Squaring the circle?
Some Thoughts on Improving Adult Numeracy in Aotearoa New Zealand

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with
Greetings from the 18th international conference of Adults Learning Mathematics – A Research Forum (ALM18) in Dublin, Ireland
Squaring the circle – mathematically... and colloquially

The areas of this square and this circle are equal. In 1882 it was proved that this figure cannot be constructed in a finite number of steps with an idealised compass and straightedge.

Colloquially, squaring the circle means trying to do something impossible.
Squaring the circle

- Survey evidence of low levels of adult numeracy in several industrialised countries
- Response: research and development geared to improving the situation
- BUT positive outcomes cannot be guaranteed and benefits may materialise in long- to medium-term
- Meanwhile, politicians, policy makers, educators, the general public and adult learners want immediate and sustainable improvement

Can this circle be squared?
A pause for reflection at the NCLANA 2011 Symposium: *Getting results: Making a difference for New Zealanders* – *Me Whai Hua Ka Tika*

- New Zealand: the present situation with respect to adult numeracy
- Numeracy and literacy make a BIG difference – to individuals, to society, to the economy…

I offer my thoughts, based on my experience in England and elsewhere
‘Catching the Knowledge Wave’ in New Zealand

The problem is that the dominant discourse of business and economics would define education as a servant of the economy, and knowledge as the prime material of economic value, displacing the traditional liberal account of education as the principal means to social justice and democratic citizenship.

The need, if New Zealand is to retain an effective public education system, is for collective agreement on a new account of the social and personal purposes of education. (Gilbert, 2007)
Jane Gilbert argues that

- NZ education system’s structure, its organising principles, and the assumptions that underlie it are designed to support an industrial age society.
- This system will not be able to meet the human resource needs of a knowledge-based society, and it will definitely not offer equality of opportunity.

How well-placed is NZ to ‘catch the knowledge wave’ with regard to adult numeracy?
Adult mathematics (or numeracy) in knowledge societies

• Still poorly conceptualized, and, despite recent activity in the UK, Australasia, North America, Europe and elsewhere, still under-researched and under-developed
What does it mean to be numerate (or mathematically literate) in a knowledge society?

- Substantial debate on how to define and characterize adult numeracy/mathematical literacy - no universally accepted term or definition

- ‘Numeracy’ only recently included in the International Standard Classification of Education (ISCED) as: “Literacy and numeracy: Simple and functional literacy, numeracy” (UNESCO, 1997)

- Reductive ‘limited proficiency’ visions of numeracy persist
The importance of problem-solving

- Fast pace of technological and societal change increasingly requires problem-solving skills at very different levels
- Pure knowledge-driven strategies for successfully coping with the complex challenges of our daily private and professional life will fail due to the sheer amount of available knowledge
- Sound strategic knowledge and adequate problem-solving abilities are needed to organize complex information and to deal with potentially competing goals
- The ALL study provided problem-solving oriented frameworks for prose and document literacy and numeracy
- Problem-solving plays a crucial role in PISA

(Reeff, et al., 2006).
Literacy and numeracy in New Zealand

- In 1996 and 2001, those in the lower levels of literacy were less likely to take part in adult training than those with literacy levels 3 or above.
- Pacific peoples show the highest participation rate in training programmes, yet are one of the ethnic groups most at risk of low literacy levels.
- Those of Level 1 literacy, when working, are largely in blue-collar occupations and in the manufacturing and agricultural, and hunting and fishing industries.
- Those with three years or less secondary education and those who are unemployed or looking for work are most likely to fall into the lower levels of literacy proficiency.
- Regional analysis indicates that higher proportions of those in Levels 1 and 2 are found in parts of the East Cape, Bay of Plenty, Taranaki, the Far North, and Auckland.

