might assist them to advance along the objective→subjective continuum.

*Five Perspectives on Teaching in Adult and Higher Education, Daniel D. Pratt and* Associates (1998), Malabar, FL: Krieger Publishing Company.

Pratt and Associates speak in teacher, rather than student, voices. The continuum, however, is similar. At the opposite extremes are "knowledge as external and objective" and "knowledge as internal and subjective". He defines perspective as "an interrelated set of beliefs and intentions which give meaning and justification for our actions (p. 33)." Based

on many years of research in several countries, Pratt identifies five perspectives on teaching:

1. Transmission-Effective Delivery of Content
2. Apprenticeship-Modelling Ways of Being
3. Developmental-Cultivating Ways of Thinking
4. Nurturing-Facilitating Self-Efficacy
5. Social Reform-Seeking a Better Society (p. xiii)

Section II of the book consists of five essays by individuals whose classroom practice illustrates one of the perspectives. Section III, authored by Pratt, discusses ways to analyze and evaluate one's teaching in light of the defined perspectives.

Ten years ago I would have described myself as a transmission perspective teacher. It is probably safe to say that many mathematics teachers fall into that category. We also tend to view our discipline as objective, after all that was a major part of our training. I suspect that this contributes substantially to reluctance on the part of senior faculty to embrace the reform movement. I no longer fit that pigeonhole. Reflecting on the descriptions of the perspectives, I could see vestiges of each in my lesson plans and discourse. At the same time, the essays provoked intentions to make a greater effort to incorporate the best of each perspective in my work.

*Women as Learners: The Significance of Gender in Adult Learning,* Elisabeth Hayes, Daniele D. Flannery with Ann K. Brooks, Elizabeth J. Tisdell, and Jane M. Hugo (2000), San Francisco: Jossey-Bass.

This book is written from yet another perspective, a feminist perspective. In the preface, the authors state their purpose in writing this book. They are:

1. To assemble, in one place, knowledge about women and their learning.
2. To place women's learning experiences in the contexts where women live…in the social structures…and institutions that influence women's learning and their participation in educational activities.
3. To promote an understanding of women's diversity.
4. To make recommendations…for future research and practice. (p. xii-xiii)

What a wonderful book! For the first time since I was a child, I was compelled to write to an author to share my pleasure in owning and reading her book. Notes of discord from my early training as a pure mathematician became understandable. Even more so, my discomfort as a middle-aged adult woman returning to academic study made sense as the authors discussed the male-oriented academic climate prevalent in the colleges and universities of the United States.

The classes I teach are primarily, and sometimes overwhelmingly, composed of women. They are also ethnically diverse. *Women as Learners* has encouraged me to consider gender and ethnicity issues in my teaching at St. Peter's and in the planning of future research projects.

Dr. Diana Coben, Nottingham University, nominated *Letter to a Teacher.*

Here are her comments on that publication.

*Letter To A Teacher* by the School of Barbiana, translated by Nora Rossi and Tom Cole (Harmondsworth, Middlesex, UK: Penguin Education Special, 1970, pp. 138, out of print).

*Letter to a Teacher* is a passionate argument for a fair deal for the poor in education, backed up by a detailed statistical analysis of the ways in which the Italian Education System discriminates against them. It was written by eight boys who left the state system and were pupils of the School of Barbiana, in rural Tuscany, Italy in the 1960s. The school was started by a parish priest, Don Lorenzo Milani, and run by the children under his guidance, with the older children teaching the younger children. Classes ran for ten hours a day for 365 days a year.

The opening lines set the tone of the book - passionate and angry:

> Dear Miss
>
> You won't remember me or my name. You have failed so many of us. On the other hand I have often had thoughts about you, and the other teachers, and about that institution which you call 'school' and the boys that you fail.
> You fail us right out into the fields and the factories and there you forget us.(p17)

In a section entitled 'The culture that you demand of us', the boys bemoan that fact that mathematics is badly taught in the state school and argue for a radical solution - the elimination of mathematics from the curriculum:

> Instead, one should learn the best way to teach maths - which is itself not maths, but has to do with the learning process or with pedagogy. (p97)

They go on to argue that

> In truth, a mathematics degree is not necessary for teaching maths at intermediate level. That need was invented by the special caste of people who have children with university degrees. This way they pocket 20,478 quite desirable jobs: minimum workload (sixteen hours a week), and no need to keep on your toes. In such a job you can repeat year after year the same idiocies that any student in the third intermediate class already knows. It is a job that requires only fifteen minutes for correcting your students' papers, because the answers are either right or wrong. (p98)

The boys' impressive statistical analysis (in which they were assisted by officers of the Ministry of Education and the Central Institute of Statistics) shows that they are well aware of the power of numbers in the right hands. 'Documentation' (statistical tables) forms Part 3 of the book, which, they say "will be useful to any friend who wants to deepen his understanding and to the not-so-good friend who does not trust us" (p115). They present the stark fact that

> Your 'compulsory school' loses 462,000 children per year. This being the case, the only incompetents in the matter of school are you who lose so many and don't go back to find them. Not we: we find them in the field and the factories and we know them at close range. (p35)

Don Lorenzo Milani died in 1967 and the school died with him. *Letter to a Teacher* was a best seller, translated into many languages. It is still controversial and it reads today as freshly as the day it was written. It was a pleasure to re-read it for the purpose of writing this review.

### Other Suggested Books

*Experiencing School Mathematics: Teaching Styles, Sex and Setting* by Jo Boaler, Open University Press (1997)

*Teaching to Transgress* (Routledge, 1994) and *Talking Back: Thinking Feminist, Thinking Black* (South End Press, 1989) by bell hooks

*Among School Children* by Tracy Kidder Avon Books (1990)

*The Reflective Practitioner: How Professionals Think in Action* by Donald Schon, Basic Books (1983)

*The One Minute Manager by Spencer Johnson and Kenneth Blanchard, Berkeley Pub Group (1983)*

# Education in mathematics for adults today

**Wolfgang Schlöglmann**
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Tine Wedege (Wedege, 1999) developed in her thesis an epistemological frame for the research in adult education in mathematics with Althusser's 'problematic' as central concept. Using this frame adult education in mathematics is on the way to develop its own subject area, problem fields and problems that are situated on the borderline between 'adult education' and 'mathematics education'. In my lecture at the ALM 8 – Conference I discussed the question 'Why must all people learn mathematics' and analysed the relationship between mathematics and society (Schlöglmann, 2002). The main reason was the penetration of the structure of our society by mathematical procedures, mathematical concepts and mathematical ideas. This was a process that started more than 10.000 years ago and led to the consequence that mathematics is an important content in school curricula. To discuss the situation of adult education in mathematics today we have to analyse the structure of our society as an industrial society and the demand on adult education within the society. 'Lifelong learning' is the key word and the 'vision' in this context. All citizens of the society should be included in a permanent learning process and adult education in mathematics today is part of a concept that considers our society as a knowledge society.

## 1. Technology – science – society

To characterize a modern industrial society the philosopher Heinz Hülsmann developed the concept of 'technological formation' (Hülsmann, 1985). Hülsmann used this term to express that a modern industrial society is formed by the technologies that are used by the society. Technology as a term

> *grasps precisely the structure and situation of this societal formation, supplies so to speak the "differentia specifica" (Hülsmann, 1985: 9)*

Technology is for Hülsmann the consequence of natural science

> natural science turns necessarily in technology (Hülsmann, 1985: 9)

If natural science turns in technology than this is

> *at the same time the change in sociality. Conversely this says that technology is social reality and realizes real sociality (Hülsmann, 1985: 9)*

Furthermore we have to consider the simultaneity of the formative power of the technology

> *We don't have first a certain technique that is later social effective and structuring. Modern technology as large scale research ... isn't even later societal formating but is as such already formative (Hülsmann, 1985: 10)*

Hülsmann emphasizes the significance of the natural science for the development of technologies but it is important to say that the technological formation of our society is also a consequence of the results of other sciences especially the social sciences and the economics (Schlöglmann, 1992). Today social organisations in our society are organized by abstract concepts that come from the social and human sciences, and the educational field works with results of the pedagogical science. Also large-scale research is not longer only a domain of natural science. Big research institutions are built up to give government advice.

Peter Heintel (Heintel, 1992) pointed out the close relationship between technological formation and societal organisation. Especially important is the form of communication within a society. Whereas in small group societies the direct communication from individual to individual is possible and for the stability necessary, requires the technological formation big societal units. In societies with many members direct communication cannot be the dominating form of communication because it is not possible to reach all members in a short time. Therefore such societies need an organisation form mediated by indirect communication where information goes to the members by special mediums like written documents. That means technological formation is only possible in big societies and these societies have a demand on intermediate levels, like writing, tools but also mathematics to communicate and to produce a common thinking and dealing. Such societies have also a high developed system of division of labour and therefore a demand on intermediate medium for a 'loss free' transport of contents (mathematics is such a medium) (Schlöglmann, 1996).

Sciences are driving forces in a society that is formed by technologies and is organized by indirect communication. Therefore specificities of sciences are also important for the conditions within the society and the structure of development. If the state of research, as the form in which sciences produce new results, is important for the competitiveness of the economy because new products and the alteration of production conditions need new results of research, we get a growing of research. But more research led to a dynamic in the changing process of the society, especially in the conditions of labour.

Furthermore research and sciences are based on the 'logos', the reason. This has a tendency to general validity and a more general result has influence on more parts in economy, production and society. A consequence is also an increasing 'abstraction of the technologies'. That means that the scientific basis of these technologies is more abstract and formal. This growing formalisation is seen in the case of the computer technology. This increasing formalisation needs on the one hand a formal basis to formulate results (this basis is mathematics) and is on the other hand responsible for the penetration of more and more parts of our society by the new technologies.

## 2. Consequences for education – lifelong learning

For economic units in a society formed by technologies that are consequences of the progression in sciences it is only possible to survive through a permanent adaptation on the conditions of a dynamic process. Only the permanent adaptation of technologies and

products lead to a certain stability. It is a consequence of each evolutionary process that adaptation on changing conditions is the single possibility to survive and get a stability in flowing movement. The main problem today is the velocity of change. Humans as part of this system are also concerned by the permanent change. Changing technologies and conditions of production lead to a permanent transformation of professional qualifications that are required. Therefore many peoples in our society are forced to adapt their qualifications. Lifelong learning is now the key word in the discussion. Mostly lifelong learning is seen as an economic demand. In economic discussions the qualification of employees are often called as 'human capital' of a company, an economy or a nation. The main idea behind this is if companies have permanently to adapt their technologies employees have permanently to adapt their qualifications.

**The educational discussion considers critically this strong economic justification of lifelong learning:**

> *This economic justification for lifelong learning is highly dependent upon two prior assumptions: one, that 'lifelong education' is instrumental for and anterior to some more ultimate goal; and secondly, that the purpose of lifelong learning is highly job related and economic – policy – dependent. This approach, as we have seen from discussion at OECD (1996), UNESCO (1996), the European Parliament (1995) and the Nordic Council of Ministers (1995), has now been rejected as presenting too narrow and limited an understanding of the nature, aims and purpose of 'lifelong education' (D.Aspin/J. Chapman/M. Hatton/Y. Sawano, 2001: XX).*

The 'vision' of lifelong learning needs are broader view on education. Education has to see humans as a person with their own need, as member of a democratic society and as member of an economic system. Therefore Aspin & Chapman speak from three elements in lifelong learning:

> The central elements in what we have described (Chapman & Aspin, 1997) as the 'triadic' nature of lifelong learning –
>
> - For economic progress and development
> - For personal development and fulfilment
> - For social inclusiveness and democratic understanding and activity
>
> - are now seen as fundamental to bringing about a more democratic policy and set of social institutions, in which the principles and ideals of social inclusiveness, justice and equity are present; and a richer range of provision of those activities on which individual members of society are able to choose to spend their time and energy, for the personal rewards and satisfactions that the confer. (Aspin & Chapman, 2001: 29).

Mathematics has a central role in the development of the new technologies (Schlöglmann, 1992, 2002). Therefore mathematics plays an important role in various parts of the lifelong learning system. If we consider the points of the triad:

* Mathematics is as basis for the new technologies central for economic progress and development

* Mathematics is used to structure our everyday life and democratic processes and therefore a necessary precondition for social inclusiveness and democratic understanding and activity

* Mathematics can as part of our cultural development also be valuable for personal development and fulfilment.

## 3. A scheme for ordering courses in education in mathematics for adults

The field 'adults and mathematics' is characterized by a great heterogeneity especially in the course system (FitzSimons et a., 1996). To get a better insight in the situation it is useful to reduce the heterogeneity and the complexity by building classes. The leading ideas by building classes must be to reproduce the important subject areas that constitute the field. Those are on the one hand mathematics as a system, representing the ideas of mathematics as science. Vocational practice but also the use of mathematics in everyday life situations is a second important aspect that has to be represented by the scheme. The third and newest aspect is combined with the new technologies. Mathematics is a key science for hardware and software of computers. Especially software programmes contain mathematical structures in the background and led to a big change in using mathematics in many vocational situations.

On the other hand the focus of educational intention has to structure such a scheme. The educational goal can be mathematics, but also the contents that use mathematics to formulate their results (mathematics as a language) or the use of software that is based on mathematics.

(The following scheme is an adaptation of a scheme which was used by Tine Wedege (Wedege, 1998: 180 - 181) to structure the field of adult education in mathematics).

| **Educational Goals**<br><br>**Organisatorial Criteria** | **Mathematics** | **Other Fields** | **Use of Software** |
|---|---|---|---|
| **Mathematical systematic** | | | |

| | | | |
|---|---|---|---|
| **Working/Vocational Criteria** | | | |
| **Software Criteria** | | | |

The presented scheme can be used to categorize courses for adults on different levels, also on the university level, but the following comments refer mostly to courses on the secondary level.

Various numeracy courses are organized by a mathematical systematicness and their goal is to learn mathematics, just as courses for adults to make up school examinations. But some of the numeracy courses are organized by mathematical criteria (percentage calculation) their aim is to calculate credits. Today are existing many computer programmes exist which contain mathematical algorithms but the goal of the course is to use the programme and not to learn mathematics.
Mathematics is for many occupations an important tool and therefore mathematics is (often a hidden) content of many vocational courses. To handle the problem of mathematics learning two different concepts are used in the course organization. In the first concept the required mathematics is separated from the vocational field and taught in separated courses (for instance mathematics for building construction) and the application of mathematics in the field take place in a second step. The second concept does not separate mathematics and teaches the required mathematical algorithms as part of the vocational content. In this concept the mathematical algorithms are often very special and only usable in isolated situations (a more extended discussion of this problem follows in section 4). Many computer programmes used in production processes contain mathematical algorithms but the user is only trained to handle the programme and is often not aware that there are mathematical algorithms in the background that control the working process. An example for this kind of courses are courses for handling CNC – machines.

Today learning programmes exist to practise mathematical operations and algorithms (for young students often combined with play elements) that are used in courses for training. This software belongs to the category of 'training programmes' and their goal is to practise mathematics. Other software programmes used in adult education courses are classified by vocational criteria (for instance book keeping) but require mathematics. The aim of the last group of courses is to use a special software programme (for instance EXCEL) but handling the programme needs mathematical concepts (variables etc.).

## 4. Vocational mathematics vs. school mathematics

The scheme demonstrates the 'problematic' of adult education in mathematics. The aim of education is on the one hand to learn mathematics and on the other hand to require

occupational and professional qualifications in which mathematics is part of the context. There is a long discussion about the relationship of school mathematics or academic mathematics and vocational mathematics (Benn, 1997). In the following text I will discuss the problem from the point of view of lifelong learning.
In the most cases we have to distinguish between two different forms of learning: on the one hand learning in practice and on the other hand learning in school.
Learning in practice was studied by Jean Lave (Lave, 1988) and she developed in collaboration with Etienne Wenger the concept of 'situated learning' (Lave/Wenger, 1991). The basic idea is that the learner can participate on the working process by guidance of an experienced person. This participation is possible on the basis of a contract that legitimates the learner to a 'peripheral participation' on the working process. For interest it is important to analyse the structure of knowledge that is required in such a learning process. Vocational knowledge of an experienced person is often an repertoire of actions which can be seen as a unit and which belongs to a special task. Many of these actions are used in a form of routines. Such 'action units' contain a plan to organize the course of the actions, the use of different tools, the need of collaboration and so on. The organizing elements are vocational conditions and the special context. If mathematics is part of such an action unit it is integrated in actions which form the action unit and that means mathematics is part of an action course and also the tools used in these actions are part of the vocational process. The learner requires in the learning process not a system that is composed by different parts and the learner has to combine the different parts, she or he requires a unit that has to be used in a special situation. For the learner the mathematical part is often not visible because it is part of an action system that is realized by the use of special tools. This action and tool relationship leads on the one hand to an optimal integration in the vocational situation and prevents on the other hand a transfer to other situations. (For a deeper discussion of the problem (Evans, 1999)). For our problem we have to hold in mind vocational mathematics is context related, needs special tools to fulfil the required actions and is often hidden within the context and actions. 'Mathematical terms' get their meaning from their position within the vocational process and not from their position within a mathematical subject systematology.

School mathematics is based on criterions of mathematics and its systematology. To the position of mathematical terms and mathematical theories there exists more than 2000 years philosophical discussions that cannot be part of this paper. For our problem it is important that the process of mathematical development led to a theory system with terms which have a description by properties and in many cases we have no reference objects in the reality for this terms (Dörfler, 2002). Operations with these mathematical objects are based on their properties and are rule leaded. A consequence of this position of mathematical objects is they are 'context free' only controlled by their properties.
The development of mathematics as this context freeness has some consequences:

- Mathematics is a 'general language' for many different contexts. The correspondence of context and mathematics is a problem of the structure of the context.
- A mathematical formulation of a contextual problem is context free. The mathematical terms and signs get a contextual meaning only by an interpretation within a context.
- Operating with mathematical objects is operating within the mathematics and not within a context.

Summarizing these short reflections: Mathematics can be seen as a ‘general tool’. The same mathematical method can be used for many problems in very different contexts. The condition is only that they have to fulfil the same structural properties.
On the other hand mathematical methods cannot be part of a vocational action units. The use of mathematics requires structural reflections of a problem. Such reflections are not part of situated learning processes. Situated learning processes deal with a problem ‘as it is“ and are not reflecting the situation from a structural point of view.
The concept of lifelong learning is based on a society with quick changing qualification requirements. Qualifications which are acquired in situated learning processes are optimal adapted to a special vocational situation and therefore very useful in this situation but they are also very strong connected with this special context and a transformation to an other context is often very difficult or impossible. Therefore lifelong learning requires both general qualifications that are transferable and special qualifications for special vocational requirements.

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# The Psychology of Adults Relearning Mathematics

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## ABSTRACT

This paper reports on a pilot research project on the psychology of adults relearning mathematics. Research on mathematics education of adults relearning mathematics, is an issue of great importance because the requirements made on the mathematical curriculum of adults are very restricted. Its aims can be summarised as follows:

- To gain experience for myself in interviewing techniques.
- To devise a schedule for semi-structured interviews.
- To test the interview schedule on students.
- To revise and develop the schedule as required.
- To transcribe the interviews.
- To obtain views on the schedule from a number of ALM members and friends.
- To carry out some preliminary analysis using grounded theorising.

The report concludes that there is a great need to raise the low level of adult students' participation in mathematics education. This can be best achieved through maximising their potential by the development of effective teaching methods and learning strategies which will lead to skill acquisition.

## INTRODUCTION

The purpose of this pilot research paper is to report on a piece of mathematics education research, the psychology of adults relearning mathematics. Research on mathematics education of adults relearning mathematics, is an issue of great importance and its main aim is to raise the low-level of the adult student participation in mathematics education. At present mathematics occupies a marginal position within adult education whereas adult educators should be tackling this disadvantage just as rigorously as others, in order to equip older people to be more active citizens, a right which underpins the principles of democracy. Beliefs, attitudes, emotions and values are the categories of affect psychologically used in mathematics education research (Schlöglmann, 2002). The categories of affect in research on mathematics education are on the one hand a consequence of research methods and on the other hand motivated by observed phenomena.

Much can be gained when teachers not only are included but also are empowered to become researchers on their own (Watt et al 1991). Their activity represents a new genre of research that adds to our understanding of the teaching and learning process in mathematics classrooms. Proponents of research by teachers (Cochran-Smith et al 1993) argue that for substantial progress in improving classrooms to occur, teachers themselves must become researchers and take charge of the research process in their classrooms.

Teachers-as-researchers has its roots in action research. The linking of the terms "action" and "research" highlights the essential features of this pilot research paper, trying out ideas in practice as a means of increasing knowledge about and/or improving curricula, teaching and learning. It is characterized by spiralling cycles of problem identification, systematic data collection, reflection, analysis, data-driven action taken and problem redefinition.

## RESEARCH QUESTIONS

My review of the research literature led to a number of research questions:

- Why teach mathematics to adults?
- What are the economic and social benefits of adults learning mathematics?
- How should we as adult educators teach mathematics so as to support adults to function satisfactorily in their work and everyday lives?

In the body of the research study, other research questions will be addressed critically. This might lead to new insights into the research domain and it can also help to uncover further key questions which have not been addressed.

## RESEARCH STRATEGY

My concern for the pilot research report is with the learning and teaching of mathematics to adult students. If mathematics is presented in a non-threatening way, with adequate provision made for those older people who want to study the subject, it could lead to a much more numerate society with considerable benefits for industry. This can be best achieved through maximising their potential by the development of effective teaching methods and learning strategies.

As a part-time researcher intending to gain experience for myself in interviewing technique, there are at least two things of interest for me in this pilot research report. First, my main interest in mathematics education for adult returners has arisen out of my experience of being a mathematics teacher in inner city comprehensive schools in London for 18 years. In addition, I have also substantial professional experience as a lecturer teaching mathematics in adult continuing education for 12 years in a higher education institute.

I am responsible for the development of Mathematics in an adults continuing and community education access course, set up in 1986 at Goldsmiths College. Ten years on, it has been renamed "Mathematics Foundations Course". The course is designed to give those older people as well as young people without the conventional qualifications in this subject the opportunity to study mathematics for entry to higher mathematics education in the College's Department of Mathematical Sciences. There are many courses in which mathematics is taught at various levels - aiming at the acquisition of selected knowledge both at college and university levels for scientists and engineers, and the demand for such courses is increasing.

Second, the study will look at a group of adult students as well as young people from across a broad section of the population in London. The adult students and young people are returning to relearning mathematics with the hope of gaining access to read a BSc (Hons) degree course at Goldsmiths College Department of Mathematics and Computing Sciences in either Mathematical Studies, Mathematics and Statistics, Mathematics and Psychology, or

Mathematics Studies with Computer Science. There is no doubt whatsoever, that many adult students as well as young people (possibly the great majority of them) are apprehensive about mathematics education under the influence of the nature of teaching they have had in the past. Hence, I have been exploring the hypothesis that there is extensive evidence to show that if the initial reluctance and fear of mathematics learning can be overcome and an opportunity provided for adult students and young people with an interest in learning mathematics in ways appropriate to them in a more friendly environment, then a genuine sense of enthusiasm for achievement in mathematics education is possible.

The approach to teaching methods and learning mathematics developed by philosophers, sociologists and psychologists of education can change and open up many new avenues for the adult learner of mathematics, be they young and still in full-time education, or older people attending evening class or community college during the day. In the course of learning mathematics, there are varying types of mathematics tasks, seeking to cover a substantial range of the mathematics curriculum (Angiama, 1998), including the contrast between traditional arithmetic and mathematical investigation, which is fundamental both to the study of mathematics itself and also to an understanding of the ways in which mathematics can be used to solve problems in many fields (Cockcroft Report, 1982). In addition, group work is encouraged but the students first work individually to develop conjectures and then move into groups which should consist of two to three students, heterogeneously mixed in gender, ethnicity and ability.

Unlike many subjects, the study of mathematics requires the assistance of a qualified teacher. The lack of an experienced mathematics teacher teaching the subject at an early stage counts among the many factors discouraging many able and talented adults and young people from studying mathematics. Discussing with adult students their coursework on the mathematics access course and spending a two hour tutorial session with them enables me to assess their real competencies in mathematics and to plan the curriculum using appropriate contexts. The evidence drawn on here is that of Tout (1995), who describes using similar methods in teaching adults. Adult learners of mathematics need to be given the opportunity to study mathematics and encouragement to explore new horizons to seek out the next level of knowledge and to face the unknown. Given my overall interest in learning and teaching of mathematics to adult returners and young people, specific objectives for the pilot research will be the impact of different teaching methods on the academic success of students/teachers which has long been recognised, if not systematically studied. Most of the research workers in the field of education and psychology have been interested in the study of teacher effectiveness.

## METHODS OF RESEARCH

Having identified the broad focus of the study, its aim and specific objectives, I turn now to the research methodology which would assist me in my pilot study. From my reading of research literature, the central ideas of the 'qualitative' research paradigm make me realize that this approach would be useful for the pilot research. But what does my preference of the 'qualitative research' paradigm mean? It means for me what some call 'naturalistic' field research, what others call 'ethnographic', 'interpretivist', and 'constructivist'. The reason why I chose the 'qualitative research' methodology is investigations related to this paradigm are often connected with methods such as depth interviewing, participant observation and collection of relevant documents, which in turn can generate qualitative data, such as transcripts or texts. The pilot research is, therefore, exploratory in nature and will be undertaken using a variety of qualitative techniques .

I had recorded interviews with some of the adult students on the Mathematics Access Course to determine the needs of students and their views on different teaching approaches they had experienced. The information obtained from the interviews has been directly relevant to the content of the hypothesis. Our hypothesis about the possibilities of adults relearning mathematics is to be explored in the light of their own views (Angiama, 1998), and so why not ask them directly.

## ADVICE FROM COLLEAGUES

In preparing for the interviews with students, I consulted a number of (professional) colleagues about the proposed piece of mathematics education research on the psychology of adults relearning mathematics and the interview schedule. I incorporated their advice about the need for a course questionnaire. It is useful to have the views of participants of the Mathematics Course and it helps to improve the future direction of the course, including teacher effectiveness. Thus on a general note, all the colleagues I spoke to felt that the questions proposed for the study were appropriate.

## INTERVIEW TECHNIQUE AND ANALYSIS

I think the most useful outcome of the pilot research report for me was the experience of carrying out research interviews and listening to the tapes. However, it is not quite as simple as that of course, and the actual carrying out of research interviews has helped some of us as part-time researchers to see why.

The research methodology for the pilot study is qualitative (McKerman 1991), and my main research tool is the semi-structured interview based on subjects' own narrative accounts (Spradley 1979, Denzin 1978, Schatzman and Strauss,1973). I chose this technique because it will enable me to maintain points of comparison between subjects while engaging in in-depth open-ended conversations with students.

The interviews were done at the end of the first year with the new students on the Mathematics in Adult Continuing and Community Education Access Course. For practical reasons, I adopted a one-to-one student interview technique and all interviews were conducted on the university's premises in a lecture theatre. At the beginning of the interviews, I offered coffee or tea with Jacobs biscuits. I described my work to the interviewees, that I am in the process of doing research on exploring the psychology of adults relearning mathematics (PARLM). It is a new field of research between adult education and mathematics education. For purposes of ethical considerations I asked the student's agreement to record the interview. I also emphasised to the student that s/he did not have to answer any question if they did not want to.

## EXCERPTS FROM TRANSCRIPTS OF FAR'S INTERVIEW

"The only way to get better at it is to do more of it" (Ball, 1990, p.33).

R: What I would like to do Far in this interview (a copy of interview schedule was given to the student), is to give you some space first, to talk about the course and how would you rate the structure of the course?

Far: A well structured course which enables adults like us to re-enter into the study of mathematics I have always believed I would benefit from the course and I have. Not having studied mathematics for 13 years, the course has enabled me to relearn a number of vital skills, concepts and knowledge. I thoroughly enjoyed the entire course. The units on binary system, calculus and indices were a real bonus. I have in particular acquired a better

> knowledge of the laws of indices, standard forms and inequalities. Thus on the whole, the course has been very interesting and stimulating and well informed. The lecturer Mr R has been very helpful, kind, patient, caring, respectful, sensitive to students' needs, enthusiastic and encouraging. He has put a great deal of work into all the units and sessions he has taught. He raises students' self esteem and is determined they should succeed with his positive leadership. (Far, 1996-1997)

The programme of learning is presented to the learner. The learner, therefore, experiences a coherent programme of mathematics studies (questions 1-5). Most teaching includes the setting of assignments for students to do in their own time. These are usually intended to promote mathematical thinking and to practise skills and techniques but they can also be used for diagnostic purposes.

Effective teaching must take into account not only the ways in which we teach and students learn but also how well the tasks associated with the teaching/learning process are accomplished. This involves a recognition that effective teaching is a multi-faceted activity which demands more than superficial examination.

## EXCERPTS FROM TRANSCRIPTS OF DOP'S INTERVIEW

I began the 'life history' questions, then moved on to the other questions with Dop's interview.

R: Tell me a bit about yourself and the changing attitudes of mathematics education.

Dop: I was the only child of working class parents who both worked and I was looked after during the day by my deaf grandmother, so there was little chance of conversation. There were no books around the house as my parents had little chance to read. So I became used to spending time on my own with puzzles which I enjoyed. After leaving school without any mathematical qualifications, I tried evening classes, as I still had a desire to understand mathematics. However, these classes seemed to assume that all that was needed was revision, whereas what was needed was relearning of the whole subject. This is how I have become completely disillusioned with the mathematical and the education system. (Dop 1993)

Mathematics histories are replete with similar examples. An adult student can be so fearful of studying mathematics that even the thought of studying the subject makes him or her anxious (Buxton, 1981).

Clearly, Dop's interview has thrown up some unexpected and fascinating insights into adults' experiences and life history. Many adult students returning to study mathematics sometimes arrive at basic mathematics classes announcing that they cannot do any more mathematics because of fear and need to start from the beginning. Coben et al (1995), found that people tend to describe the mathematics they can do as 'common sense' and only what they cannot do as mathematics. At the same time, many other adults, whilst being able to perform mathematical calculations, felt inadequate because they were not using the proper methods (Hughes, 1986).

The interviews provide primary source material for an initial analysis of the data obtained in the pilot study, as recommended by Strauss et al (1990), as well as Ball (1991). This requires one to look at the transcripts very carefully, picking out concepts and then grouping these concepts into subgroups.

I think that we should be aware of the advantages and limitations of interview techniques. Eisenhart (1988), quoted by Jaworski (1994, p64) says of interviewing,

> 'Interviews are the ethnographer's principle means of learning about participants' subjective views; thus, ethnographic interviews are usually open-ended, cover a wide range of topics, and take some time to complete.'

At the same time, for this pilot study, some of us see the interviewing exercise as an important part of developing our skills in qualitative data analysis on a piece of education research and interpreting it critically. A critical approach must be thoughtful and thorough. Thus, it is in the nature of such qualitative research that any analysis at this stage is a pointer for future work. Interviews for the future will consist of more than two interviewees and the future interviews will be guided by this initial analysis, but the categories may well change significantly as the research progresses over the years.

In conclusion, qualitative research methodology has continued to gain acceptance in the adult mathematics education research community in recent years. The pilot research proved for me an effective test ground for the main project, accommodating very interesting information related to the research proposal. Research on the psychology of adults relearning mathematics is an issue of great importance because mathematics is a basic structure of our society.

The categories described above will no doubt inform the interviews but will also develop and change as new data is obtained and analysed. The questionnaire/interview schedule was appropriate and perhaps only minor changes could have been made. The interviews provide useful primary source material for the research, and the transcripts too have proved effective methods of data collection, and shall be used in the main project.

All in all, it seems reasonable to conclude first that raising the low level of the adult students' participation in mathematics education can be best achieved through maximising their potential by the development of effective teaching methods and learning strategies which will lead to skill acquisition. Second, Vygotsky's (1962) acknowledgement is echoed here. He acknowledges individual differences in mathematical achievement but suggests that the cognitive level of student response in mathematics is determined not by the 'ability' of the student but by the skill with which the teacher is able to engage the student in mathematical 'activity'. This implies a need for a pedagogy which relates to students' own goals and culture. Adult students labelled as mathematically less able can dramatically raise their levels of performance and participation when they become engaged in socially and culturally-related activities in mathematics education.

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**Art and Math**

**Eigil Peter Hansen**

**VUC Vest, Denmark**

Art and Math has been on the programme several times. This session shows new examples of using Art as an entrance to working with simple math problems. Art pieces "found" on the internet and from various Museums will be connected with math and examples on how to implement them in teaching adults at basic level are given.

Experiences from lessons in Denmark are given.

The focus will be on using Art in sessions with open problems, where the students take part in asking the questions trying to give space to the experience they have from other (not math/learning situations) part of their life.

Apart from the math we'll find in the actual picture we'll have a look at the many (math) possibilities we meet if we also think of framing, reducing, enlarging, mistakes etc.

Finally, if interest is shown for working with math teaching that way, we might make an agreement on working together across borders and via the internet exchange new ideas and experiences.

A promising programme it was. And all we had together was 45 minutes. But feel I made a good and involving presentation. Here are some of the things I shared with the group.

I gave two examples from Denmark where my class had been working with open math problems in Art and Architecture. You'll have the Architecture first, because it developed into a standard introduction to open exercises.

*Photo: Eigil Hansen, 2000 – Building in Prague*

*Colour version at www.eh-mat.dk/images/prague1.htm*

In the classroom a photo of a building in Prague was available in different sizes – 10×15cm, A4, A3 and A1. The students had the following text:

> Photo: A building in Prague
>
> Get some ideas as to what kind of investigations you can do in the photo – investigations where you use numbers and math.
>
> Ask questions. Questions you are able to answer immediately yourself or think you'll be able to answer after some calculating. Also questions you are uncertain you might be able to answer, but questions you find interesting or just want an answer for fun.
> Express your questions in a way so that other people can work with them.
>
> Make the necessary investigations. Measure where you need to. Make reasonable decisions where you cannot find another way / get the exact measurements. Use what you have found or decided and try to give answers to your questions.
>
> Pass your questions on to other students. Remember to offer your help if they need/want it. Discuss their answers.

Here are some of the opening considerations one student had:

> A gorgeous building, big awkward windows – so awkward they need a closer look.
>
> How big are they? Then what? Hmm.
>
> I will have to use approaches I already know and then I might just guesstimate some measurements. The entrance and ground floor? There are a few people at the entrance and windows of the ground floor and some cars.
>
> The people look quite normal so let me approximate the height of the windows of the entrance. Then I will try to use the measurements as a basis and thereafter find the rest of the measurements.
>
> I need…..

These opening considerations are now in other classes part of the introduction to the work with open exercises.

The next example is from Art. This time you'll have some of the questions one student asked, tried to answer, passed to other students and helped them, when the asked for hints or clarification.

*Photo: Eigil Hansen, 2001 – from the exhibition: Patterns – Between Objects and Arabesque, Brandts klædefabrik, Odense, Denmark*

*Colour version at www.eh-mat.dk/images/pg1.htm*

Work of Art: "Targets" made by the Danish artist Poul Gernes – actually he made a lot of them in different colours, and important for the use in connection with Math he made them with circles of different size. The photo is from an exhibition in Odense, Denmark, November 2001 and you see some of his "Targets". These are all 122×122 cm. He also made some in 244×244 cm. (The square patterns at the tables are "Make your own work of art" inspired from Ellsworth Kelly. See the internet links.)

And here comes the considerations and questions one of my student made when he met it as an open exercise.

> First I'll examine one of "Targets" made by Poul Gernes.
>
> I'll make the measurements I need and I'll make a copy in a scale so I can make it on my A4 paper.
>
> Which scale? I have to find out.
>
> What will the radii be in the circles on my copy? I'll have to know how to convert to my scale.
>
> When my copy is finished I'll make some calculations to see if there is a certain pattern. I'll investigate for patterns in area and in circumference.
>
> Then I want to make some of my own "Targets". The following rules will help me to design some special Math Targets:

1) The inner circle and all the circular rings will have the same area. For circular rings that cannot be complete because they have to fit in to the square shape it is their area as a completed ring that counts.

If I finish this Target I'll let other students examine it and challenge them to find "my rule".

If not I'll just suggest them my rule and invite them to make a Target.

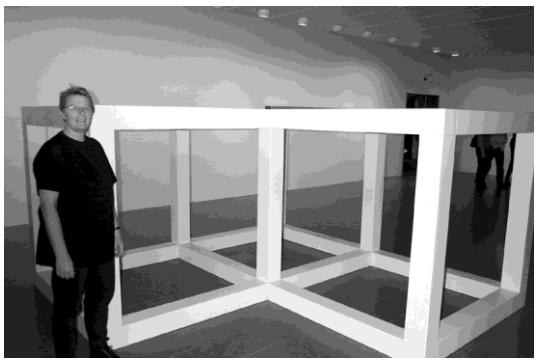
2) The area of the inner circle is x cm². The area of the next circular ring is 2x cm². The next again is 3 x cm² and so on.

If I finish it, I'll let other …., and if not I'll just suggest…..

3) The area of the inner circle is x cm². The area of the next circular ring is twice as much. The next is twice as much as the previous and so on.

If I finish it, I'll let other …., and if not I'll just suggest…..

At the session I showed some more examples and the group had time (5 minutes) to be in the students' situation. They worked in small groups, picked one or more work of arts and discussed which mathematical ideas the works could give you.



*Some of the photos I use as open exercises – all taken by Eigil Hansen 2001 and 2002*

Some of the work of art I brought was photos or copies from art books and because of copyright I cannot present them here. But here you have some literature and links to the Internet. Be sure you can find something there to inspire you.

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*Louisiana – The Collections and Buildings*

Eigil Peter Hansen: *Matematik i kunsten* (in Danish), isbn 87-16-11204-0

## On the Web

Search for pictures at www.google.com - choose pictures and if necessary advanced search where you have more opportunities.

http://members.tripod.com/vismath/mart.htm

good site with focus on math and art

http://artchive.com/ftp_site.htm

American site with links to a lot of artists and their art.

Look for Ellsworth Kelly or try www.artnet.com/magazine/features/cassidy/cassidy12-9-99.asp

http://www.louisiana.dk

Famous Danish museum

http://mathforum.org/~sarah/shapiro/

Geometry through art

http://www.walkerart.org

The Minneapolis Sculpture Garden – have a look at some of the works by Sol Lewitt

http://www.artnet.com

Search for artists and you'll get a lot of informations

Eigil Peter Hansen

Lundemosen 89

DK 2670 Greve

Denmark

e-mail: eh-mat@post4.tele.dk

web site: www.eh-mat.dk (might soon have an English section)

phone and fax: ++45 4361 1104

**Risks - Do the mathematical materials available to our students enable learning? How could we make them more effective?**

**Pat Healy**

**Lewisham College, UK**

The good old worksheet or chapter from a textbook! How do we choose what we use and recommend to our students? Invariably our choice reflects our individual learning style or simply because this is what is available. How well do the materials meet the learning style of our students in their aim to learn a particular skill?

In the first part of this workshop we will briefly explore different types of learning styles. In the second part of the workshop we will evaluate some resources and discuss criteria for selection and creating materials in relation to meeting students differing learning styles. Topics for the evaluation of resources will be a choice from: teaching multiplication tables, area and perimeter, Pythagoras' theorem and correlation and regression.

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# Workplace literacy and numeracy at Kappa Vandra Golfkarton, the Netherlands

**Ben Hermeler, Baronie College, Edujob, the Netherlands**

## Introduction

When we talk about workplace literacy and numeracy we mean knowledge and basic skills that can be used in a practical way, and are meaningful within the work setting.

We will describe a wide range of knowledge and basic skills; the functional language and mathematical skills of the Kappa Vandra Golfkarton employees at Oosterhout (the Netherlands).

Vandra is an industry that produces cardboard boxes for both the food and non-food sector. There are more than 250 employees, and about 180 of them are employed in the production itself. 20% of these employees have a non-Dutch background.

The company specialises in small orders with an advanced service package. The employees aim to offer a packaging solution with a focus on service, speed, reliability and advice. The result is a yearly production of 200 million custom-made packages.
Very fast delivery of small numbers of custom-made packages and a high level of service is a Kappa Vandra's speciality. This entails a daily production on a large amount of different orders and therefore a continual changeover among these production orders, in order to serve the clients adequately.

This paper will first outline the working programme at Vandra which will make clear what skills the employees need in the field of language and mathematics to be able to function in an adequate way. Then we will examine the activities of Edujob at Vandra's. Edujob is the department of the Baronie College that facilitates basic skills education at the workplace.

## General

At the Vandra company work is executed and divided into several sections:

the corrugated cardboard machine (the cardboard is actually produced here);

the section 'processing' (divided into several task units that make the boxes);

the section 'many-sided' (specialise in very small orders and additional attributes);

the expedition (they take care of the adequate transport of the product to the clients)

the section 'planning' (they produce the instructions on paper for the shop floor).

In the near future the communication of orders and production instructions will be done by computer. So far this has been done in writing.

316090/ 1 PRODUKTIE-OPDRACHT NUMMER 316090/ 1

Kontaktpers. intern : Voermans
Kontaktpers. klant : Venema
Ordernummer klant : AV3099156

This is a small part of such an order.

At Vandra's they work in shifts, from Monday to Saturday. There is a day shift, an evening shift and a night shift. The work at the machines is done by a team of three or four employees, consisting of production workers and machine operators. Production workers supply the machine with cardboard plates and pile up the boxes, the operator is responsible for the machine and the whole process around it. The production workers support this, but they are as responsible as the operator. The production workers also work independently from the production instructions.
The cornerstone of the success of Vandra is the way they work in self-supporting teams. The teams work independently and have their own area of responsibility, which allows a lot of freedom for new ideas as well as for personal development.

Vandra has a policy to put responsibility on the workers on the shop floor. To work in these so-called self-guided teams demands a lot of the language –, mathematical – and social skills of the workers.

Working for Vandra requires more skills in the fields of language and mathematics than those which are strictly necessary for the actual task. If one wishes to function competently within Vandra, then one should understand and act according to Vandra's vision. This is another competence than the mere ability to read a production order and its strict execution. The level of entry or key skills must be high as the production is organised in self-guided teams.

**Research**

Vandra invests a lot in the training and development of its personnel. Among others the company avails itself of the Baronie College. In 2000 Vandra commissioned the Baronie College as follows: "Examine the specific skills of language and mathematics that are required for the various functions on the floor. Then test the workers in these skills. Vandra then can school or train them more specifically when necessary"

Edujob provides four issues at Vandra's. We started assessing the competencies in the fields of language and mathematics of the functions on the floor. There are four key functions: production worker and senior production worker, (machine)operator and senior operator. Then we started developing a Vandra-test in order to be able to test the required basic skills for the employees mentioned above. At this moment workers are being tested and a number of them have started a training route during work. Edujob develops and gives maths and language courses tailored to individual, organisational and job-related needs.

**Working procedure**

During their work the investigators were enormously helped by a 'production-mentor', a previous head of department who had experienced the complete development from a near craft production of cardboard boxes up to the more automated production in the 'self-guided teams'. He knew all the ins and outs of the whole production process. Besides that he knew all the workers on the floor and, what's more, everybody knew him and addressed him to get information, discuss problems or inquire about the way things go at Vandra's. For the investigators, he was an important link with the shop floor. Again and again he knew the right people to approach for information about the activities within the various functions and which basic skills were needed.

We investigated situations in which maths and language had to be used at the workplace. These so called 'maths and linguistic usage situations' have been mapped out by interviewing different people from various sections and by observations during the production.

In that way there have been interviews with someone working in planning and with workers in the expedition, with operators and production workers, and with the production staff.

Besides that we went to the floor for observations and to analyse the daily work of the people. On the floor we saw people at work and had the opportunity to talk to them. In doing so it became clear what resources the workers use during their work (production orders on paper, package stickers, computer screens, production figures, calculators, spring-tape and such-like)

The researchers also saw the communication lines with others. Who sends the orders and in what form are they ? How the team communicates? And in what way is there communication at the end of the production order ?

**Examples of maths and linguistic usage situations.**

Every order is executed on the basis of a written production instruction. To work on the basis of a written instruction requires a lot of skills. We give some examples of that:

In the domain of **Dutch language** for example a worker has to be able to:

- Read and understand the following elements: the order-number, the name of the client, the ordered number, the block-number, the punch-number.
- Know the codes: A6, GKM, C6 Processing, F12 Expedition, 20* Bundle by 20 pieces.
- Understand the things that are filled in at 'special features'.
- Read the written instruction and know then: how many pallets there are to be ordered, how the boxes must be distributed on the pallet, the number of boxes on a pallet, if there have to be bundles or piles, what the size of the pallet is.
- Know what the main abbreviations mean on the production instruction.

In the domain of **maths** the following skills for example are required to function well:

- Can one imagine the size of the product on the basis of the notation LBH: L318 B57 H85 ?
- Can one estimate the number of stock-plates and compare them with the given planned number ?
- Can one calculate the number of boxes by the formula: pieces in a pack x packs by the layer x layers on the pallet ?
- Can one clever count quantities, for example 25 x 7 x 4 makes 7 x 100 ?
- Can one add up figures above 1000, for example 3 pallets with 1060 boxes and a rest-pallet with 540 boxes make together ……..
- Can one estimate if the number of produced boxes fits the planned number ?

**Tests**

On the basis of a description of the maths and linguistic usage situations we have made test-items. Then, these items are tested and calibrated and from this the tests are developed. There is a Vandra-test for language containing more components: a test on paper for reading and writing abilities and a (self)assessment-form to be filled in by the worker and the manager for the communication skills. There is also a Vandra-test for maths.
For applicants we have developed a test to assess the level of basic skills needed to function well within Vandra.

Examples of **test-questions**:
**Language:**
Reading:
24) What is A6 ? a. Cardboard machine b. processing c. Expedition
25) Who is the principal ? a. Bosboom b. Avort c. Peacock Garden
26) When do the boxes have to be delivered ? Fill in when the client wants to have the boxes.

Writing:
Complete this task: You have received 190 warped plates. You can't do anything with them. Fill in the Shredder-ticket the way you do this at work.

**Maths:**
For the production of boxes you need 16 000 plates.
On a full pallet there are 3600 plates
a. How many full pallets must there be in the waiting line ?
b. How many plates must there be on the rest-pallet ?

With the help of these tests it is possible to identify fairly accurately which parts require further training to function well in the work situation. An individual training course is developed for every worker who does not score high enough. The training sessions are run during company time. We expect to improvement in a short time as the training is tailored to the individual needs of each worker and his function in the work process. The teaching materials are derived directly from the maths and language used at Vandra. The following example is from the maths course.

*Task 50*

*Leo is cutting plates.*

*The stock-plates are going into the machine two by two.*

*Out of one stock-plate the machine cuts five plates.*

*The counter is on 42.*

*How many plates are cut at this counter figure ?*

*Make the calculation on the scribbling-block.*

In February 2002 we started a language course for six workers and a maths course for eight workers. The groups have a maximum of eight participants. Each time we work with a cycle of eight training sessions, after which an outflow of participants is expected (the ones who have achieved their level) and a new influx becomes possible.
We will inform you about these courses and their results at a later stage.

## From Adult Literacy Campaign to Basic Skills Provision: A Policy Analysis

**Mary Hamilton, Lancaster University, Yvonne Hillier, City University, Samantha Parsons, Institute of Education, London**

Would you like to put your experience of adult basic education (ABE) and English for Speakers of Other Languages (ESOL) on the record? Do you have documents, photographs or teaching materials that you have used in the past? Do you have accounts of student experiences and life histories? Would you like to share some of your experiences and memories of working in this field with others?

The 'Changing Faces' study started in October 2001 and aims to track policy initiatives in the UK stemming from the 1970 adult literacy campaign up to the launch last year of a new basic skills campaign, Skills for Life. The study is a collaboration between Lancaster University, City University and the Centre for Longitudinal Studies, Institute of Education, London, and is funded by the (UK) Economic and Social Research Council. The study is based in the UK, but we would be interested to hear too from anyone working on similar studies in other countries.

Our study aims to track policy initiatives stemming from the 1970s adult literacy campaign in England up to the launch last year of a new adult basic skills campaign as part of the National Literacy Strategy. Using documentary, longitudinal and quantitative data alongside oral history interviews it integrates the perspectives of three key stakeholder groups implicated in the field: decision-makers in a range of government and national agencies, practitioners engaged in teaching and organizing within ABE programmes and adults with basic skills needs. ABE is treated as a criterial case study of change in post-16 provision In England and Wales, and this experience will be situated in the context of parallel international developments.

The study is underpinned by a socio-cultural approach to literacy and numeracy which enables us to compare policy rationales and everyday practice both within and outside of educational settings. It makes use of the National Child Development Survey cohort to explore the relevance of ABE policy to the lives of people identified as having basic skills needs, many of whom who have not participated in formal education or training provision. This longitudinal study has been tracking the lives of every person born in a particular week in March 1958, a total of 17,000 people. As cohort members are now adults, there is a mass of information about their education, learning and use of basic skills, along with information about their health and lifestyles (Bynner and Parsons, 2000, Parsons, 2002). This enables us to investigate the interface between policy, educational practices and everyday practices in literacy and numeracy. Our policy analysis will be informed by theoretical perspectives which draw on post-structural analyses of educational policy; notions of organizational culture and change; the development of professional knowledge.

By bringing together the perspectives of the main stakeholder groups on basic skills policy, the study will be able to identify the key issues and mechanisms that have driven change in the field. By assessing the relevance of the policies to the changing context of basic skills in everyday life, it will contribute to the effectiveness of future policy and practice in ABE.

We have an advisory group that comprises people with a range of perspectives from the policy, research and practitioner communities. This is not a formal steering committee but a working group that acts as a 'sounding board' for our project throughout the process, as we design the methodology, carry out the data collection and analysis, and devise an effective dissemination strategy. We have members who have a good knowledge of both policy and practice in adult basic skills, and who are also sympathetic to the kind of mixed method, collaborative research strategies we intend to employ.

The first stage of the project involved sending a questionnaire survey to providers, inviting them to contribute their experiences and to help us identify key moments, people and organizations that we should include in the project.

We have developed an interactive website http://www.lancs.ac.uk/depts/edres/changingfaces which provides a forum for discussion and a place where people can contribute their experiences of ABE, even if we are unable to interview them face-to-face. We are working collaboratively through groups as well as individuals to find new and enjoyable ways that people can document the history of ABE together.

One method of working with groups is to ask participants to think of key events from their own experiences of teaching adult basic numeracy. Each moment is captured on a yellow ‘sticky’ and placed on flipchart paper for the appropriate five year period within the 3 decades from 1970 – 2000. This stimulates much discussion amongst participants, and helps to clarify ‘fuzzy memories’. It also helps us trace the developments of numeracy which we can compare with overall policy initiatives in literacy, numeracy and ESOL. This method, employed at the ALM conference, has provided an important contribution to the Changing Faces project.

We will communicate the progress of the research through the website and consultations. We will also organize events towards the end of the project to publicise our findings. Throughout the project, team members will be available to talk to groups and individuals who want to get involved or simply want to know more about what we are doing.

For further details please contact: Mary Hamilton, Lancaster University
m.hamilton@lancaster.ac.uk or Yvonne Hillier, City University, y.g.j.hillier@city.ac.uk

ESRC Ref No: R000239387 Oct 2001- March 2004

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## Modelling Workshop: Which is my Favorite Phone Tariff?

**Juergen Maasz and Wolfgang Schlöglmann, Linz**

This was the announcement of our workshop at the ALM 9 conference in Uxbridge in the year 2002: "Many people use phones. Many companies offer different payment systems: Most of these tariffs are linear functions from a mathematical point of view. One step to answer the question "Which is the best offer?" is to plot these functions and to compare them. Another step is more important: What are my ideas to use the phone? Do I want to phone some minutes per week or some hours per day?

Our workshop has two parts: Firstly we work as a course to find models for some different users and offers. Then we will discuss about our experiences in this simulation of a course and the possibilities to transfer it into our practice as teachers."

Our plan for this workshop has some **background ideas** that we want to summarize before we report some results of the workshop.

1. In many countries in the world governmental services are privatised: Transport, energy support, electronic communication and media are now offered by several companies. People have the chance to select between different offers of taking a bus, a railroad, transporting a mail, paying for telephone and mobile phone, buying electric energy or oil or gas for heating and so on. Whether we like the privatizing trend or not: This trend opens a chance to save money if people find out the best offer for them. But: What is the best offer for a person? The answer depends on the structure of the scale of charges and on the individual needs. Mathematics is very useful to analyse and to understand the structure of tariff offers. This process of understanding leads to many questions about the intended individual use of the offered services. Answering these questions helps to find out what are the individual needs “really”. Therefore mathematics is helpful to save money and to act more rational using this services.
2. If this view on the situation is correct (we think so) it is useful to talk about scale of charges structures in mathematics courses for adults for at least two reasons: It is helpful for them (for all consumers) to know more about that for their daily live and is helpful for them to have the experience that learning mathematics and using it to understand the world has really a practical use.
3. The practical use of mathematics is a magic word in many mathematics courses for adults. At school many of them learn a lot of mathematics as a “theory”, a long list of mathematical (and this means: abstract) algorithms were learned step by step (sometimes it seems: only) for the next test. With this history of learning mathematics in their mind many adults do not like to learn mathematics. They often ask: “What is the practical use of the mathematics we should learn now?” Sometimes this question is a sign for a general dissatisfaction. “Practical use” is sometimes a metaphor for “easier to understand” or “please not so difficult”. We as mathematicians know that more abstract concepts are often easier to understand but this is what we have to teach before it is understood by everyone.

These three points are concentrated on the content: They are keywords for reasons why we think that the type of content we wanted to offer in the workshop is as an example for teaching mathematics with practical use. The next points shows our **didactical intention** realised in the way we presented it in the workshop.

1. At conferences a lot of people want to present their work of years in a few minutes. This often leads to the result that the presentation is reduced to a short information about the content: what could be taught or has been done. Presentations about teaching are often reduced to explanations about the content that has been taught. We wanted to give a chance to discuss the methods of teaching. We know that there are presentations about such methods but if someone is talking about methods it often tends to be theoretical (for example research results about the psychological effects of learning in groups or of listening to presentations). Sometimes research to compare different methods is done and reported. This all is very important, but we think that it is not enough.
2. Our question was: How is it possible to talk about the practice of teaching? One idea is showing a video or a transcript (a written document of a classroom situation). One other way happened in our workshop: a simulation of teaching was used as common basic experience. We initiated a simulation of a course with adults learning mathematics with us as teachers and the participants of the workshop at the conference as learning adults.

**Report about the workshop:**

Preparing the simulation we found a lot of information about telephone scales of charges in Austria in the internet. The internet part of an Austrian newspaper gave an overview with a long list of companies offering the telephone service. We do not want to show here the long list (a printout of internet pages) that we gave the participants in the workshop. It had a structure like this:

| | Region | Austria | International | Online | Additional information |
|---|---|---|---|---|---|
| Company A: | 5,01/2,4 | 5,01/2,4 | 18,17 | 2,54/1,31 | … |
| Company B: | 4,6/2,1 | 4,6/2,1 | 7,2 | no | |
| Company C: | 5,0/2,0 | 6,0/2,5 | 10,7 | 2,04 | |

There are about 20 telephone companies within this list and some of them have up to 5 scales of charge offers for special groups of customers like business or - one the other end of the spectrum - for people who seldom use their phone. To understand this information a little explanation is useful: Company A offers to connect a customer to someone in his region (for example 50 km around his home) or in Austria for 5,01 Cents per minute at daytime and for 2,4 Cents per minute at night. Company C makes a difference between region or Austria. Some companies offer a service as internet provider and some not. Special offers are for example a cheap tariff for connections to the USA or Arabia. Some companies have a basic connection charge (for example 15 Euro per month) and some not. Other additional

information says something about additional offers like a (free or paid) list of phone calls made in the last months and their costs.

We started the workshop with a short introduction in our planning and the background for the workshop as written at the beginning of this text. Then we gave some information about the role which they and we should play: The course we simulate has learned a lot about linear functions, graphs of linear function, solving systems of two linear equations (numerically and graphically) in the weeks before this lesson. This gave the mathematical frame of what is needed to work in this simulated lesson. We did not explain the mathematics (linear functions and equations,...) because we were sure that the participants in the workshop know enough about the mathematical background to enjoy the workshop.

To start the course we asked the participants to go into subgroups of 3 or 4 members and work on the following task written on a paper that we gave to the groups:

***Please help!***

*My neighbour has got a new job in Austria. He is working as a commercial representative for his company. At his new home he needs a phone with an answering machine to be reachable at any time.*

*Looking for the best (cheapest) telephone company in Austria he found a lot of information. But he has no time to analyse it. Could you please help him? Please have a look at the attached information from the internet and work out an overview (use graphics).*

We distributed the information from the internet about the offers of the telephone companies. The groups started to read it and asked some questions. We (as teachers) helped them to understand the texts. Some of the additional information had to be translated and explained.

The groups started to understand the information. Some groups decided to work with the first aim to reach more detailed assumptions about the person (neighbour) who wants help. They "modelled" this person with assumptions like this: He will phone a lot in Austria (business for his company). He will often phone home to GB (family and friends). He will seldom phone in his region - he is a stranger there. From this more detailed description of the person it is easier to select an offer of a company.

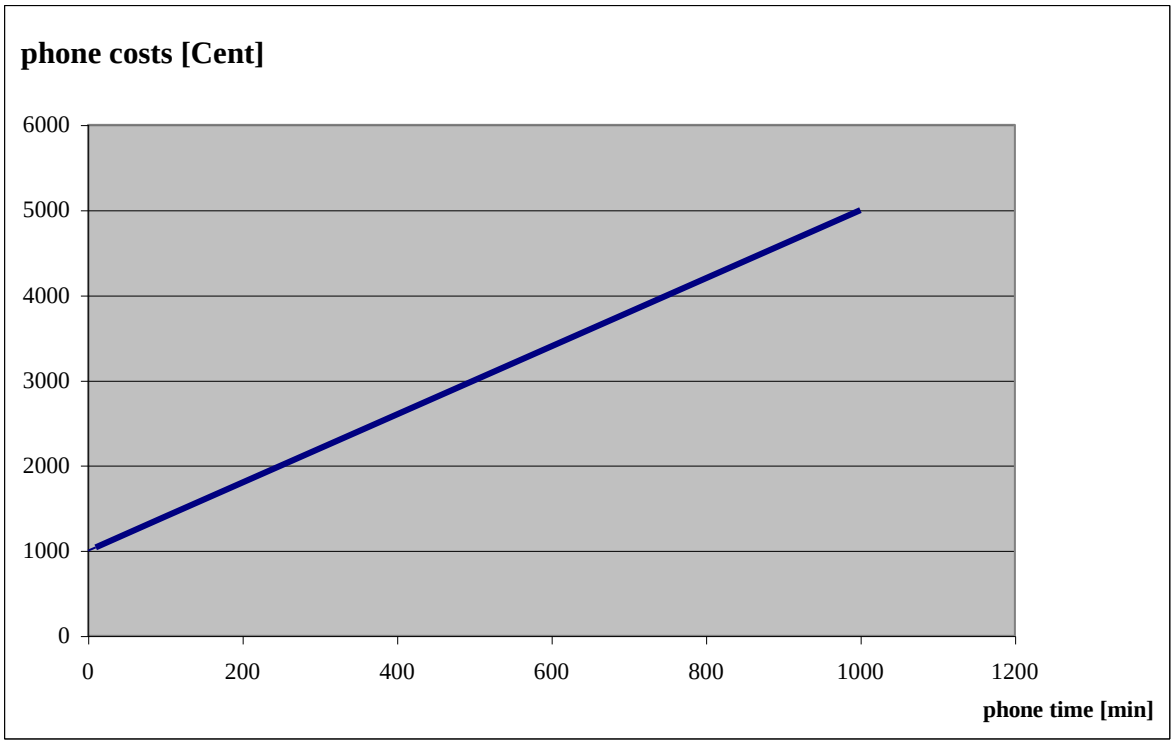
Some other groups started to sort out high price offers and in this way they reduced the number of offers they want to analyse. After finishing this sorting out they started to look closer at the information about three companies. They intended to graph the linear functions and calculate the intersection points.

We did not have enough time to bring the results together. After about 45 minutes working in subgroups we finished the course simulation and started a reflection phase.

**Results and Reflections**

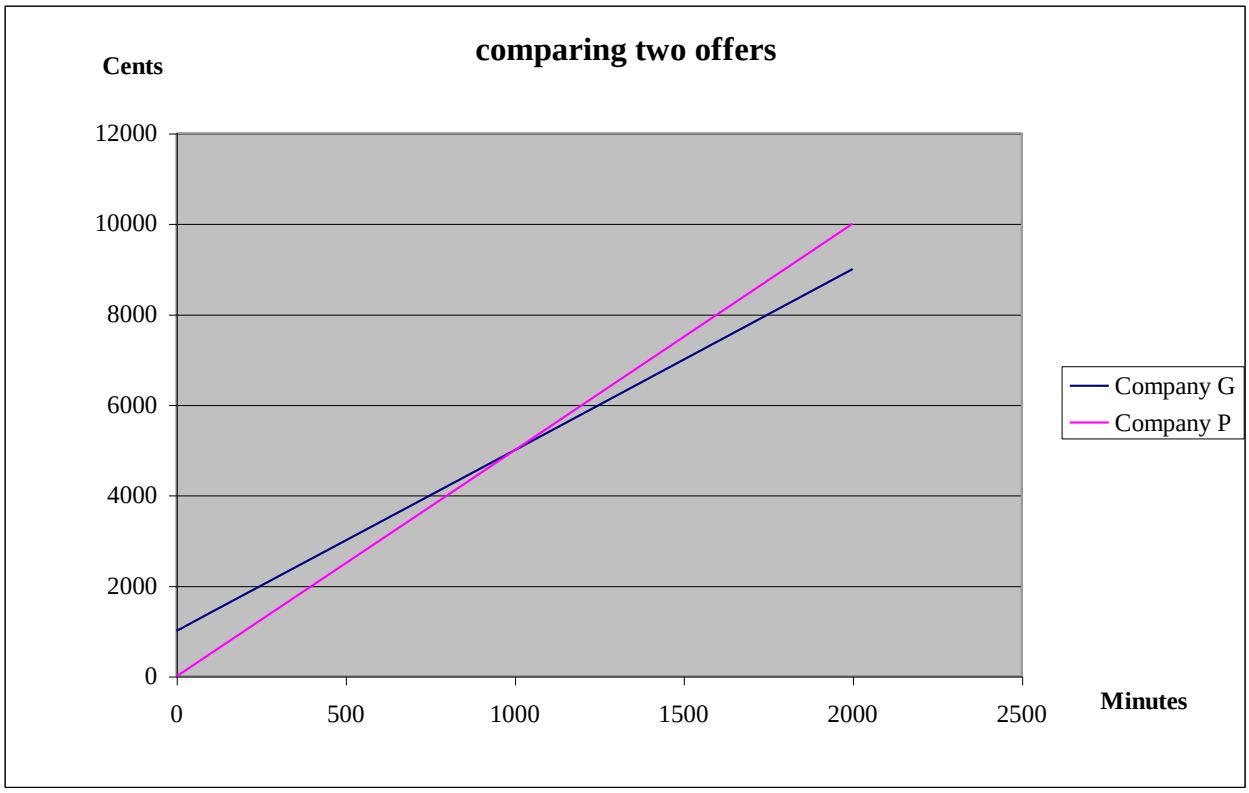
The first feedback of all participants was positive: They liked to be students and to work in subgroups. But before the participants agreed to debate in more detail about the method we simulated they wanted to know "the solution": What is the best tariff? How should we present our solution to the neighbour?

We presented this simplified way to graph two different offers as examples and as a starting point for more complex graphs. Company G offers a basic charge of 10 Euros per month and costs of 4 Cents per minute at daytime for phoning in Austria (and the region). This is the graph 1:




Graph 1: First draft

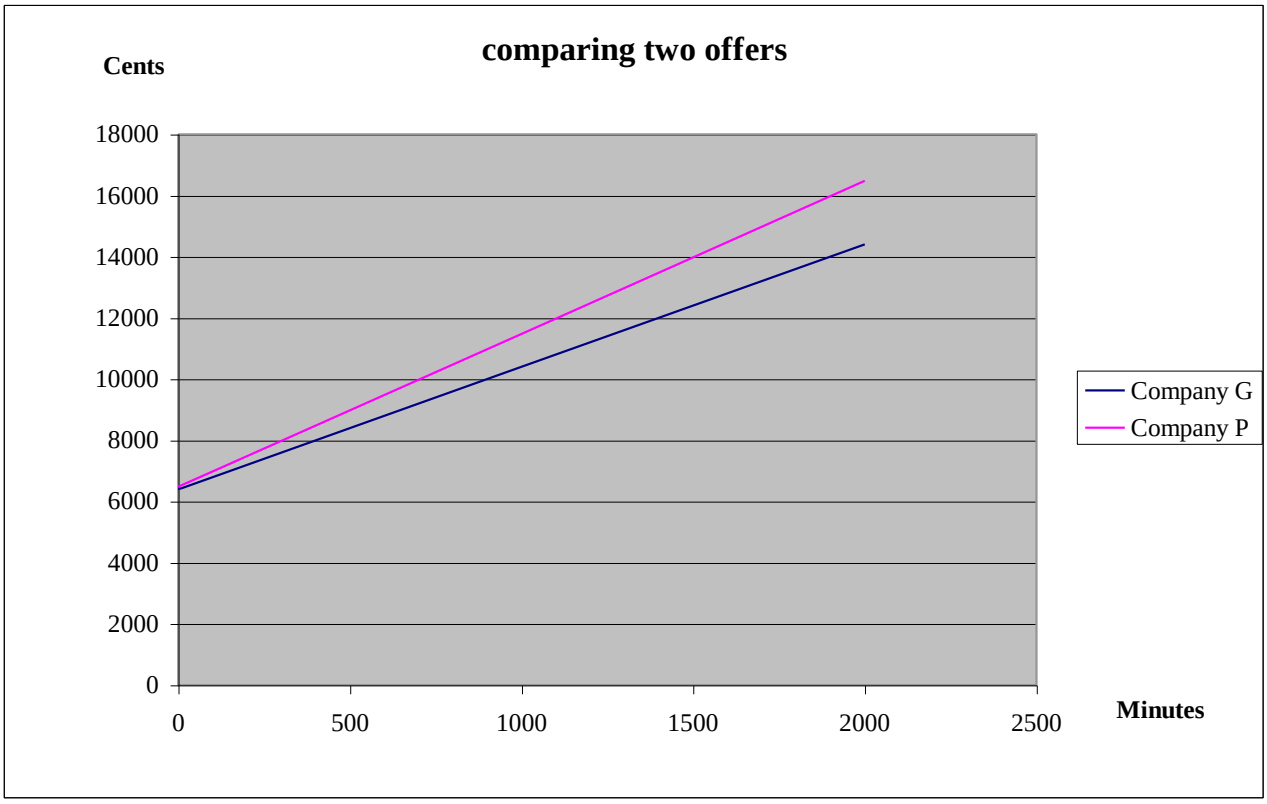
Company P offers costs of 5 Cents per minute at daytime for phoning in Austria (and the region) and no basic charge. We add this offer to the first graph and get graph 2:




Graph 2: Comparing two companies

If the neighbour is phoning less than 1000 minutes (16 h 40 min) he should select company P and if is phoning more than 1000 minutes company G is the better offer for him.

Perhaps the neighbour would not accept this help: "I will phone home to GB about one hour a week! Will this influence my decision?" Yes! We must look at the tariffs for phoning to GB. Company G offers 15 Cent per minute and company P 18 Cents per minute. We calculate the effect: 1 hour a week is 4 hours a month. The costs are 5400 Cents per month (company G) and 6480 Cents (company P). Let us graph it!




Graph 3: Comparing two companies

The result is clear: Company G should be selected (the neighbour will phone more than some minutes).

Other additional information may change the result in a similar way: We have to calculate the resulting costs (or the reduction of costs) and change the graph. We do not show the solution of the linear equation system here - it is easy for the readers of this text.

**Discussion about the method (working in subgroups)**

The participants of the workshop had the feeling that the given task was too difficult to be solved in 45 minutes time. This is a real life problem with very complex concrete information, many offers, many conditions for special groups of users etc. But they had the experience that this is a typical situation for real life problems. Some of such problems are much more complex and difficult to understand for us. But if we want to teach mathematics for adults not only in an abstract way it is necessary to work with such examples. The motivation to understand them is very high. An additional effect often seen in such learning situations is that in this case the motivation is very high and it seems to be very easy for learners to understand the mathematics they need.

A hint for all teachers who want to use this idea for their course is that it seems to be a good idea to prepare this part of the course by cutting the whole question into several steps, as shown with the graphs in this text. It is an important task for the method of solving real world problems to cut down complexity in a first step, solve a simple part of problem and reintroduce the real complexity step by step. Working in subgroups in parallel, with the same task, or in a working cooperation with different tasks, is a good method to handle real world problems in the classroom.

# Numeracy, Communication and Power

**Kate Newman**
**ActionAid**

## Abstract

*Reflect* is an approach that emphasises the importance of sustained reflection and action for learning and social change, currently being used by over 350 organisations in more than 60 countries. The roots of *Reflect* include the theories of the Brazilian educator Paulo Freire, and participatory methodologies. Central to *Reflect* is the belief that people's capacity to communicate depends as much on understanding and ability to deal with power relations as it does on technical skill. Thus, by focusing on communication and power *Reflect* aims to improve the meaningful participation of people in decisions that affect their lives.

Mathematics is crucially important in strengthening people's capacity to communicate. Whether in oral or written form numbers affect everyone – especially in relation to money. The workshop at ALM9 enabled participants to work through some of the new resource materials developed for *Reflect* practitioners, thinking through how the resources might be applicable to their work contexts.

## Introduction

This article briefly outlines the main principles and techniques used in the *Reflect* approach. It then considers numeracy in *Reflect*, highlighting the key elements. This is followed by extracts from the resource material, 'Communication and Power' discussed in the workshop, and brief conclusions reached by the participants.

## What is *Reflect*?

*Reflect* is an innovative approach to adult learning and social change, conceived by ActionAid and piloted in El Salvador, Bangladesh and Uganda in 1993-95 It fuses the theory of Paulo Freire[1] with the methodologies of participatory rural appraisal[2].

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[1] **Freire, a Brazilian educator**, was one of the most influential philosophers of his generation. He believed in the power of education – which could be liberatory, or could be used to oppress – but is never neutral. (see, for example: Pedagogy of the Oppressed, 1972, Penguin, London)

[2] **Participatory Rural Appraisal:** PRA is a family of approaches and techniques that were originally developed so that development professionals could have a better understanding of the reality of the poor, and their own priorities for action. The best-known method of involving all members of the community is through participatory visualisation techniques: the construction of maps and matrices on the ground, and the subsequent agreement about the findings and their implications for development activities as well as the structural causes of poverty. Although PRA is often used to 'extract' information from target groups, *Reflect* emphasises the need for this information to remain in the control of the group. Another criticism of PRA is that it treats the community as an homogenous unit – over the last few years *Reflect* has begun to realise the complexities of power relationships in both the public and private spheres, and has adapted many of the tools to work with these issues. See the Reflect materials, or contact the Participation Group at the Institute of Development Studies, Sussex University, UK, for more information on PRA.

Key to the *Reflect* approach is creating a space where people feel comfortable to meet and discuss issues relevant to them and their lives. The meeting and discussions serve a dual purpose – not only does this personal and group analysis form the basis for learning and action, but people also have the opportunity to share their opinions with others – to practise communicating in different ways.

Abolishing the need for a text book, the approach enables groups to develop their own learning materials by constructing maps, calendars, matrices, diagrams or using forms of drama, story-telling and songs, which can capture social, economic, cultural and political issues from their own environment. In this process the development of literacy and other communication skills becomes closely linked to the engagement of people in wider processes of development and social change. This enables *Reflect* participants to recognise, value and strengthen the skills that they already possess. However, this does not mean local knowledge is romanticised: through this process participants may identify additional skills/knowledge that they wish to acquire.

A Reflection-action cycle is developed where participants analyse their reality, identify what they would like to change, plan how they will go about it, act – and then reflect on what they have achieved.

In the same way *Reflect* practitioners reflect and act – which means that *Reflect* is continually evolving, and innovation keeps the approach alive. Since its conception *Reflect* has been continually adapted, drawing on practitioners' experiences and insights from other research. This has resulted in the development of new materials entitled *'Communication and Power'*.

***Communication and Power***

The basis of these materials is the understanding that no communication is neutral – the capacity to communicate and be heard is determined by power relationships that need to be analysed. By linking communication and power *Reflect* focuses beyond the technical aspects of communication and considers the various factors which influence our ability to get our voice heard. Being unable to communicate is both a cause and effect of inequitable power relationships.

The pack has been created with contributions from *Reflect* practitioners in 30 countries and aims to cover different elements of communication. For ease of reference it is divided into 6 sections: Getting Started (an outline of the key aspects to consider if planning to work with *Reflect*), Written Word (ideas for working with literacy at different levels), the Spoken Word (ways of strengthening people's oral communication), Images (use of posters, photos, television, body language etc.), numbers (explained in detail below) and examples from practice (case studies of different *Reflect* experiences). However, rather than focusing on one section, it is hoped that people will work across the categories, exploring how different forms of communication are inter-connected.

Each section is made up of A4 sheets which give a brief description of the focus of the sheet, and explain why you would want to work with the topic, when to do so and how, with examples from practice and any additional information.

**Aim of the workshop**
Most of the numeracy experiences included in the resource pack have been drawn from the experiences of practitioners based in developing countries, involved in a wide range of development programmes, of which numeracy only plays a very small part. I was interested to share these materials with practitioners from the numeracy field - to find out what they thought about our materials. I was particularly concerned to see whether the ideas contained in the resource pack appealed to those involved in Adult Learning Mathematics and what sort of adaptations they thought would need to be made.
Thus I introduced the ideas and principles behind numeracy in *Reflect* and then asked the participants to look through the materials, and pick one sheet, thinking through how they might use the ideas contained on that sheet in their particular context.

**Numeracy in *Reflect***
Numeracy in *Reflect* draws on ideas and understandings developed in the fields of ethno and critical mathematics. The focus is on **discovering and using prior knowledge**, linking this to the idea of **critical mathematics.**

Numeracy is understood broadly, as being about solving problems, analysing issues and expressing information clearly and concisely (spanning written, oral and mental forms). The visual representations, and the idea of graphic construction in *Reflect* are intrinsically mathematical. Further, many of the graphics, such as matrices, pie charts and bar charts (calendars) use mathematics explicitly in the analysis.

**Why numeracy?** Mathematics is extremely important in strengthening people's capacity to communicate and has a crucial role to play in challenging power inequities. Numbers affect everyone. The most obvious and powerful use of numbers is in relation to money. This affects every individual both directly (for instance, in relation to the price that we secure for our labour or produce, or the price of basic goods and services we rely on) and indirectly (for example, through budgetary decision making, concerning both income and expenditure, at international, national and local levels). Moreover, numbers in the form of statistics used by different agencies for planning also have a huge, but often unrecognised, influence on people's lives.

**What does numeracy involve?** Work with numeracy in *Reflect* includes a critical reading of existing 'texts' and the active construction of alternatives. Much of the work includes challenging traditional understandings of mathematics, highlighting and strengthening the mathematical skills that participants already have. Another focus is on using these skills within a process of analysis, challenging the power of written mathematical texts and constructing alternatives.

**Key Principles:** The starting point is to demystify mathematics and analyse the links between the uses of numeracy and the practice of power.

***…maths in context***: Numeracy must only be introduced in context. It should not be taught mechanically, but focus on real use. Work with numbers should only take place if it is relevant to the particular topic being discussed. Calculations should be used to solve real problems and contribute to a process of analysis.

***…previous knowledge***: Participants should be supported in discovering, using and strengthening the mathematical skills that they already possess. This implies working with oral/mental mathematics. The problems encountered by adults joining a learning process are often due to formal written processes clashing with the mental way of calculating. Conversely, using participants' prior skills helps in confidence building. The participants recognise their own power and knowledge, while simultaneously enhancing their skills and understanding.

***…written mathematics*:** This does not mean that we believe mathematics should never be written down. Participants should be able to read and write numbers. It is also important to be realistic and analyse the power of written mathematics. It is only through taking part in this analysis that participants will be able to make informed decisions about what mathematical knowledge they need. When written down mental processes look cumbersome. However, if participants have a record of their workings, and can see the complexity of what they are doing, it is likely to increase their self-confidence. Moreover, the written process can be used to show how the same mathematical processes are employed in different contexts. This understanding is crucial if people are to use mathematics to expand their opportunities.

***…calculators*:** Where appropriate *Reflect* practitioners are encouraged to use calculators. These can be used to demystify the mathematics, so that participants can focus on the issue at hand. Further it is a way of checking mental calculations, and of illustrating how the same mathematics can be used in different situations.

***…micro-macro links*:** A common problem with participatory tools is that they can lock people into a micro-level, local analysis, isolated from the wider context and missing the links between the local, national and international situation. Much of the work with numeracy in *Reflect* aim to provide a bridge, enabling people to place their reality in a wider context.

***…external information*:** Further information is often necessary to make the micro-macro links. This gives rise to two issues. *Firstly*, who decides when it is appropriate to introduce external documents and how can this be done without corrupting a process which is controlled by the learners themselves? *Secondly*, how and where is this information best accessed?

There are no simple answers to either of these points. However, it is important that participants take part in these discussions. To ease problems of access, the implementing organisation can play a role in linking with other organisations, libraries and Internet centres. Further, these organisations may wish to present the information in a user-friendly format.

**Working with numeracy:** Although work with numeracy will have different aims and focuses at different times one way to sequence the work is the following:

- **Participants develop a graphic** (using numeracy, either in the construction or analysis – integrated into the discussion and analysis rather than seen as a separate process).
- **An external text** (with a numeracy element) on the same broad theme is introduced and critically read.
- Participants place their previous **local analysis in wider context**
- Participants identify ways in which **numerical communication** may contribute to wider action to **advance their interests**.

**Limitations/Assumptions:** It is assumed that all participants have some level of interaction with a market economy, and that the national currency is based on a decimal system. In addition, we suppose that the participants will have devised their own mathematical systems for working within this market economy, and that there exists a developed counting system in their local language (i.e. that things can be grouped specifically according to number, and that a number sequence exists - more than just one, two, many...).

**The workshop**

After outlining the principles behind numeracy in *Reflect* I asked the group to divide in two and do the following

- Glance through the numeracy sheets and choose one which they thought looked interesting.
- Read through the sheet and discuss:

  *i. Whether they agreed with the ideas?*

  *ii. Whether there was anything particularly interesting or controversial contained in the sheets?*

  *iii. How they thought the sheet would work in practice? – is it realistic?*

  *iv. How they would adapt it to their context?*

  *v. What they would add to the sheet?*

  *vi .Any other comments*

One group chose to look at a sheet which outlined ways of 'Building on existing knowledge' and the other examined 'Credit, Loans and Interest Rates'.

Below are some extracts from the sheets discussed.

**Building on Existing Knowledge**

Even where people have strong numeracy skills these may have been developed in a specific context, and may need to be 'generalised' in order to be able to apply them to new situations.

*1.1.1 Choosing examples*

The first step in this process is to choose an example where participants use mathematics in their everyday life. For this different graphics, such as daily routine charts or community maps, could be used.

Participants should outline the steps they follow to make calculations in this specific context and then follow the same process in the new situation. Links between the two contexts should be continually highlighted.

The key to introducing an abstract mathematical formula is to tie it in to something concrete from the participants' life experience. This involves applying problem solving strategies that people have developed from experience to new, different contexts. Through enabling them to see that the same techniques are applicable in a variety of situations - from farming, to cooking to understanding interest rates - their existing mathematical knowledge will be strengthened and generalised. This flexibility in understanding can be hard to achieve – and it is crucial that the individual discovers links for her/himself.

***Example from Practice:*** Participants in a *Reflect* group in Koffiefontein, South Africa, are involved in a small bread-making business. By generalising this experience the group were able to calculate the amount of money spent per child in school.

**The mathematical formula is as follows**:

Total Cost/ Total no. loaves = individual loaf cost

***Or***

*Total school budget/ no. of pupils = amount spent per pupil*

First participants talked through the steps they go through to calculate the cost of each loaf they produce. They used photocopied money (counting out the cost of each ingredient and then counting out all the money to reach the total cost) to find the production cost of a batch of bread. By sharing the money equally between the number of loaves they arrived at a cost per loaf. Participants then generalised this experience to calculate the amount spent on each child in their local school – the total budget divided by the number of pupils.

**Credits and Loans**

Many people live on borrowed money. Patterns of credit and debt are similar worldwide – both for individuals and at national or governmental level. A discussion of these issues should enable participants to make links between their local situation and wider debt issues – to engage in more complex debates about the structural causes of poverty, and the relationships between money and power. The questions in the adjacent box could be asked when discussing credits and loans.

- ? **Why** do we borrow money?
- ? **How** do we feel when we borrow money?
- ? Are there **certain times** of year when we need to borrow money? Why is this?
- ? What **different ways** are there to **access** money locally? Who can you borrow money from? What are the **dis/ advantages** of different sources?
- ? How does the money **repayment** work? How **often** do we need to make repayments? How and when is the **interest** calculated?
- ? What **happens** if you are **not able** to make the repayment?
- ? What **influences** the rates of interest – how are the interest rates decided, and by whom?
- ? What do we feel should **change** about the system? What **can we do** to achieve this?

***Example from Practice*:** In Kanatalabanda community, India, participants in a Gotti constructed a graphic to analyse why they borrowed money, and from whom. They discussed how the different money lenders operated and the rates of interest they demanded, the power the money lenders had over them, and how they were made to feel when borrowing money.

Participants found that the moneylender was their main source of money, and used his power to humiliate them, making them wait all day before he would lend them money. The lender would also insist that the borrowers planted cash crops from which he could make money rather than traditional crops, creating further food security problems. The lender would then insist on collecting seeds to cover the interest of the loan, reinforcing his power over the borrowers as they were pushed further into debt. Following the analysis the group decided that they would refuse to use seeds to pay back the interest, and instead would start repaying the capital immediately. They also decided against borrowing from the moneylender in the future and began exploring alternative avenues with more favourable rates of interest.

**Conclusion**

A forty-five minutes workshop was not enough time to explore in detail the issues on the sheets, or think through how they could be adapted. However, it was interesting to see that our ideas did resonate with participants and that materials developed in Africa, Asia and Latin America did have a relevance in diverse European, and more formal adult learning contexts. There appears to be greater convergence between development projects and adult learning classes than I originally expected.

For example, the group which looked at issues around credit, loans and interest rates highlighted how it was not only the interest rates and repayment schedules which are important when considering which loan to take out. Questions of access are important, as is

the reputation of the person/organisation providing the loan. Issues of flexibility, small print and ethical basis of the organisation might also be considered. These issues are applicable whether based in an industrialised western city or a rural context in a developing country.

It was also clear that adults, wherever they are based, develop their own strategies for dealing with everyday mathematical problems they encounter. And if these skills are recognised, valued and built on this can be extremely empowering. The recognition that there are a wide range of methods which can be used to solve mathematical questions can, however, give rise to difficulties when considering mathematics learning in more formal situations, especially if there is pressure on the participants (students) to achieve a particular accreditation – or if the facilitators (tutors, teachers) lack confidence in their own mathematical ability and hold a narrow definition of numeracy. This pattern is replicated around the world and although there are various strategies that have been developed to overcome these issues it could be that there is further development needed in this area.

The *Reflect* approach is a powerful way of enabling numeracy learners to engage with wider issues, to expand their focus and understand how numeracy can be used within a change process. I hope that there are more opportunities to explore how *Reflect* can be adapted and integrated with more formal processes of learning.

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*Reflect* website: www.reflect-action.org

**Thinking and writing about maths activities: a student's perspective.**

**Caz Randall**
**Lewisham College, UK**

Adults returning to study often have anxieties about the mathematics that will be required of them.

During the last two or three years, I have tried to do something about this by producing materials for a "study skills for mathematics" course.

The students carry out a number of activities; some tightly focused on particular study skills, but mostly loose, open-ended mathematics problems. As part of their assessment portfolio, they must keep a diary of their thoughts and feelings about the maths.

The diaries make very interesting reading, and the poster consists of extracts from one student diary, along with the resources that were used for the activities she mentions.

## **Reference**:

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# Sharing IT experiences in the delivery and support for numeracy practitioners

**Valerie Seabright**
**Uxbridge College, UK**

This workshop was arranged as a result of discussions at an ALM London members' meeting which raised issues concerning the external pressures to increase and improve the use of ICT in the delivery of vocational, academic and basic skills programmes in further education and basic adult education in the United Kingdom.

Concerns included the lack of funding to enable consistent provision; lack of good, tried and tested software for use in numeracy classes in particular, and lack of training in the use of ICT for both tutors and learners to be able to gain benefit from the use of a computer instead of a worksheet, book or tutor as a resource. The workshop was initially designed to investigate websites which related to numeracy teaching and topics and to discuss their relative value for either or both tutor and learner.

As organiser of the workshop my thanks are extended to Eigil Hansen, Denmark for his contribution to the workshop both in expertise in use of the hardware and his contribution of a list of websites he particularly finds useful. My thanks also to Michaela Benbow, Uxbridge College, for her support in working on the sites before and during the conference workshop. The workshop was attended by over twenty participants who worked individually and in pairs enjoying the time to spend evaluating specific sites and topics

The workshop opened with a short introduction setting the scene under the following headings:

Internal and external pressure to use ICT

Economic Constraints

Internal and external pressures

Colleges of further education and adult basic education establishments in the United Kingdom are constantly being pressured to use ICT in the delivery of programmes and this is backed by the Basic Skills Agency , which suggested 'ICT enables new approaches to the teaching of basic skills, particularly in the use of sound support, graphics and digitalised TV and video clips; the use of ICT emphasizes to adults that basic skills provision is 'not like going back to school '(Basic Skills Agency,2000).This was further reiterated by the Adult Literacy and Basic Skills Development Project , 'Unemployed programmes that have made effective use of computers have found that they are popular with both trainees and staff…However, programmes that provide for the unemployed often have an inadequate level of computer equipment and relevant software.' (Adult Literacy and basic Skills Project,1987).

Reference in the Basic Skills Agency report is made to work undertaken in Australia which again emphasizes the positive benefit of use of ICT,(Literacy Learning through Technology,1998).

Government inspections of teaching and learning in further education and adult basic education establishments assess the amount of use of ICT in delivery and assessment of programmes and pay particular attention to the use or lack of it referring often to mathematics classrooms.

Internal pressures within institutions guide more and more hours of study using individual computer based programmes in large open planned IT centres where it is gauged that it is more economic to deliver with 'technician' status staff rather than with specialist staff such as numeracy tutors.

Economic constraints

Many colleges offer students open access to use ICT but little research or development is directed to evaluating the software or programmes used and the benefit or otherwise to the learner. In fact many packages on offer are an electronic replacement for pen and paper which remove the interaction with other learners. Whilst not denying the value of using alternative sources of learning and experience instead of worksheets, books, peers and tutor there needs to be a more consistent approach to what is the added dimension to the learning which would ensue as a result of using ICT.

Much of the delivery of adult basic numeracy is in small isolated, ill equipped outreach centres and in spite of the pressure to deliver numeracy using computers and some provision of limited numbers of laptop computers very little attention has been given to access, training and security so provision is not always consistent in all areas.

The national strategy to improve numeracy and literacy in the United Kingdom has involved the development of new resources at the same time as ignoring some of the excellent materials used over many years and this approach is duplicated in its development of ICT. The internet is a resource with relatively easy access, which has a plethora of sites with numeracy based topics which have not been evaluated and some of which could be more economic than the expending of hundreds of thousands of pounds to private software providers where quality control is limited.

This workshop was designed to be hands on where participants could investigate sites recommended as being of particular value in the numeracy classroom and in planning .

It was agreed that the sites which were found to be of value would be assessed in terms of What is useful? What is not useful? How could this be used in the classroom? It was agreed that a list of the sites with comments would be produced during the next academic year and that members would be asked(via the newsletter) to contribute sites and comments to be included in a photocopiable pamphlet to be produced for the next conference.

The following sites were recommended.

www.ask.co.uk

www.maths.co

www.bbc.co.skillswise

www.funbrain.com/cashreg/index.html

http://sunsite.anu.edu.au/language-australia/numeracy/anamol

http://www.alm-online.org

www.eh-mat.dk/links.html (then click on) Hjemmesider pa engelsk med direkte relevans for matematiklaerere

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**The importance of adequate Teacher Training for teachers of adult Numeracy**

**Tiggy Ayoub**
**Southwark College, UK**

With the introduction of the new adult basic skills numeracy core curriculum a need has been identified for more specific training for teachers of adult numeracy. A national programme of teacher training has been introduced by the Adult Basic Skills Strategy Unit within the DfES, in conjunction with The Basic Skills Agency and co-ordinated by the local Learning and Skills Councils together with The Basic Skills Agency.

I will introduce this workshop by considering statistics compiled from the London Central Learning & Skills Council (LSC) Teacher Training events of the last 12 months which I have gleaned from the Personal Profiles of all the delegates present at these 10 training events, showing levels of competence of numeracy teachers. I would like to encourage a discussion on the implication of these statistics on learners and also identify to what extent these results are specific to Britain.

We will then discuss the main content and effectiveness of the current training programme under the following headings:

New training qualifications at both Level 3 and Level 4

New standards for teachers of Numeracy from a vocational point of view

**Availability of new qualifications throughout the country – who will be able to deliver? Do we have enough teachers of Level 5 ability to instruct on these new courses?**

Bringing poorly qualified teachers up to standard – how to do this successfully and without embarrassment

Implications for quality criteria within learning organisations

Finally I would like to look at ways to implement necessary changes and to summarise the issues raised throughout the workshop.

For additional information contact Tiggy Ayoub at 35 Tamarisk Close, Bognor Regis, PO22 9JQ, email tiggy@ayoub-page.fsnet.co.uk

## References:

The Basic Skills Agency (2001) *Adult Numeracy Core Curriculum*
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# Consultation on Research in Adult Numeracy at ALM9

**Ruth Polkinghorne**
**City of Bristol College**

The following is a report on discussions held at the ALM9 Conference at Uxbridge College between 17th and 20th July 2002. I was asked to prepare this report specifically in respect of the workshops held on 18th and 19th July, where research issues in adult numeracy were discussed as part of a consultation initiated by the new National Research and Development Centre for Adult Literacy and Numeracy (NRDC) in England. I am also including in this report notes from other sessions held at the conference where research ideas emerged.

The invitation to participate in the consultation workshops read as follows:

**Consultation on Research in Adult Numeracy**

Adult numeracy is a seriously under-researched area, although research interest is now developing apace amongst researchers, policy-makers and practitioners. The new National Research and Development Centre (NRDC) for England is keen to strengthen the links between research, policy and practice in adult numeracy, to encourage practitioners to use research findings to enrich their practice and to help them to become practitioner-researchers.

As a first step, we are undertaking a review of research in adult numeracy. The aim is to review what is known about numeracy, in the UK and internationally, in order to inform future research and development and enrich practice.

We plan to make information about a wide range of sources accessible to practitioners, policy makers and adult learners for research and study purposes. In particular, we aim to produce:

a synopsis outlining the main lessons to be learned from the review;

a searchable annotated bibliography, available via the NRDC website.

We are asking you to:

- identify questions and issues to be investigated;
- identify sources to be included in our review of research;
- give us your ideas on making the review as useful and accessible as possible to practitioners, policy-makers and researchers.

Thank you.

Diana Coben, NRDC

The workshops were introduced by Diana Coben and were attended by 26 conference participants, including researchers and practitioners from Britain and abroad. After the introduction to the first workshop the group was asked to identify general areas that they were interested in and felt would be a good starting point for the discussion. Three main areas were put forward and the participants split into three sub-groups to discuss these broad areas. These were:

1. creative approaches to the teaching of mathematics/numeracy;
2. information technology;
3. Training and personal development issues.

The participants agreed to return the following morning to follow up on the discussions and either to continue the sub group discussions or to develop new areas for discussion. In the event, not all those participating in the first workshop were able to attend the second session and people not involved in the first discussion joined the new topic area on Day 2. In the event, the second workshop did not follow the pattern of the separate discussions started on the previous day and instead developed a new theme, starting with a question about how people assess risks. The discussion spread out from this in a very fruitful way.

The issue of personal development and teacher training was one which was picked up in other sessions during the conference and I am including notes arising from these sessions, in particular:

- 'The importance of adequate teacher training for teachers of adult numeracy', a workshop led by Tiggy Ayoub of Southwark College, London, who presented statistics gleaned from personal profiles of tutors undertaking the 3-day training associated with the new Adult Numeracy Core Curriculum;
- 'Professional Development', a Discussion Group led by Terry Maguire of the University of Limerick and Lene Johansen of Aalborg University, Denmark.

Further ideas were put forward by individuals, or arose from informal discussions during the conference, or have been sent to me since. These have been included as miscellaneous contributions at the end of the report.

**Summary of discussions on Day 1, 18th July, 2002**

**Group 1: Training and Development**

In this group questions were raised about the level of numeracy qualifications held by tutors and what numeracy qualifications are necessary. There was seen to be a disparity between these two aspects. The question was raised about how the disparity can be handled. There were seen to be consequences arising from this in the implementation of any additional training.

**Group2: Information Technology**

Here the participants were concerned about the way the ICT is being used, or not used, effectively, in adult numeracy education. Some of the participants had access to modern sophisticated IT systems and were in the process of trying to get to grips with the technology. The discussion was not only concerned with the way that computers can be used by students either as part of a classroom session or as a distant learning tool but also with the range of technology that can support tutors such as presentation software and interactive whiteboards.

It was felt that people are being given access to these facilities without adequate training or without its role in the delivery of Adult Mathematics teaching being evaluated. People are isolated within their colleges (it is mainly at colleges that such technology is available) learning to use them and developing resources or teaching methods from scratch (the 're-inventing the wheel' syndrome). Not only are ideas not spreading from one college to another but departments within the college are not very good at communicating new ideas. There were seen to be many positive ways in which the technology could be used. However more work needs to be done in this area to evaluate what is being done; what further can be done; in developing appropriate materials and in the development of the skills needed by tutors to deliver and use the technology effectively.

**Group 3: Creative Approaches**

The group took the student as the centre for their discussion. From this there was seen to be a need to question - what does the student need to be able to learn; why should they learn? Following from this was the idea of the relevance of the curriculum to the needs and wants of the student. There are many external pressures on students to learn - the need to earn a living; pressure from government; other life experiences all bear on the desire to learn and the requirements of the adult learner. So what does society want of the mathematics student? And is this the same as what students want for themselves?

**Workshop, Day 2, 19th July, 2002**

(Whole group discussion)

The discussion started with the question being posed – 'How do adults assess risk from data?'. This was put by one of the members of the group who felt that issues around the use of the MMR (measles, mumps and rubella) vaccine with young children raised many numeracy and citizenship issues. It was felt that we needed to know more about how adults access data; how do they understand data and how confident are they to assess risk using the data? Everyone with children needs to consider the question of whether to have their child vaccinated against these diseases and the information given in the media can be confusing giving conflicting points of view. People need to be able to understand the figures given and the way to interpret probabilities to be able to assess the risks mathematically. And this is something that has to be considered by parents of all levels of ability. We cannot say "You haven't covered the basic level mathematics yet, so we need time to build up to looking at probability" if the parent has to make the decision this week! Whether or not you teach the subject, the decision still has to be made. So materials and approaches are needed that are accessible to students at all levels.

This is typical of the sort of topic that students would be interested in, even if they are not interested in the mathematics content. So can mathematics be infiltrated into a general discussion about controversial topics like the MMR debate? How can this be done and what materials may tutors need? The subjects however must be of interest and relevance to the students and the students should be included in any decisions about the topics. Someone cited the example of a video used by a tutor on Brazilian farmers and problems they faced. This was seen as irrelevant to the British students watching it who could not take from it the general aspects that applied across geographical boundaries. This was considered to be a rather sad reaction to the video. This is surely part of what we need to teach - to be able to take from a complex issue the main points that are of interest and relevance. Maybe this example shows students' attitudes at the start of a learning programme and it would be interesting to see to what extent these change as their education progresses. To what extent can changes of attitude towards such issues be seen as a learning outcome? We discussed the way that mathematics can be taught via these topics. But is this pretext or context? Topics can be used as a pretext for teaching mathematics - sneaking it in - or it can be seen as the context which makes mathematics important and interesting, it can be a way in which students recognise that they need to know about mathematics. In order to be able to teach the subject, though, we need to know what the mathematics content is in making decisions about risk. The discussion then moved on to whether or not basic skills teachers are adequately qualified to teach subjects that include statistics and probability. Up to this point the focus was on how to teach statistics via topics. However people do not always use their knowledge of figures and probability in making decisions, even if they have the required skills.

This then led on to how people make decisions about risk. We talked about smoking and weight in this connection. Weight/height charts can be interpreted in different ways - the optimum level indicated can vary according to who is presenting the data. There is more to making a decision on the level of risk attached to particular decisions than an assessment of the probability of a negative outcome to the decision. Taking smoking as an example, it was seen that although people know the dangers of smoking, many still continue to smoke for various reasons. Sometimes, as in this case, risk-taking relates to an addiction. Following on from this we discussed gambling, bringing in the work done by Donald Smith in Australia on mathematics teaching for the prevention and reduction of problem gambling (reported on at ALM8: Smith, 2002:146-55). Risk-takers want to gamble; they like the feelings associated with it. Age can be a factor in risk-taking.

Even where there is no addictive behavior, nor any reward for dangerous behaviour, emotions can play a part in the assessment of risk. However, whatever the context, it seemed to us that more work needs to be done on understanding why people take risks. And how do people make decisions about risk without good data in conditions of uncertainty?

These questions led us to discuss where people get their information from. Lancaster University research on 'leading lights' (Barton & Hamilton, 1998) found that people will turn to certain others in the community to ask for advice and help on literacy problems. Does the same thing happen in numeracy - are there people to whom those with poor numeracy skills will turn when they need help? There is often a suspicion of experts,

particularly concerning financial matters, where experts may be paid on a commission basis and therefore may not give impartial advice. There are power relations involved here, as those with mathematics abilities are often perceived as being in a more powerful position. Is there such a thing as an unbiased source of information? This is a matter that will also concern us as teachers as our attitudes can colour the way a subject is seen; our own views will affect the way the problems are framed.

Some subjects involving risk can raise other problems for the student and teacher. There are certain risks that are private. Sexual behaviour, e.g. risks concerning HIV/AIDS, or financial matters, may not be areas that students will be willing to discuss either in an educational context or in their own lives, where advice may be needed but difficult to obtain.

This discussion came to a close with thoughts about the empowering aspect of numeracy being tied in with so much of what we were concerned with. In this discussion numeracy was seen as the servant of civic issues.

**Topic Group, 20th July 2002 - Personal Development**

There was an overlap between the ideas which came out of this presentation and those which arose out of the Topic Group discussion and in other sessions at the conference, so I will deal with both together.

The starting point of the Topic Group was 'What makes a good numeracy tutor?'. We first of all considered what we mean by mathematics and the distinctions between 'school mathematics' and 'everyday mathematics'. This led to considering what is included in curricula both in Britain and abroad. It was put forward that tutors benefit from having an understanding not only of what is in the curriculum applicable to their teaching but also the way curricula are designed. One of the group members described how this forms part of a training course that they are involved in and how it benefits tutors. So one aspect of what makes a good numeracy tutor would be knowledge of the curriculum and an understanding of the way they are designed.

Knowledge of the needs, experiences and intentions of the student groups was considered to be an important aspect of teaching well. Related to this is an understanding or an appreciation of the way people learn in general and in particular of the way adults learn.

Knowledge of the subject may seem an obvious requirement, but what subject knowledge is required? This discussion was echoed in the discussion following the presentation given by Tiggy Ayoub. The new FENTO (Further Education National Training Organisation, http://www.fento.org/) Standards set for teachers in Britain, which come into effect this September, require new tutors to have a subject qualification considerably above the level at which they are teaching. On the face of it this seems reasonable - teachers should be confident in their abilities in the subject. We were shown statistics that demonstrated the poor level of subject qualifications held by tutors practising in Britain at present.

This means, however, that specialist teachers in adult numeracy need to have a NQF (National Qualification Framework) Level 4 qualification which equates to the level of a British undergraduate degree. This raised questions in two main areas:

1. Is it really necessary for a basic skills numeracy tutor to know about calculus or frequency polygons, etc.?
2. How are existing tutors to be trained to bring them to the level required?

In both these sessions participants felt strongly that higher level qualifications in mathematics may not necessarily make for good numeracy tutors. The knowledge needed by tutors was seen as broader than competence in GCE 'A' level Mathematics or mathematics at undergraduate level. People may achieve high levels of qualifications in the subject but not have any depth of knowledge about the basics. Teaching adults with poor numeracy skills requires a deeper understanding of the basic arithmetic processes than is developed through a schools curriculum. People rarely consider the importance and significance of, say, place value until they see someone struggling to grasp the idea. Most people who go through school as capable if not brilliant mathematicians have grasped this concept without needing to have it taught to them directly. But as tutors we often need to teach these fundamental concepts, and we do it without having experienced being taught the skills explicitly. There may therefore be a lack of information on how to teach these basic concepts. It is not so much that tutors need a higher level of mathematics qualification, rather that they need a richer understanding of the basics. We talk too often about moving 'up' to higher levels of skills, with basic skills being considered the lowest; we 'come down' to the basic skills level. This can lead to a devaluing of the skills needed to teach everyday numeracy.

The conclusion of this discussion was that we need to review the way basic skills teaching is considered, in order to value the different sorts of skills needed by adult numeracy tutors. The question is: what are these skills exactly and how can new training incorporate the development of these skills?

Involving teachers in research was one way in which these skills could be identified and fed back into future training. This would also help to promote these skills in people's minds and boost the confidence and self-esteem of teachers.

**Conclusions**

Certain themes emerged through the conference, with training and the content of new teacher training curricula being seen as a major issue at this time. This was then linked to what should be included in an adult mathematics curriculum and what the implications are, following on from this, for the depth of subject knowledge required.

Social topics and the empowerment aspects of numeracy teaching was another general heading that raised research ideas. This is linked to the phrase 'mathematics literacy', how it is defined and what constitutes mathematics literacy. How can we integrate these ideas into

teaching and what methods and materials are needed to do this well? This of course then comes back to teacher training and the development of the skills both in subject matter and generic teaching skills that lead from it.

**Summary of ideas relating to the questions posed at the start**

**1. Questions and issues to be investigated:**

- What should the content of teacher training be?
- What do students need to learn?
- The need to evaluate of materials used, particularly in respect of IT.
- What skills are involved in risk?
- What are relevant topics and how can they be used?
- What teaching methods should/could be used?
- The need to develop materials to be used with lower level students on statistics.
- How do people assess risk and what mathematics is needed?
- What pressures are students under from - external sources, curriculum, political imperatives, work-based requirements?
- What pressures are tutors under, including the positive and negative affects of curricula?

**2. Identify sources to be included in the NRDC review of research:**

- Donald Smith on mathematics education in relation to gambling (Smith, 2002);
- Lancaster University 'leading lights' research (Barton & Hamilton, 1998);
- research by HOST on forecasting future skills needs in the development of basic skills in the post-16 sector (unpublished);
- international dissertations, for example Kathy Safford-Ramus' work on doctoral research in mathematics education in the USA (reported on at ALM7, Safford-Ramus, 2001).

3. Ideas on making the review as useful and accessible as possible to practitioners, policy makers and researchers:

- involve practitioners in research, for example through the Teacher-Researcher programme currently under development in NRDC;
- set up local fora for numeracy tutors, such as the ALM London Group.

Miscellaneous questions:

- What kind of mathematics is used in the work place?
- Mathematics literacy is more than a knowledge of arithmetic skills but what exactly do we mean by mathematics literacy?

- Can materials be cross-cultural?
- How is mathematics seen in different cultures? How does this affect the way that students acquire skills with particular reference to the way mathematics anxiety may be a cultural construct (in some countries mathematics anxiety is not found)?

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**Reflection on the New Adult Numeracy Curriculum in England**

**Dhamma Colwell**
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The new Adult Numeracy Core Curriculum is being introduced in England at present. At ALM8 I gave a paper critiquing the thinking behind the introduction of the Adult Numeracy Core Curriculum in England (Colwell. 2002). I was concerned with the way adults had been assessed as lacking in the numeracy skills essential in everyday life. I suggested that their ability to do school maths had been judged, not their abilities to do use maths in everyday life. I was also critical of the underlying epistemology of the new curriculum: a view of numeracy as a set of unconnected abstract procedures which could be taken out of the classroom like a toolbox and applied in any situation in everyday life. I argued that the curriculum was a reduced version of the school curriculum. Although there was emphasis on using 'the learner's context' for teaching the numeracy elements, I have suggested that this will not be an unproblematic process for teachers of numeracy to adults, or for their students.

I would like to facilitate a discussion by teachers about their thoughts and feelings about the new curriculum, perhaps based on their past experience of teaching, or recent experience of being trained. I would also welcome practitioners from other countries who are being required to use similar curricula.

If you would like to participate in this discussion, you are invited to prepare a short report to present (5-10 minutes) on any aspect of the curriculum (or other curricula) that interests you. The report of this discussion will be submitted to the compilers of the Proceedings of the conference as an unedited aggregation of these reports, with a short introduction and conclusion.

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# Why Teach Numeracy to Adults?

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There are different reasons and interests in discussing the issue *Why teach mathematics to a specific group of students?* One is concerned with the *enrolment problem* (Jensen et al, 1998; Jørgensen, 1998; Schlöglmann, 1998) where students seem to opt out of education that involves mathematics at a certain level. Another perspective is concerned with the general level of mathematical skills in specific parts of the population and the need for improving the level of basic skills (Crockcroft, 1982; OECD, 1995; OECD, 2000; Jensen & Holm, 2000). In my research project, I am specifically interested in clarifying reasons for providing mathematical education to adults who lack basic skills given in the Danish society. I see my research as an attempt to discuss *The Justification Problem.* Paul Ernest has defined the justification problem as:

> The justification problem in mathematics education concerns the following questions. Why teach mathematics? What is the philosophy of mathematics education in terms of the purposes, goals, justifications, and reasons for teaching mathematics? How can current mathematical teaching plans and practices be justified? What might be the rationale for reformed, future or possible approaches for mathematics teaching? What should be the reason for teaching mathematics, if it is taught at all? (Ernest, 1998)

It is easy to ask these questions but it is not so easy to answer them. According to Mogens Niss, reasons for mathematics education need not be explicitly formulated, and often the reasons are implicit and only in rare cases, therefore, do we have direct access to reasons for mathematics education:

> Reasons for mathematics education need not be explicit, well defined and articulated, let alone agreed upon and stated in public. More often than not, reasons are implicit, indirect, fuzzy and vague, and form part of a complex conglomerate of other reasons, societal or group interests, cultural and political ideals, and so on. They include also, in fact quite frequently, impersonal societal forces, of which inertial forces are particularly relevant in this context. Only in rare cases, therefore, do we have direct access to reasons for mathematics education. (Niss, 1996:12)

## The RARE case

When the Danish Government, in May 2000, presented a reform of the Adult educational system I imagined that I had a rare case. Part of this reform was a new adult education named Preparatory Adult Education (PAE), which included a new course in mathematics (Undervisningsministeriet, 2000). The Danish Ministry of Education engaged two researchers to develop "A New National Adult Numeracy Curriculum" (Lindenskov & Wedege, 2001). As part of the curriculum planning process, the government financed a

special training course for teachers wanting to be involved in the PAE programme. The aim of this course was, on the one hand, to prepare a group of selected mathematics teachers to teach the target group for PAE, and on the other hand, to give those teachers a chance of influencing the design of the new curriculum. During my work, I have followed and collected data from the public part of the political process and from the work of curriculum planners. In addition, I have followed and collected data from the teacher-training course for special selected mathematics teachers from different parts of the adult educational system. As mentioned I imagined that PAE would be a RARE case and that the reasons for teaching adults mathematics would be explicitly articulated – but I was wrong, or at least I was not satisfied with the reasons given by the politicians, the mathematics teachers and the curriculum planners.

Going through my huge amount of data-material, I thought *someone would argue against this new mathematics* course asking questions like *Why mathematics?* Or *Wasn't it more important that adults learned to use computers?* Or questioning the importance of having mathematical skills in today's society. But no one did! The politicians did not ask that kind of questions and neither did any in the public debate. It seemed as though everybody agreed that teaching mathematics to adults who lack basic skills was a good idea! Thus, the real reasons for providing mathematics education to adults who lack basic skills stayed implicit.

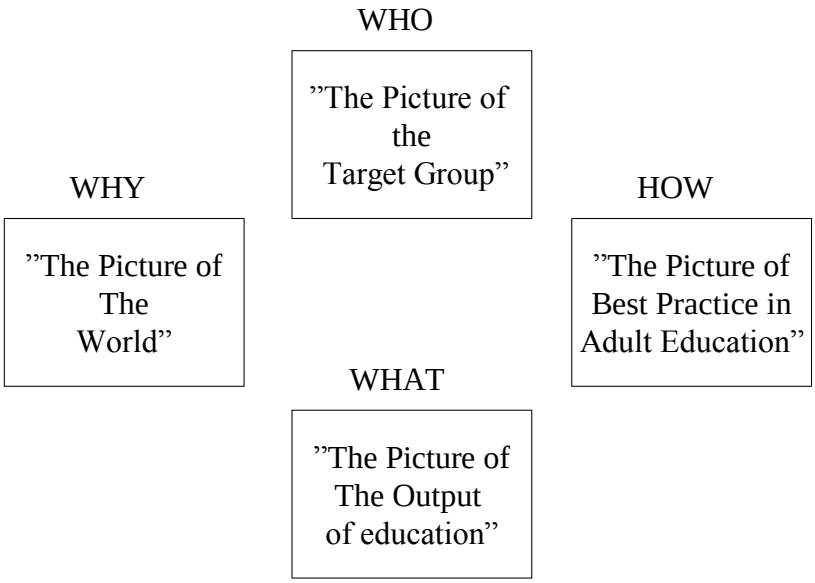
I started to wonder how could I construct an answer to my question out of my data-material? How is it possible to recognize implicit answers? My case is the curriculum-planning process; perhaps it was possible to find inspiration in *curriculum theory* or *didactical theory*. Thus, I asked four didactical questions: WHO is going to learn? WHAT is going to be learnt? HOW is it going to be taught? WHY should it be taught?

In Discourse Analysis I found inspiration for my further work. (Gee, 1999; Laclau & Mouffe, 1985) What if I assumed that designing a new education course and developing a new curriculum is *a social construction*? And what would happen if I assumed that it would be possible to distinguish between two different discourses, a political discourse and a curriculum planner discourse. Combining the didactical questions with the two discourses gave me the following matrix:

| | The Political Discourse | The Curriculum Planner Discourse |
|---|---|---|
| WHO | | |
| WHAT | | |
| HOW | | |
| WHY | | |

Asking the four didactical questions of my data-material connected to the two discourses helped me to find some answers. But I still felt somehow that I was missing the point, how to catch the implicit reasons – the unsaid, or the things said but not in straight words. Inspired by the discourse analysis I realised that through conversation we in a way build the world we

are living in. Understanding (and accepting) this, I found it possible in the two discourses to find different images or pictures of for example the society we are living in and the society to come. Combining the didactical questions and the inspiration from discourse analysis I constructed a kind of landscape for my analysis.




In my analysis I will not just ask the question *who is going to learn* but also look for the pictures drawn of the *target group* in the different discourses, I will not just ask the question *how is it going to be taught* but also look for pictures drawn of *Best Practice*, I will not just ask the question *what is going to be learnt* but also look for pictures drawn of the *output* of the education, and in the same way I will not just ask the question *why is it going to be taught* but also look for pictures drawn of the society and of the world we are living in today and the society to come. In this paper, I will present the different reasons represented in the two discourses: the political discourse and the curriculum planner discourse.

**The Political Discourse**

Asking the four didactical questions to the Political Discourse (Undervisningsministeriet, 2000) it is possible to identify the following answers:

WHO – according to the law, PAE is for all Adults over 18 years who wish to improve their general skills to become better equipped for the labour market and as citizens in a democratic society and who have the prerequisites/basis for following the course with outcomes or results.

WHAT – according to the law, the subject going to be learnt is basic skills in arithmetic and mathematics. It is mentioned that it should be selected skills compared with the skills

evaluated after Grade 9. The skills should be necessary in order to cope with the demands from the labour market, the information society and the democratic society.

HOW – according to the law, there are no instructions as to how the subject is going to be taught. The law does allow for the mathematics course to be held not only in the ordinary adult education institutions but also in the workplace of the participants, on trades union premises or other places where adults meet during their daily life. It is mentioned as well that the interest, needs and wishes of the participants determine the content and the subject for teaching.

WHY – according to the Danish Politicians, PAE is offered to adults to meet the changing demands from the labour market, the information society and the democracy. The Politicians are referring to the Danish results form the "Second International Literacy Survey" – SIALS (Jensen & Holm, 2000 & OECD, 2000), which showed that 28% of the adult population lacks basic arithmetic skills.

Considering the reasons given by the politicians I felt disappointed. This kind of reason covers the whole educational system; I would call it global reason. No one could argue against this kind of reason. A closer look at the data-material using the inspiration from Discourse Analysis opens up other explanations. One thing became clear to me studying the debate among the politicians: through their articulation a *Target Group* for PAE was constructed as being a group of people excluded from society. First of all, the politicians only talk about early school leavers; and the picture they draw shows a group of people who are not able to cope with the demands from the labour market, who are not able to take part in democratic processes, who are not active citizens, who do not use the library, who dislike schools, and who are unmotivated to join education. An example of this kind of construction is Dorit Myltoft from the Social Liberal party who during the discussion of the bill in the Education Committee says:

> In the Social Liberal party we will work to prevent the society being split into two groups of citizens, a group with strong resources and a group with weak resources where the latter will have huge difficulties in taking part in the future society. We will not accept that a group of citizens do not have the prerequisites to meet the demands of the daily life […] We know it is a fact that one million adults do not have the same prerequisites to be engaged in politics, in unions, in societies and organizations, in boards of governors, the public debate etc. […] It will produce a lot of problems if society does not provide this group of citizens with a better offer of education than today.[1] (Myltoft, 2000)

[1] My translation from: *"I Det Radikale Venstre vil vi arbejde for at forhindre, at samfundet knækker over i en ressourcestærk og en ressourcesvag gruppe, hvor den sidstnævnte får meget vanskeligt ved at begå sig på fremtidens betingelser. Vi vil ikke uantastet se på, at en gruppe medborgere ganske enkelt ikke er rustet til at honorere de krav, der stilles til den enkelte i forskellige […] Vi ved konkret, at der er tale om omkring en million voksne, der ikke har samme forudsætninger som resten af befolkningen for at engagere sig i politik, fagforening, foreningsarbejde, skolebestyrelser, den offentlige debat osv[…]. Det giver en række problemer, hvis ikke der satses på at give den gruppe nogle endnu bedre tilbud, end vi gør i dag."*

I call this a construction of "The excluded" (Johansen, 2002). The reason for the Politicians to provide adults with mathematics education can be found in the picture that the Politicians draw of the *Target Group* as being "The excluded" The Politicians want through education to give the *Target Group* the possibility to change their lives so that they will be able to take part in Danish society – in the labour market as well as being active citizens.

Another interesting thing I found was the way the Politicians see mathematics education. It is as if they see numeracy skills as a toolbox you can carry around. As soon as you have this toolbox you can use it everywhere. You will always have the tool you need to solve your problem. The Politicians see numeracy skills, as not being dependent on or related to the context– they are context free skills.

**The Curriculum Planner Discourse**

Asking the same didactical questions to the Curriculum Planner Discourse I identify the following answers:

WHO - according to the Curriculum Planners, the PAE is for Adults and they repeat again and again that we cannot talk about *a* Target Group but should talk about several *Target Groups*. As well as the Politicians, they talk about early school leavers but also about semi-skilled workers and other people skilled as well as unskilled.

WHAT - the aim according to the curriculum is to develop the participants' *numeracy*, which consists of the functional mathematical skills and understanding that in principle all people in society need to have. The content is described as a dynamic interplay between a series of *activities*, various types of *data and media*, as well as selected *mathematical concepts and operations* (Lindenskov & Wedege; 2001:19).

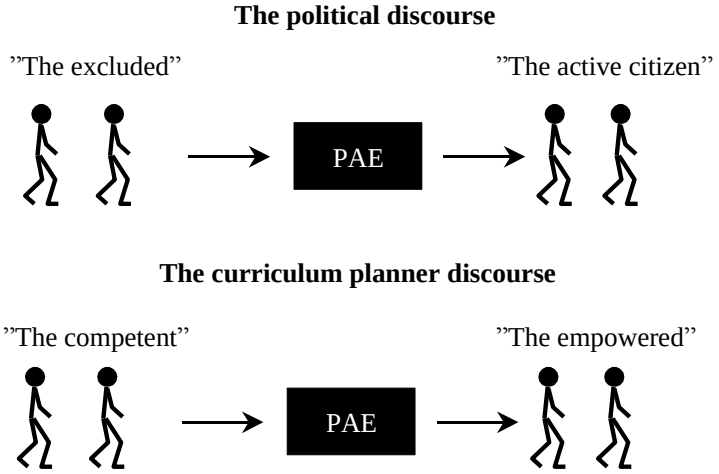
HOW – according to the curriculum the concrete aims, content and organisation are arranged so that the background and the foreground of the participants take centre place (Skovsmose, 1994). The relevance of the content is made clear by concrete connections to activities outside education. The way the problems are posed and formulated as well as the problem solving methods are authentic in relation to the chosen context. There is a wide array of materials available, as well as a possibility for out-of-house activities. The teaching makes the participants own correct methods for calculating and solving tasks visible. (Lindenskov & Wedege; 2001: 24)

WHY – adults' ability to act in all areas of life increases considerably with good functional literacy and numeracy skills (Wedege, 2000). "We hope that the new Adult Numeracy Curriculum will make adults' mathematics visible and open doors named 'mathematics' to adults." (Lindenskov & Wedege, 2001:17)

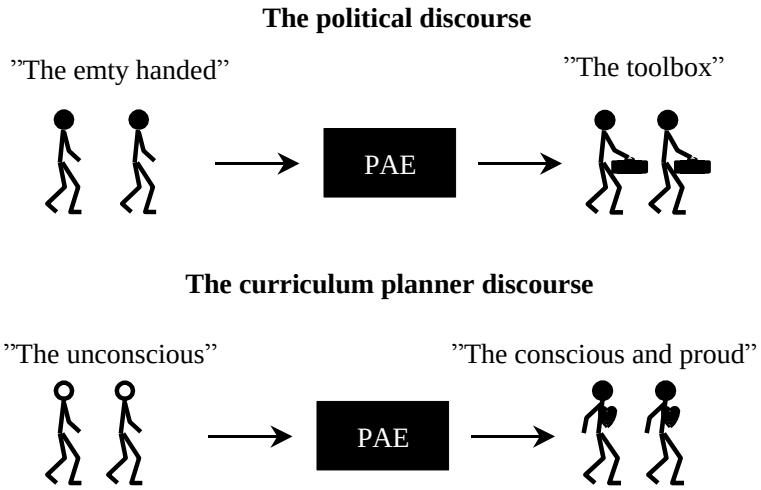
A closer look at these data shows me that contrary to the Politicians the Curriculum Planners draw a picture of the *Target Groups* as groups of competent people. People who live their daily life the same way as everybody else, who manage their jobs in a competent way and take part in society. But they also draw a picture of people who are not aware of their own competencies, who see the way they solve problems at there jobs as common-sense solutions, not including mathematical skills. They draw a picture of people who think, *Mathematics is not for me!* And *I don't need mathematical skills to cope with MY life!"* and *Mathematics is the subject I can't manage!* The Curriculum Planners see numeracy courses as a mean to lead people from being able to - to knowing that they are able to, knowing which kind of skills they have and what they can use them for. Another area where the Curriculum Planner Discourse distinguishes from the Political Discourse is the view of mathematics and numeracy skills. Where the Politicians see numeracy skills as tools you can carry around, the Curriculum Planners sees numeracy skills as context dependent.

## Discussion

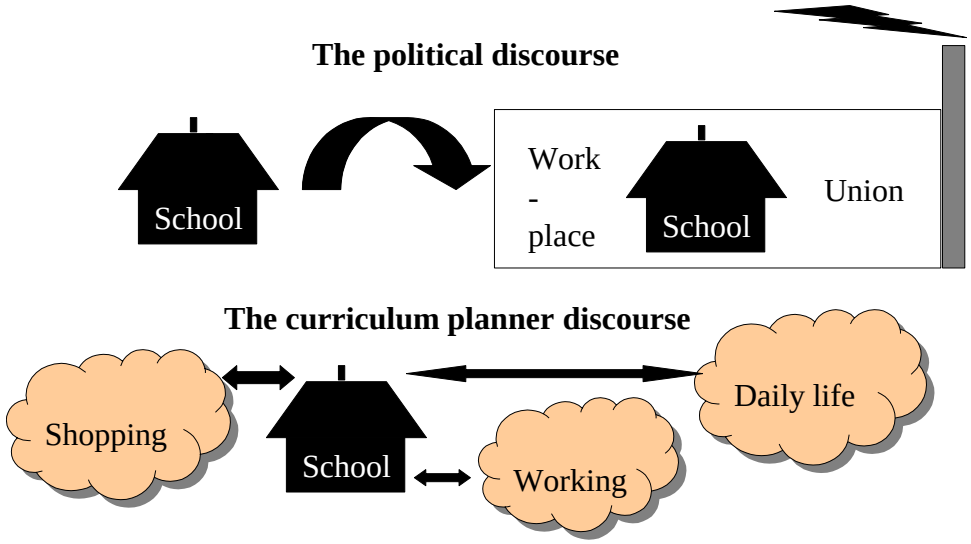
I have a working hypothesis saying: *There exist in society different and conflicting reasons as to why adults, who lack basic mathematical skills, need to learn mathematics. These conflicting reasons are bounded to different discourses about what mathematics education is, and to various assumptions about the benefits that adults can get out of it.* Based on how the Politicians and the Curriculum Planners answer the who-what-how-why questions, I have identified three different pairs of pictures – different pairs of discourses constructed by the politicians and the curriculum planners.




The first pair shows two different pictures of what happens to adults passing through the "Black box" PAE: According to the Politicians the participants change from being "the excluded" to being "The Active Citizens". According to the Curriculum Planners the participants changes from being "the competent" to being "the Empowered".




The next pair shows two different pictures of what the participants are gaining going through PAE: according the Politicians the participants are going from empty handed to gaining a “Toolbox”. According to the Curriculum planners the participants are going from being unaware of their own skills and scared of mathematics to being aware of their own skills and competencies proud of themselves, and no longer afraid of learning mathematics.




The last pair shows two different pictures of “Best Practise”: According to the Politicians it is important to move the education/and the teacher out of the school environment into the workplace or other places where adults meet in their daily life – the school is moved into the “real life”. According to the Curriculum Planners the environment of the teaching is not important, but it is important that the activities, the data and the mathematical concepts used

in the teaching are used in an authentic context and in an authentic way – the teaching should link the everyday practice with the mathematical concepts.

Back to the question *Why teach numeracy to adults with a lack of basic mathematical skills?* I have identified different explicit and implicit reasons in the system for providing mathematical education to adults. The explicit reason for providing PAE to adults is, according to the Danish politicians, to meet the changing demands from the labour market, the information society and the democratic process. But looking at the pictures drawn by the politicians of the *target group* and *output* of PAE, I would argue that the implicit reason given by the politicians for providing PAE to adults is *to save* "the excluded", help them back to society making them "active citizens" by giving them *a toolbox* – containing basic numeracy skills to be used everywhere.

The explicit reasons given by the curriculum planners for providing PAE to adults is the belief that adults' ability in all areas of life increases with good functional numeracy skills. Looking at the pictures drawn by the curriculum planners of the *target group* and *output* of PAE, I would argue that the implicit reason given by the curriculum planners is to move the adult from being "competent" to becoming "empowered", by making them conscious of their own skills and competences.

The conflicting points I would argue is the different ways the politicians and the curriculum planners describes the target group and the way the politicians sees numeracy skills as independent of the context in which it is learned compared with the curriculum planners understanding of numeracy skills to be context dependent.

**Acknowledgements**

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# The ALMAB-project, opportunities and risks in exchange across borders

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In each country ideas, methods and materials for adult mathematics education are created and practised It is done by innovative teachers as well as by others engaged in adult mathematics education . ALMAB is an EU project with the aim of exchanging good materials and good practices between countries. Participants come from Belgium, Denmark, the Netherlands and Norway.

## *Child of ALM*

The acronym ALMAB stands for Adult Life Mathematics Across Borders. It is no coincidence that the first three letters in the acronym are ALM. Without ALM this project would not exist. It is born of ALM.

After listening in 1997 to Dutch presentations at ALM-4 in Limerick, Ireland, some Danes felt the wish to make a follow up visit in Holland. It was arranged in 1998 and our first cautious impressions were strengthened. We felt that the mixture of similarities and differences between Danish and Dutch adult basic mathematics deserved to be explored and highlighted on a larger scale among teachers, consultants and researchers in Denmark. A paper in Danish was produced informing teachers on some of the Dutch ideas. It was very widely read. We presented some of the ideas in a few oral presentations too.

Four teachers from Eindhoven were invited to Denmark in order to visit a school and join a meeting with six Danish teachers, two consultants and a researcher. At this meeting on November the 9$^{th}$ 1999 in Slagelse the mutual interest was confirmed, and it was decided to work towards a formal EU-project.

The project then was prepared and designed during the first months of 2000 on e-mails and at a preparatory meeting in Copenhagen. Participants in preparing and designing came from Holland, Spain, Norway and Denmark. From April 2000 the project was established in co-operation between institutions from Holland, Norway and Denmark, both educational institutions and research institutions. Unfortunately the Spanish institution, CREA in Barcelona, was not able to join. In 2001 Belgium joined.

*Grundtvig – the person*

The project is an EU-project under Socrates, to be more specific under Grundtvig. N. F. S. Gundtvig lived 1783-1872 and was a Danish clergyman and writer. He is the intellectual architect of what can be considered as traditions and values in Danish educational policies and thinking about education. Especially he is regarded as the ideological father of popular and adult education. In one of his poems "Is light for the scholars only", 1839, he advocates "enlightenment" aimed at giving each individual, regardless of age and background an opportunity to learn throughout life:

> Enlightenment should be our desire
> even if it is just about the rush,
> but first and last with people's voice
> enlightenment about life;
> it develops from people's deed
> and grows as it is rocked,
> it sparkles in our people's board
> till the evening star goes out.

To Grundtvig the objective of learning was twofold, to give the possibility of personal fulfilment to the individual and to ensure the active participation of all citizens in public life.

*Grundtvig – the EU-Action*

The Grundtvig action is part of the European Commission's aim of promoting lifelong learning. The action can be characterised by its four sub-aims:

- to promote development of concrete products and valid results
- to promote European co-operation between bodies providing adult **education**
- to contribute to improving the quality of teacher training for adult education
- to further the debate of lifelong learning and contribute to the dissemination of good practice

The Grundtvig Action is divided into four periods. ALMAB has become part of the first period, where the wish is to develop something new, provoking and possibly epoch-making

for education used by adults. The aim is to have developments that are product oriented, but the aim is not implementation. Not yet!

The aim of the later so-called Grundtvig Action 3.3 is implementation on a broader European scale. The ALMAB group will probably apply also to this. In 2003 we will probably apply for funding of teacher courses, open to teachers from more or from all European Countries, that takes place in a country other than the country where the participant normally works. That means grants for the teachers who attend the courses.

*The four countries*

Educational and research institutions from Belgium, Denmark, the Netherlands and Norway form ALMAB. All four countries have relatively small populations, as seen in a global or European scale. The countries differ very much in area and population density. Concerning climate and nature there are differences. Neither the distribution of wealth nor the distribution of consumer goods is very different .

The countries have four different languages, none of them is a language commonly spoken in other countries. Norwegians and Danes though, can understand each other. In ALMAB the common working language is English. None of us has English as our first language, none of us is a fluent speaker and writer, so it is natural and not embarrassing to speak slowly and ask each other many questions at the ALMAB conferences. That is fine, but the language situation forces us to make double translations. All national materials from the four countries are first translated into English, and then into the national language.

*ALMAB – theoretical background and challenges*

First: internationalisation in general

It seems as if we face similar challenges in all the countries. The need for lifelong learning places in sharp focus the interplay between learning in formal settings and learning and practising in informal settings. The interplay seems to be fragile especially in mathematics education. It seems as if the kinds of challenges are similar in general terms, but specific challenges might be different or show similarities. Also our perceptions of the interplay might differ largely from country to country.

We face a thrilling paradox of two trends in adult mathematics education and adult mathematics research. One trend is the interest of Ethnomathematics in the mathematics which is practised among identifiable cultural groups (D'Ambrosio, 1985/91, p.18.) The other trend is an internationalisation, or maybe globalisation, consisting of co-operation with equal status and/or dissemination, which tends to wipe out cultural characteristics.

Maybe the characteristics of the four countries will provide ALMAB with an opportunity to become a good example of co-operation and co-reflection with equal status. And maybe what at first looks like a language problem, might turn out to be an advantage, because it forces us to exemplify how we interpret the words in use. There are reasons to doubt that practices are similar, even if descriptions of didactical ideas are alike.

Co-operation across borders on student-level might motivate and improve the adults' mathematics learning and support the transfer/transition into everyday settings. It is our general hypothesis. But the core groups of adult learners in the four countries will face

language problems, which we at the moment do not know how to handle within the subject of mathematics.

Second: co-operation among teachers

We see similar challenges in adult basic mathematics education all over Europe which have arisen from societal trends. But we also see that didactical ideas, methods and materials differ from country to country. It might be grounded in distinctive traditions and values in the countries, but the differences might also be a matter of chance. Ideas, methods and materials might very well be convenient in other countries, and it is our hypothesis that adult mathematics teachers can benefit from interchanging across borders, and by implementation and reflection in several countries. But it is worth examining, and examination of this has become the core element of ALMAB.

Third: mathematics a mean of intercultural understanding

Obviously we acknowledge a need across Europe to improve intercultural understanding. It is a hypothesis in ALMAB that adult mathematics has the potential to improve intercultural understanding. Why let Danish adults solve mathematical problems about the bus system in Copenhagen, if they can also compare the bus systems in Amsterdam, Oslo and Brussels? During comparisons like this they can learn more mathematics and more about real life circumstances in different capitols, instead of just Copenhagen. Why let adults express and discuss their competencies and conceptions, if they can engage in comparisons and discussions with adult learners in other countries? This will not only improve their knowledge and understanding of mathematics, but also their knowledge and understanding of adults in other countries.

Declared aims and goals of mathematics education in general and for adults do not exclude this issue, nevertheless they do not support the issue. If it is possible in ALMAB to justify and exemplify how adult mathematics education has a role to play in improving intercultural knowledge and understanding, then it would certainly be something new, provoking and possibly epoch-making for adult education. But in this concern, language will be a difficult obstacle in ALMAB.

*Good practices in plural*

The internationalising and globalising aspects in Mathematics Education and Adult Mathematics Education are in play in international comparisons, as TIMSS, PISA, SIALS, ALL; in advisory projects from first world to third world countries; in broad researcher communities, as ICME, PME, ALM; and in co-operation projects such as ALMAB. We want to be conscious of new opportunities and of possible risks of repeating former aspects of colonialism and neo-colonialism (Atweh & Clarkson, 2001). Analysing and conceptualising country differences of developed ideas and methods, is a two-edged sword. It is a risk that our engagement in co-operation and our common search for ‘best practice’ (singular) as stated in the *Grundtvig document* (see above), will narrow our view so we cannot perceive that there might be no best practice which is best for all countries and cultures. Even not for European countries, and even not for the four ALMAB countries.

We have to carefully discuss if, on the contrary, using more types of materials and ideas represents good practices (plural), and if locally developed materials and methods need to be supported in order to preserve cultural diversity in adult mathematics education. For small countries like these four there might be a special advantage in cross-border activities. In a small country you easily get a feeling of knowing everyone and you are at risk of applying prejudices towards colleagues, but fresh input might challenge you to reflect more deeply and inspire you to make creative improvements.

*Project activities*

The activities in ALMAB consist of exchange of materials between countries and exchange of examples of good practices. The project is organised with a steering committee with one from each country, and with Cinop, Centre for Innovation of Education in 's-Hertogenbosch, as the managing institution. We organise conferences for participants from all four countries once a year. These conferences are very useful, actually we consider them as necessary. Here we have presentations from each country about the adult educational system, actual efforts and changes and basic didactical ideas and methods. We try out some of the materials from each country and discuss and plan the near future of the project. We also have national meetings and conferences, and conferences with only two countries. Between conferences we communicate by email and by internet. The ALMAB website has a protected area, for members of ALMAB, and a public area.

The exchange of materials worked like this in the beginning of the project:

1. Teachers from each country choose materials they themselves find support good practice.

2. The materials are translated into English in the country where the materials are produced and chosen.

3. The materials in English are placed at the website.

4. The materials are translated into the other three languages, e.g. the Dutch translate them into Dutch.

5. The materials translated are tried out in practice in the national adult mathematics classroom and the trial is evaluated by adult learners and by the teacher.

6. We discuss the experiences at the international conference.

To give an impression of this exchange of material we pick out two examples:

*Problem:*
*A family has an old washing machine. They want to change it to a new one that uses less water and electricity. Before making the final decision they want to find out how many times per year they have to wash before the new washing machine is a good investment.*

*Facts about the washing machines:*

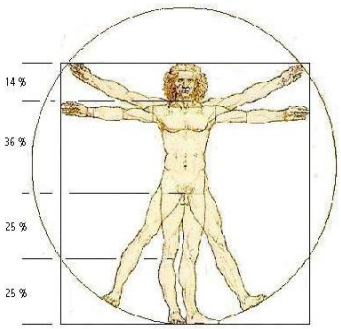
*The old one: Zanussi*
*Use of water per wash: 110 litre*
*Use of electricity: 1,9 KWh*

*The new one: AEG/ÖKO LAVAMAT*
*Price: Find a price in your own country*
*Use of water per wash: 42 litre*
*Use of electricity: 0,94 KWh*
*Life time: 10 years*

*Before you are able to answer the following questions you need to find out how much you pay for water (all included) and electricity in your country.*

*a) How much does the new washing machine lose in value each year?*
*b) How much does it cost in water each time you use the washing machine both the new one, and the old one?*
*c) How much is the price of electricity each time you use the old and the new washing machine?*
*d) How much is the total price of a, b and c if you wash 100 times per year, 200 times per year, 300 times per year, etc. both the new one, and the old one.*
*e) How many times per year has the family*

**The human measure**




*Take each other's measurements. Does reality fit the picture?*

At the last international conference it was decided that in order to have the materials tried out to a larger extent, we might as well place the materials and the evaluation scheme on the public web area before it is tried out in all countries. So, we will conclude this article by inviting you to search at www.almab.dk, choose materials, try them out and fill in and send the evaluation scheme.

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# Lifelong Education: an Organising Principle for Numeracy Policy Development - An Opportunity?

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## Abstract

This paper discusses various views of Lifelong Learning. The relationship between the concept of Lifelong Learning and Lifelong Education is explored. A paradigm based on a clearly defined construct of Lifelong Education is put forward as an organising principle for effective numeracy policy development.

Characteristics that would underpin a system that adopts this organising principle are identified. This model is used to evaluate the current approach to numeracy policy development in Ireland. Recommendations are made as to how the model offered could contribute towards more effective adult mathematics education policy implementation in Ireland, in light of changing legislation. This approach might inform future directions for other countries

## Introduction

This paper elucidates a position on Lifelong education that facilitates the research work being carried out as part of a PhD thesis. The research work in progress has highlighted the effect that policy has on adult mathematics education. A model of a system of Lifelong Education has been developed that provides an analytical tool to look at the Irish education system and in particular mathematics education in Ireland in the context of Irish policy. In the context of this discussion 'mathematics education' is viewed in the broadest sense incorporating school mathematics, numeracy and adult learning mathematics. The model can be applied to any lifelong education system and may have use for other researchers.

## Background

The notion of learning through life is anything but modern. Although posited by (Dewey 1916) together with the importance of experiential learning, Traditional philosophies e.g. Confucianism and Buddhism have for centuries promoted continuous learning. UNESCO's report 'Learning to Be': The World of Education Today and Tomorrow' accurately predicted that the impact of change on social, economic and political life would be such that continuing education into adulthood would be necessary for everyone (UNESCO, 1976). Education is now engaged in preparing individuals for a type of society that does not exist yet. (Faure, 1972). It is estimated that 60% of the trades and jobs to be performed in the next two decades or so are not yet known. In this environment Lifelong learning has become a guiding and organising principle of education reforms and is recognised as an indispensable tool to face its multiple current and emerging challenges. (Medel-Anonuevo, Ohsako, and Mauch, 2001).

The terms lifelong education and lifelong learning are often seen as being synonymous with one another and have been used in a wide range of contexts, to the extent that some workers regard it as an elastic concept to mean what ever the person wants the term to mean(Pucheu,1974)[quoted in (Knapper, and Cropley, 2000.) However, despite the loose use of the terms, education is not the same as learning and lifelong education is not the same as lifelong learning. Learning can be viewed as a cognitive process internal to the learner, that can occur 'both incidentally and in planned educational activities', while, 'it is only the planned activities is called 'education' (Merriam, and Brockett, 1997), Education is the set of circumstances that facilitate learning but education is not just schooling.

One view of lifelong education as a set of organisational and procedural guidelines for educational practice established with the aim of fostering lifelong learning - has that been put forward by (Knapper and Cropley,2000). In this context is not the spontaneous, unplanned even unconscious learning of everyday that is the object of lifelong education but learning that is intentional, has specific goals, and will be retained for a considerable period of time. Lifelong education is the system and lifelong learning the content the goal and the result. This paradigm provides a way of looking at what already exists in order to perceive shortcomings and see ways in which improvements could be made. It allows for different systems of education according to national policies, culture tradition and industrial development (*ibid*).

**What are the characteristics of a lifelong education system that facilitates lifelong learning?**

Some workers have already outlined principles for a system of lifelong education for example (Cropley, 1980.) suggested that in such a system education would:

- last the whole life of each individual
- lead to a systematic acquisition , renewal and upgrading of knowledge, skills and attitudes, as this became necessary in response to the constantly changing conditions of modern life, with the ultimate goal of promoting self-fulfilment of each individual
- be dependent on people's increasing ability and motivation to engage in self directed learning activities
- acknowledge the contribution of all available educational influences, including formal, non-formal and informal. [quoted in (Knapper, and Cropley, 2000)].

Viewing lifelong education through the lens of expansion, innovation and integration Dave, (1976) suggests that lifelong education encompasses the learning process in time, both in the range and content of learning and in the multiplication of learning situations. Expansion refers to the creation of alternative structures and patterns of learning in response to multiple and diverse learning opportunities. Innovation facilitates the process of expansion through adequate organisation and meaningful linkages -Integration.

Both provide a useful base for looking at lifelong education as a system but they do not go far enough or provide an easily usable tool for policymakers, researchers, and learners to

evaluate a 'lifelong Education system' perceive its shortcomings and see ways in which improvements could be made.

## The Model

### Backdrop

A new National Qualification Authority is currently being established in Ireland (NQAI) The new qualifications framework is underpinned by the following key values and principles: comprehensiveness and coherence; transparency and simplicity; equality and accessibility; quality and relevance. The proposed model is adapted from those put forward by Cropley (1980) and Dave (1976) latter but also incorporates the key values and principles outlined above.

### Rationale

The system of lifelong education must promote a learning environment that encourages the development of a self-directed learner. The system should maintain a strong focus on the acquisition of higher order skills. The system should take account of both education and training. The system must be dynamic to counteract scleroses that creep into any established system, by ensuring continuous bottom up and top down reality checks at the macro (big picture) and micro (on the ground) levels to insure the values and principles of lifelong education are being appropriately reflected in the system. The system should allow for change not for change sake, but as a healthy process to keep pace with the reality of a rapidly changing environment.

The model proposes that an effective system of lifelong education will be *comprehensive and coherent*, incorporate a view of education as a continuum from 'cradle to grave' and provide integrated provision with seamless transitions, in a coherent way. There is a need to ensure that all the elements that make up the system are fully visible. The relationships within the system need to be clear and easy to understand so the system should be *transparent and simple***.** The system must *offer equal opportunities* throughout life to all people for access to quality learning opportunities. It must *be accessible* to all learners for personal development, economic benefit or community benefit, both in the range and content of learning and in the gamut of learning situations. It must recognise previous learning achievements. *Quality* should permeate all aspects of learning and must be a central issue in relation to the lifelong education system. The system has to be *relevant to all users*: learners, employers and providers and wider society. It must facilitate the cultural, economic, political/democratic and/or social participation of citizens in society. The system should have recognition internationally and in particular must allow transnational mobility.

The model as elucidated allows a macro and micro level of analysis that is further extended by the inclusion of two additional dimensions - the external (forces working on the system from the outside) and internal forces (i.e. caused by anomalies within the system itself).that influence the system.

**External Forces**

These forces can exert influence when the system is set up or alternatively on how the system is administered. External forces that can influence the system can be broadly divided into: economic, cultural and political. These forces can be summarised as:

Economic

Strong economic influences promote the development of skills using an outcomes based approach while giving little attention to the development of higher order skills eg problem solving, critical thinking, which make for a an adaptable individual reducing the concept of lifelong learning to a narrow interpretation of equipping the workforce with necessary skills and competencies.. (Aspin and Chapman 2000; Field, 2000). Emphasis put on the VFM (Value for money) concept does not sit well with education.

Cultural

The value that is placed on particular elements within the system in different cultures can exert an influence the system, e.g. a good secondary education is prized in Ireland and the terminal examination rather than other forms of assessment has primacy.

Political

Priorities set by successive governments often differ. Governments have the need politically to be seen to have done something (usually proved by numbers and outcomes achieved) learners must perform and be seen to progress in a way that can be measured so often the focus of teaching is making sure outcomes are met which lead to continued funding. Governments themselves are influenced by external legislation for e.g. as a member of the European Union.

**Internal forces**

Internal forces arise mainly from anomalies within the system often caused by the effect of external forces that influence the system. There is a natural tendency within an established organisational structure for the status quo to become a self-justifying system. Administrative partitioning of elements within the system is evident often in tandem with service providers 'protecting their patch' in an environment of limited resources (financial, physical or human). In Ireland as in many other countries mathematics acts as a gatekeeper to employment and higher education. There is strict compartmentalisation within mathematics education at all levels. There is a lack of specialised training for teachers, especially mathematics teachers and adult educators. The need to have a teaching qualification to work within and between levels varies greatly within the system. Many teachers use traditional methods and are reluctant to alter the status quo. Strong teacher trade unions often make it difficult to introduce change.

Using this model in an ideal situation, all mathematics education, including adults learning mathematics, would form part of a seamless continuum with a strong foundation in education and would be based on the values and principles outlined earlier.

**Using The Model To Look At Mathematics Education In Ireland**

Ireland has a highly centralised education system administered and regulated by a central Government department, the Department of Education and Science. There are four distinct levels, Primary (4-12+); Second level (12-17+) comprising of a Junior and Senior cycle; Further Education and Higher Education. Almost all the adult education in Ireland, formal and informal, is located within the FE sector. Mathematics is a compulsory subject for all students throughout the formal education system. (For further information see O'Donoghue, J 2000).

At primary level a new mathematics curriculum has been introduced that advocates the use of constructivist and guided-discovery methods and stresses the importance of enabling the child to use mathematical language effectively, in discussion with the teacher and in group activities ( (Department of Education & Science 1999.). The terminal exams in mathematics at the end of the Second level, Junior cycle and Senior cycle places an emphasis in teaching and learning on the elements that are assessed to the neglect of those that are not part of the assessment. One of the key features of mathematics in the further education system is the sheer diversity of the number of organisations involved and the range of mathematics and mathematics related provision that exists for adults. Within the further education sector adult mathematics/numeracy provision can be broadly divided into four distinct categories.

*1 Mathematics of second level programmes (at Junior Certificate or Leaving Certificate level.)* Many adults opt to complete the Junior Certificate or Leaving Certificate programme despite the centralised examination because they feel the award has a value.

*2 Mathematics modules developed through the National Council for Vocational Awards.* The mathematics framework developed through the NCVA has been the subject of previous papers at the conference (Maguire and O Donoghue, 2000; O'Donoghue, 2000). Within this framework mathematics is regarded as a core element in a framework of 'life skills'

*3 Specific vocationally related mathematics*

Mathematics is also delivered by organisations with responsibility for specific vocational training. The maths completed by learners related directly a specific vocational area.

*4 Non- accredited numeracy/mathematics programmes*

A large number of adults do not complete any accredited programme of mathematics, instead an individualized training programme is devised to suit their particular needs by tutors. Provision of this type involves directly or indirectly the National Adult Literacy Association (NALA).

**So how does Mathematics Education in Ireland measure up in terms of the lifelong Education model outlined?**

Comprehensiveness and Coherence

The fundamental inconsistency in pedagogical approach between the primary and post-primary cycles which, if the new primary curriculum is implement in 'spirit' will be wider than is seen currently; may well cause additional problems in the future. The business of secondary schools seems focused on getting learners to higher education. The goal of secondary education as a preparation for life has been usurped and diminished and only gets attention during debates about early school leavers etc. Transitions between SS/FE and HE are not seamless but provide sharp interfaces, which students have to contend with in order to progress. Numeracy as a concept has not been problematised although it is a stated priority in primary school. In secondary school it is not a stated priority, its use is confined to the context of early leavers or under achieving students

Transparency and Simplicity

There is an evident lack of articulation within the system with few clear pathways for progression between the different levels of education. There is an absence of a system of equivalencies

Equality and Accessibility

Recently significant progress has been made in this aspect; workplace learning is coming on the agenda, as is accreditation for prior education and learning (APEAL), the availability of funding for part-time learners in FE (since 2002) has improved opportunities for learners. The higher education links scheme which provides a bridge between FE and HE has also had an impact. However Mathematics acts as a gatekeeper to progression and the focus of workplace initiatives is centred on literacy rather than numeracy.

Quality

There is a variability of standards because of the range of service providers especially in FE., Many tutors of mathematics at all levels have formal qualification in mathematics or training as teachers. At present responsibility for quality rests with the Department of Education however new legislation will shift this responsibility to providers.

Relevance

Mathematics education is not always relevant to the needs of the learner e.g. school mathematics for adults. A key aspect of the latter is the lack of tutor expertise especially in mathematics. A systematic professional development programme needs to be put in place to implement long-term change in the classroom.

**An Environment of Change**

There are changes taking place so the system is not static but here is an absence of vision. The development of the system has been piecemeal and is not based on sound educational principles, but it is becoming more coherent. New legislation in Ireland coupled with the results of the IALS survey and economic forces associated with the 'Celtic tiger' has prompted systemic changes in the existing system such that there is no part of the system that is not affected. Changes are taking place at primary level, secondary level at FE and HE level. Changes in Mathematics Education provision have resulted.

At primary level the new mathematics curriculum places less emphasis on long, complex pen-and–paper calculations and a greater emphasis on mental calculations, estimation and problem solving skills (Department of Education & Science 1999). However it is unrealistic to expect major alteration in pedagogy overnight; especially from teachers who have had limited opportunities to share in formulating the vision for change (Oldham, 1996).

At second level the Junior Cycle curriculum has recently been fine tuned, leading to very little substantial change other than a strong emphasis on how the subject should be taught ( promoting active learning) with a concurrent, on going, in-service programme for teachers. Assessment in mathematics however takes place solely by means of a terminal examination. The revision committee did recognise that a number of the objectives for Junior certificate mathematics cannot be met by this form of assessment for e.g. the student's ability to create mathematics, exploring and solving extended or non-standard problems and the committee suggest that on going development of the Junior certificate might address ways in which these areas can receive some coverage even in formal examination e.g. OECD programme for International Student Assessment (PISA). (National Council for Curriculum Assessment 2002.) The important thing from the perspective of the model posed is that it is on the agenda and the anomaly has been acknowledged at this level.

The most substantial changes are taking place at the level of further and higher education. The Qualifications (Education and Training) Act, 1999 will address the long-standing problem of lack of coherence in further and higher education qualifications in Ireland. Key principles enshrined in the Act, include access, transfer and progression for learners. The establishment of a national qualifications framework under the Act has the potential to bring about far-reaching change in Irish education and training and as a consequence in mathematics education. The Act also provides for the establishment of the Further Education and Training Awards Council and the Higher Education and Training Awards Council, as independent bodies with their own functions.

This legislation goes someway towards facilitating the setting up of a system of lifelong education in Ireland. However it has taken over two years, since the Act was passed, for any progress to be made in terms of implementing the legislation. The authority has now set very tight deadlines for the actual development of the framework. In this environment it maybe tempting to find 'quick fix' solutions to anomalies, with out considering the longer term or taking a holistic view. This outcome should be avoided.

Currently the National Adult Literacy Association have initiated the development of an assessment Framework for adult basic education that will reflect the values and principles of adult literacy in Ireland. According to NALA the framework will compliment existing provision and allow for access and progression to other qualifications e.g. Foundation Level NCVA. The framework has three levels built around four corner stones of progress; knowledge and skills; depth of understanding, fluency and independence; range of applications. It includes mathematics at a basic level. A weakness of the framework is that it has been done independently and without consideration of existing provision. The framework once established potentially will facilitate movement and transfer of learners, but

may also provide a system for measuring progress of learners that could be adapted by funding organisations as evidence of outcomes achieved.

Formulating the perfect system of lifelong Education as outlined is not easily achieved.

Mathematics education is situated firmly within the system of lifelong education. The model proposed advocates that a holistic view of mathematics education be taken in planning future development. The model provides a facility for identifying anomalies and tensions within the system so that systematic and coherent future development can be planned.

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**The differences between competence testing and diagnosing the underlying reasons for the problems some students have with mathematics.**

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The problems of many students of mathematics are such a riddle to their teachers that we feel powerless. For example, those students who are over or high achievers in many other subjects but who find themselves on a comparatively low level in mathematics. A competence test is seldom enough to help these students find their correct level of study. It is more important to attempt to identify the underlying reasons for their specific difficulties with mathematics.

Two years ago I produced a set of materials designed for screening difficulties in mathematics. The aim was to get the students to describe the strategies they had once learned which enabled them to work out simple calculations in their heads and even to describe any strategies of their own they may have evolved. This screening was conducted for the first time by two colleagues and myself on about two hundred and fifty adult students studying at secondary school level. The results of the screening showed that a vast majority of the students had underdeveloped or even seriously underdeveloped strategies for counting at the basic level. This could greatly explain their poor performance in mathematics and their general lack of self confidence in the subject. We developed a special introductory course, ”Develop Your Own Way of Thinking Into A Mathematical Way of Thinking”. The students who had shown underdeveloped strategies were offered the opportunity of undergoing an analysis designed to clarify the specific obstacles for their mathematical development. A screening test in word-decoding which the students underwent at the same time showed no correlation between undeveloped strategies in counting and poor word-decoding.

At the conference I intend to present some methods for revealing obstacles which may hinder the development of good counting strategies and also how we can help the students who have these problems develop their own ways of mathematical thinking.

I have been a teacher of adults and teenagers in Gothenburg for twenty years. As well as giving instruction and advice to other teachers, school leaders and parents I also conduct individual mathematical analysis for schools and the employment authorities.

# The education and the final examination must be a single coherent unit

**Per Ødegaard,**
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*When seeking new knowledge, adults often experience the education given as a confirmation of their earlier school defeats. Is it possible that they might experience education in a way which would make them analyse mathematics and take a positive approach to figures and graphs encountered in daily life?*

In 1993 the Norwegian Board of Education decided to work out a final examination on secondary school level specially tailored for adults. I had the pleasure to be in charge of the group to which the commission was given. I am also a teacher at an educational centre for adults in Bergen, Norway and this paper will reflect examples from my work. I will attempt to show how meaning and democracy have been incorporated in preparation of the task. I will start with a remark on the importance of awareness of the student's earlier learning history.

## The learning history

Many adults describe their return to school as very difficult. Earlier school experiences, defeats and the feeling of a return to an environment where nothing was achieved resurface when initially entering the adult training community. In conversations with adult participants of an organised education, they often describe the first meeting as frightening. They especially refer to the re-introduction of mathematics as the return of an old ghost.

It is of great importance that the teacher is observant and fully aware of the participants' previous learning history and attempts to change a negative past experience into a positive approach to self-development. Even simple elements, a classroom with the blackboard and the organisation of the desks, can reinforce all the feelings of a futile environment.

A new layout to the surroundings in which learning is to take place will contribute to a renewed motivation for the participants in their approach to re-entering the education arena.

Of equal importance, the teacher must bring to the forefront the students' previous interpretations of the mathematical topic.

## Mathematics as a sense giving subject.

Very often students have an understanding of mathematics as a topic where the most important element is to pick up a number of formulas, memorise and apply in the correct

context to arrive at the one and only correct answer to a problem. The problem solver may not necessarily understand the relevance of the components within the given formula. It is more important to examine the everyday understanding of mathematics than to examine isolated bits of knowledge.

One of the most revolutionary facts we give the students at the start of a course, is that they are allowed to make – and use throughout the course *and* even during their final examination – a book that contains formulas and examples needed for any mathematical problem solving. This information surprises the student because their understanding of mathematical skill is to remember formulas and use them in the correct way. It is important to inform the student that mathematics is also a means to analyse and make critical notes to figures, graphs and diagrams presented through the media. Above all it is important to discuss with the students that mathematics can be used to reflect a democratic attitude and influence on any mathematical matters they are exposed to. Adult students – and perhaps any pupils learning mathematics – are surprised at the fact that problems may have several solutions.

Mathematics has to be more than formulas and simple figures as the answer to a problem.

To solve a problem is a process and you are allowed to use different methods. Sometimes a drawing can be the simplest and best way to present a solution – and it is acceptable. It should be emphasised to the students that any way to an answer is a good way. The students should also be told that knowledge is not something you get, but something in which you are a participant.

We have to exploit the motivation adults have for seeking knowledge. In that respect we have to be good at giving the mathematical elements meaning and presenting them in a respectful way. The students must comprehend that mathematics is a topic where they can obtain means and tools to participate, comment and constructively criticise any numerical or graphical object they encounter. For example, it is important that they can decipher any potentially misleading advertisements from the media. To make people analyse and understand mathematical objects is the main task in educating people for ground level mathematical skills.

**The education and the final examination must be one unit.**

To be able to attend secondary school courses students have to pass an examination at the same curriculum level as the $10^{th}$ grade in our ordinary education system. The curricula are equal in content and topics, but the educational path is worked out by the authorities which will guide the teachers during the relevant course. Even though the curricula are the same, the Department of Education has decided that the final examination for adults should be worked out separately; this has been done for ten years. The contents of this final examination vary a great deal from the traditional mathematical task given in the $10^{th}$ grade examinations. The students are often very motivated for new learning, excited about the frames of education given and the reality of the examination.

The number of students taking the final national examination varies over years between 600 and 1000. Our students are people who for various reasons have not finished their obligatory school, or who want to improve their grades. Their motivation for attending school is often very high and many of our students have, in spite of what we could believe, a great potential for learning mathematics.

For the education to be functional according to the goals set by the government, the final examination has to be fit for the intended purpose. In this respect the final examination includes elements the students can recognise and relate to by incorporating problems encountered in everyday adult life. The Norwegian final examination also takes seriously the fact that knowledge is created in a dialogue with others. The Norwegian examination gives the students an opportunity to discuss a problem with others – as we certainly would do in real life – and then to present an individual solution to the problem. The social competence developed in the course must obviously be a part of the final examination. In Norway we have implemented a dialogue break where students can co-operate and discuss for 45 minutes.

Furthermore, tasks from the final examination must support Mogens Niss' (1990,1994) democratic aspect of mathematical education. It is essential for a democratic development of the society that everybody can act actively and critically on mathematical subjects wherever they appear, open or hidden, in society or in every day life. If we were to change students' mathematical knowledge the final examination have to bear in mind all the above-mentioned facts. These tasks will force teachers to change both educational practice and assessment.

Our new way of presenting mathematical tasks was not received with enthusiasm for the first two years; in particular, the response from teachers was furious. They were no longer allowed to just repeat previous problems based on ability by the students to have memory recall and reproduce. But as years passed, our most persistent opponents are now our greatest fans. The working group has recognised a remarkable change in attitudes to mathematics and education over the last years. Feedback from our students has been exclusively positive. Last year one of my students exclaimed at the end of the course: "This have been so exciting, when I came here for the first time I saw a huge mountain in front of me", he paused and continued, "and, Per, - now I am at the top".

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# Numeracy and Human Rights; some reflections

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On the surface, the UK appears to have moulded an internationally recognised human rights paradigm, flexible enough to thrive in a global political climate, yet accessible enough to appeal to the general population. Instrumental to this success has been a general awakening to the "human rights industry" aided as much by legislation as by the popular press.[1] Although it remains too early to state with any degree of certainty, initial reports suggest that the Human Rights Act has been quietly (if a little too quietly) adopted by public authorities. Whilst it is evident that in the majority of instances, the government appears to have enthusiastically embraced the ethos of human rights, since the adoption of the Anti – terrorism, Crime and Security Act, 2001, the practical implementation of these rights for internees remains sporadic.[2]

Paradoxically, it is often such a dichotomy (between state rhetoric and state practice) that becomes a useful tool for exploring mathematical processes, in particular statistics, as well as discussing the implications of life long learning.

Traditionally, maths in the UK has been taught in a contextual vacuum, divorced from either political or social meaning. Over the last decade, changes have introduced a curriculum based on the workplace with an emphasis on life long and active learner participation. On the whole, this move has been welcomed; with up to 40% of adult population struggling with the fundamental principles of numeracy, few would argue against concentrating on the basic number skills necessary for the work place and home setting. However, many practitioners are concerned such an industry-dominated curriculum will be at the expense of, rather than complementary to, the principles of mathematics and education. For optimism to remain amongst UK maths teachers, a flexible attitude towards the curriculum remains essential. In order that adults engage the philosophy of life long learning, a broader vision of education is necessary, reflecting the needs of the learner.

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1 "Although the press on the whole readily supports the principles on human rights, in its time, it has opposed almost every campaign to redress the inequalities of power disaffecting those groups excluded from positions of social power."Civil Liberties in Conflict, edited by Larry Goslin, Routledge, London 1988 137

2 In February 2002, Members of The European Committee for the Prevention of Torture and Inhumane and Degrading Treatment or Punishment visited Britain in order to investigate the treatment and conditions for the detainees under the anti – terrorism legislation. According to John Wadham, Director of Liberty, "The Committee's visit shows just how far Britain has stepped beyond the normal bounds of justice with these anti terrorism powers."

The Adult Numeracy Core Curriculum aims to empower the learner by improving the skills necessary for employment. Critics argue that such empowerment is primarily founded in rhetoric rather than in implementation (to encourage social mobility and ensure equal opportunities). However, a numeracy curriculum that is based on training for work, but which incorporates the wider social issues (including human rights and development) will provide an educational framework for the learner to challenge previously held assumptions thereby providing a real impetus for self empowerment.[3] It is in this vein that the purpose of this paper is to highlight the informal links between human rights (and development) and the industry-led numeracy curriculum rather than to attempt to provide a framework for a formalised revolution in the educational agenda for Further and Higher Education.

**An Introduction to Human Rights Law**

Domestic law is governed by the relationship between governmental bodies, private individuals and groups of individuals; however, international human rights law has a number of unique legal characteristics. Primarily, it is not written in absolute terms, with a few exceptions, and can in many instances (particularly since the events of September 11th) be lawfully derogaded. As such, international human rights law guides (as opposed to rules) the relationship between apparently equal sovereign states, and as such, lacks a supreme authority.

The United Nations General Assembly is not a world legislator and the International Court of Justice (ICJ) has no jurisdiction to operate unless it gains the consent of the sovereign state it is challenging. An interesting, although often disturbing topic for mathematical debate, and indeed a striking example of the power derived from the ability to represent numerical information, is the 1503 procedure; the means by which a community (or its members) can initiate criminal procedures against a state.[4] It is particularly useful for higher level classes to examine the dichotomy between using a subjective reporting model (eye witness accounts) of objective statistics (physical evidence of the number of victims is required).[5]

A useful, although over simplified, demarcation in the structure of International law places human rights within three categories.

Blue Human rights: Referring to Civil and Political rights, blue rights comprise many of the fundamental values of a democratic society: pluralism (the right to vote and multi-party democratic models), tolerance (the right to a fair trial and security in the home) and broad

[3] Roseanne Benn, Adults count too: mathematics for empowerment, NIACE, Leicester, UK 1997

[4] www.un.org. You can find country specific, or violation specific, reports under the special rapporteur section

[5] For an in depth report on the analysis of human rights data can be found in the Human Rights Quarterly, Volume 8, Number 4, November 1996

mindedness (freedom of thought, consciousness and religion). These are considered the most enforceable of human rights and they are often dovetailed with aid packages. Whilst the majority believe the language of human rights to be a useful tool for discussion, a sizeable minority are concerned by the merging of human rights with free market ideologies, effectively restricting the accessibility of human rights to purely those states engaging in democratic governance.

The second stratum of rights are the Red rights setting out the Social and Economic rights. Red rights are often the most interesting to educationalists as they focus on social issues: The right to education, the right to a family life, to just and favourable working conditions. Due to the Sovereign nature of these rights (most full under the jurisdiction of domestic law), international law has yet to provide a meaningful enforcement mechanism.

The third stratum is often referred to as Green or "Soft" laws and is widely regarded as both voluntary and unenforceable, particularly by the Unite States of America. Such rights encapsulate the principles of sustainable development, including the right to development, and the right to a safe environment. Human rights and international development can provide numerous opportunities to investigate and debate mathematical paradigms incorporating a social, political and economic context into the learning process. Human development country indicators can provide a useful discussion basis, particularly statistics [6] as can an investigation, for example a comparison between the readjustment policies of the Breton Woods Institutions as compared to juxtaposition taken by the Grameen Bank or other Fair Trade paradigms.

**The UK's Human Rights Act (The Act)**

Historically, the British public has demonstrated a capacity to understate and under-participate during political and legal transition. Yet the Human Rights Act could be viewed as Britain's twenty-first century "bloodless revolution"!

There are three main strains underlying its ethos[7]:

4. To ensure every branch of the government, public authority and private body with a public function, acts in a manner compatible with the European Convention of Human Rights (ECHR) drafted in 1949. These rights focus primarily on the "Blue" civil and political rights, with a popular emphasis on the "Red" Rights and at a pinch the "Green".

[6] useful websites include the Human Development Index and the New Internationalist's World Guide, which is updated yearly

[7] More information on the Human Rights Act can be found at www.homeoffice.gov.uk/hract.

- To provide a domestic remedy, without delay, for those individuals who believe their rights have been denied.
- To create a culture of human rights. Although the Act does not explicitly set out the role of educational public authority in a legally binding manner, implicitly it encourages a change in structure to stimulate the growth of a human rights culture.

At its most sensationalised, 20th October 2000 saw the Labour government voluntarily[8] diminish its own power base. Parliament can no longer pass legislation if it is not considered compatible with the Human Rights Act. Consequently, public authorities including the police and national courts "are no longer constitutionally bound to act in the manner that parliament intended; instead they are now required to interpret every law in a way which complies with human rights principles as far as possible."[9] The implications of the Act are far reaching as is the government's approach to human rights. The present situation in Iraq, the role of business in determining international policy, provides a good example of the conflicts that exist between the human rights ethos, policy and the practical implementation of rights.

At its most sceptical, The Act is little more than a legal showpiece undermined by a mismatch between the government's words and deeds. Whilst in many instances it provides a genuine framework by which to discuss and question policy and legislation, it is argued that the government has neglected to provide sufficient economic or political resources to ensure its enactment.[10]

In order for a law to be assimilated into a legal and political culture, society must become actively involved in its own transitional period. However, the government, by providing funding to secure the role of the judiciary[11] over education has ensured that the Act remains firmly within the control of the lawyers. It is highly unlikely that a Human Rights Act that has been imposed from above, will in isolation create the conditions necessary to stimulate a culture of Human Rights, yet few financial resources have been allocated to either disseminating information or promoting, and safeguarding, institutional change within public

[8] There has been no national political threat to the labour government to speak of and there has been little international pressure calling for a UK Bill of Rights. Values for a Godless Age: The story of the United Kingdom's New Bill of Rights. Francesca Klug, London, Penguin, Sept 2000, 19

[9] Supra 6 Klug, 19

[10] The Human Rights Act One Year On, John Wadham, The European Human Rights Law Review, 2001 FN2

[11] "It is somewhat ironic that after 200 years of democracy, nationals and non nationals living in the UK are invited to question legality of the (elected) government policy through the Human Rights Act which relies on the (appointed) judiciary in the event of a human rights violation. A judicial system that was rocked by the series of infamous miscarriages of justices during the 1980's..." (Neyroud, Peter, Policing ethics and Human rights, Willan, Devon, 2000, 60).

authorities. This is especially true of education. An average primary school is likely to receive between £130 and £230 and a secondary school between £1000 and £1600 for teaching training[12], as compared to the £4.5 million budgeted for retraining lawyers and judges.[13] Funds for further and higher education are, as yet, not available.

In addition to financial constraints, critics are disillusioned by the content of the Act. The ECHR is a product of its era, containing no free-standing prohibition against discrimination. For the purpose of this paper, The Act incorporates the ECHR into domestic law, yet the grounds on which it regulates discrimination within a public authority are extremely broad. Although a number of national Acts provide safeguards in certain instances, it remains the fact that the UK government did not ratify Protocol 12 of the Convention[14] which provides for a law against discrimination per se - particularly relevant to the issue of asylum seekers finding refuge in the UK. An excellent source for data concerning the inhospitable environment for non-British Citizens can be found in Teresa Hayter's "Open Boundaries: the Case for Immigration Control".

A mid-ground, and probably more realistic view regards The Act as "part aspiration, part symbolism and part law":[15]

> "The Act gives every citizen a clear statement of rights and responsibilities ... it requires all of us in public series to respect human rights in everything we do ... It is (however) too early to say whether public officials will take this appeal seriously."[16]

Even taking into consideration these limitations, the Act should radically transform the manner in which public authorities operate. Prior to October 2000, public authority employees were ordinary citizens carrying out ordinary duties. Since enactment such employees (including teachers) are now duty bound to consider the human rights implications of every action. As such, Further and Higher Institutions have acquired the positive obligation (moral rather than legal[17]) to impart relevant human rights knowledge and training.

It is essential to highlight that this legal obligation is neither non-statutory nor is it even stated within the Act. It will not result in the mass arrest of every tutor failing to incorporate

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[12] www.dfee.gov.uk/a-z/

[13] Supra 8, Wadham FN15

[14] Supra 8, Wadham, FN13

[15] Supra 6 Klug 21

[16] Supra 6 Klug 27

[17] Although the McPherson reforms for the police have gone some way to legalise the obligation.

human rights within their 2002 / 3 syllabi. The extent to which learners are exposed to human rights remains firmly with the grass roots of an institution. However, it does provide an opportunity to revisit existing curricula and develop new links with a human rights culture, which were previously thought not to exist, and is relevant to the teaching of numeracy.

**How should Further and Higher Education lecturers approach the teaching of politics and ideology?**

The false dawn of citizenship in the 1960's instigated much research into the teaching of politics and other subjects likely to evoke an emotional response from the learner. Typically, the research highlighted the critical nature of the language adopted and the links that exist between language, power and ideology. However, an international consensus on the importance of language by no means assumes consensus over ideology or even the body of knowledge for learners to acquire. The Crick report in the UK highlighted the need for learners, particularly children, to learn moral values, but did not sufficiently address *whose* values. As such, numeracy teachers embarking on human rights education cannot perceive it as a neutral or objective study and consequently the question of language and content must be addressed.

Internationally, some state and non-state actors have adopted a more radical approach, viewing education as an agent of social change. The means by which to deconstruct existing educational and social structures draws on the works of Freire, Gramsci, and Edward Said. It is of significance that, *despite* the rise of democracy, liberation pedagogies are still visible today in many post colonial societies. For example, the Landless People's Movement in Brazil currently sponsors 85,000 primary school children. Although this paper does not argue for a revolutionised overview of educational policy in the UK this resurgence of radical educational pedagogies (especially during a trend towards global democratisation) is interesting. The United Nation's Millennium Declaration, provides a useful set of economic and social targets (for the year 2015) underlying discussions concerning the globalisation and / or development.[18]

The juxtaposition to the radical approach, as taken by the UK government, is more conciliatory by nature and looks to incorporate human rights into existing policy.[19] If human rights education is to formally permeate educational policy on a national level, it will inevitably become intrinsically entwined with Citizenship, a statutory requirement in secondary schools.[20] However, although Citizenship in FE is unlikely to become a statutory

[18] The Millennium Declaration specifies a number of targets for the reduction of poverty by the year 2015.

[19]Information about the Paten recommendations of placing human rights at the cente of public authorities can be obtained from the Liberty website www.liberty-human-rights.org.uk

requirement (a more probable outcome will be the emergence of a new key skill), the formal learning content will inevitably be restricted by a government led syllabus. Fortunately, the provision of human rights training per se is unlikely to become such property of the government and by incorporating human rights with numeracy, lecturers and the learners can allow for a more personal interpretation of content and style.

In conclusion, the Human Rights Act is likely to make an impact (or at least a ripple) in everyday life and consequently, the future role of maths at home may be just as likely to encompass budgeting, as lobbying local government. Accordingly, it is important for the adult numeracy core curriculum to retain the space to develop an understanding (and practice) of transferable mathematical skills. A curriculum based on human rights, development and training for work will provide an educational framework, which not only meets the needs of the employment market, but also embraces the wider mathematical skills that accompany rational debate and problem solving.

## Books


| | |
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| Philip Alston (ed) | Human rights law (New York: New York University Press.1996) |
| Roseanne Benn | Adults count too: mathematics for empowerment, NIACE, Leicester, UK 1997 |
| Bernard Crick | Essays on Citizenship (Continuum International Publishing Group - Academic and Professional, 2000) |
| Theresa Hayter | Open Boundaries, the Case for immigration Control. (Pluto Press, London 2000) |
| Francesca Klug | Values for a Godless Age: The story of the United Kingdom's New Bill of Rights. (London, Penguin, Sept 2000) |
| Neyroud, Peter 2000 | Policing ethics and Human rights, Devon, Willan publishing, |
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## Journals


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| John Wadham | The Human Rights Act One Year On, The European Human Rights Law Review, 2001 |
| The Human Rights | Statistical Issues in the field of Human Rights. (Vol 8 Number 4 Quarterly November 1986) |


## Websites


www.dfee.gov.uk/a-z

http://www.dfes.gov.uk/14-19greenpaper/


[20] For further details please refer to the Green Paper on education for 16 – 19 year olds and for a general insight into Citizenship refer to Bernard Crick's Essays on Citizenship.

www.grameen-info.org

www.hdr.undp.org/

www.homeoffice.gov.uk/hract

www.fairtrade.org.uk

www.imf.org

www.newint.org

www.un.org

www.worldbank.org Development database

### *Teaching resources*

| | |
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| Dr G Joseph | The crest of a peacock: Non European roots of mathematics. (IB Tauris 1991) |
| UNDP | The Human Development Report (Oxford University Press) |
| Oxfam | Mapping our world (1993) |
| P Wright | The maths and human rights resource book (Amnesty International) |
| | Summing up the world: mathematics activities with a global perspectives (1993) |

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# Index


**Name** **Page No.**

***A***

Angiama, Richards ..... 151
Ayoub, Tiggy..... 193

***C***

Coben, Diana ..... 24
Civil, Marta ..... 13
Colleran, Noel ..... 70
Colwell, Dhamma..... 203

***E***

Evans, Jeff..... 60, 82

***G***

Gillespie, John ..... 93

***H***

Hansen, Eigil ..... 159
Healy, Pat ..... 165
Hermeler, Ben..... 166, 214
Hillier, Yvonne..... 171

***J***

Johansen, Lene..... 204
Johnston, Betty ..... 107

***Name*** ***Page No.***

***K***

Kaye, David ..... 102

***L***

Lindberg, Lisbeth ..... 55
Lindenskov, Lena..... 66, 214

***M***

Maasz, Juergen..... 46,174
Maguire, Terry..... 66, 107, 221
Malmivuori, Marja-Liisa ..... 116
Murphy, Eamonn ..... 70

***N***

Nankler, Jan ..... 230
Newman, Kate..... 181

***O***

O'Donoghue, John..... 34, 70, 221
Ødergaard, Per ..... 231

***P***

Part, Tracy..... 235

***R***

Randall, Caz..... 189

**Name** **Page No.**

***S***

Safford, Kathy..... 46, 124, 139
Schlöglmann, Wolfgang ..... 61, 143, 174
Seabright, Valerie .....190

***W***

Wolf, Alison.....44

***Y***

Yasukawa, Keiko .....107

# POLICIES AND PRACTICES FOR ADULTS LEARNING MATHEMATICS: OPPORTUNITIES & RISKS

The theme of the conference is for us in Britain particularly important at the moment. We have a new 'national strategy' for adult basic skills (literacy, numeracy and English for speakers of other languages), which includes a centralised curriculum and many directives about how to teach and organise courses. Of course we are pleased about the 'opportunities' provided by so much expansion in adult mathematics education - but there are also very serious 'risks'. For example, in order to 'motivate' people to join courses, the government is considering withdrawing unemployment benefits if people refuse a course, and refusing parole to prisoners who refuse a course. There are other risks too, inside the view of mathematics: for example, the government says that the skills of mathematics are universal and neutral, the same for adults and for children, and that a changing context has no effect on the core of what must be learned. So the government's discourse is of a tutor who brings the 'skills', to 'teach' them to a student who brings the 'context'. Such simplistic views have long been criticised by mathematics education research. In addition, in the world of adult mathematics education beyond the 'basic' level, the government is also becoming very directive, for example within teacher education.

For the conference participants who came from Britain these are very serious issues. But we wanted to be sure that we had also an international perspective. Thus, we are pleased to include papers from several participants from Scandinavia, where similar issues and policies are under discussion or already launched; there are other papers or workshop reports that address these issues, from a European or worldwide perspective.

Website

Further information about Adults Learning Mathematics (ALM) may be obtained from the website www.alm-online.org