(Ministry of Education, 2005)

- For all reported age groups in the 2006 ALL Survey, more than half of Māori adults in 2006 had low skills. (Satherley & Lawes, 2009)
Analysis of data from the Adult Literacy and Life Skills (ALL) Survey 2006 finds 3 key factors can account for a large part of the variation between people aged 25-65 in their literacy and numeracy skills:

- completed education
- language background
- computer use

Computer use strongly associated with higher literacy and numeracy, especially combination of work and home computer use

Computer use associated with intensive and extensive reading, writing and numeracy practices

Work computer use or non-use divided jobs broadly into those that required higher literacy and numeracy and those that did not

Large overlap between groups of people with low literacy and low numeracy, and the group of people who did not use a computer at work

(Lane 2010)
The adult numeracy story in England

• 23.8 million adults scored at Level 1 or below. 47% (15 million) of working age population at Entry Level 3 or below, including 21% (6.8 million) at Entry level 2 or below

• Even those with very poor skills did not perceive themselves to have difficulties

(DfES, 2003)
Numeracy in England

Clear evidence that:

• Numeracy is centrally important to the economic, personal and social well-being of adults

• Among teenagers, some improvements in numeracy/mathematics

• For younger children, aged 7-11, socioeconomic status may have less influence on mathematics scores than on literacy, and low-income high achievers appeared to improve more than high achievers in high-income families (Carpentieri, 2008)
Skills for Life

- National strategy for improving adult literacy and numeracy skills in England
- New infrastructure – curriculum, national tests, professional development for tutors, surveys, etc.
- Geared to national targets for learner achievements
- BUT achieving SfL targets ≠ solving the problem of poor adult literacy and numeracy
  - lure of the ‘quick fix’
  - low-hanging fruit
- Revised targets (lower level): 95% of adults to achieve the basic skills of functional literacy and numeracy by 2020, an increase from levels of 85% literacy and 79% numeracy in 2005 (Leitch, 2006)
Are there ways of squaring the circle?
Modern definitions of numeracy imply:

effective **use** not just knowledge and skills

**Purpose** making sense of use

**Situatedness** shaping use and purpose

**Critical engagement** on the part of the numeracy ‘agent’
Re-conceptualising numeracy
Mapping concepts on a continuum of development through increased levels of sophistication:

*Formative* ---* Mathematical ---* *Integrative*

- **‘Formative Phase’**, numeracy is considered as basic arithmetic skills
- **‘Mathematical Phase’**, numeracy is ‘mathematics in context’, entailing explicit recognition of the importance of mathematics in daily life
- **‘Integrative Phase’**, numeracy is viewed as “a complex multifaceted sophisticated construct incorporating the mathematics, cultural, social, emotional and personal aspects of each individual in a particular context” (Maguire & O'Donoghue, 2003)
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<th><strong>ADULT NUMERACY IN DOMAIN ONE</strong></th>
<th><strong>ADULT NUMERACY IN DOMAIN TWO</strong></th>
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<tr>
<td></td>
<td><em>use value low; exchange value high</em></td>
<td><em>use value high; exchange value low</em></td>
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<tr>
<td><strong>Why?</strong></td>
<td>To gain access to institutions of modernity; based on the belief that to be numerate is beneficial both to the individual and to society; for accountability</td>
<td>To do something; to understand something; for proficiency</td>
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<td><strong>What?</strong></td>
<td>Through a formalised, standardised, certificated curriculum, positioned as ‘basic skills’ (Kanes’ ‘visible-numeracy’). Content is abstract or divorced from context (although context may be simulated, often in highly stylised ways)</td>
<td>Through informal, non-standard mathematics practices which may be (dis)regarded as ‘just common sense’ by all concerned; invisible mathematics; Kanes’ useable-numeracy”</td>
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<td><strong>How?</strong></td>
<td>Through teaching; learning materials may be technologised, unitised, commodified Tools, including ICT, may be used; the written form is privileged</td>
<td>Through social activity or alone ‘in your head’ Tools, including ICT, may be used; orality is the norm</td>
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| **Who?**         | Learners: those deemed to be deficient in mathematics  
|                  | Teachers: professional experts (NB this is problematic in adult numeracy as the concept of numeracy is debated and the field of professional practice is poorly defined); non-professionals; volunteers | Learners: everyone, as part of processes of enculturation into ‘communities of practice’  
|                  | ‘Teachers’: more experienced people, who ‘know the ropes’ |
| **When?**        | At set times (except in Open and Distance Learning, ODL) | Anytime, incidental to other activities |
| **Where?**       | In set locations, except in ODL | Anywhere, in context, in ‘real life’; ‘everyday life’; workplace |
Conceptualising adult numeracy in terms of conceptual sophistication and discursive domain

Discursive domains of adult numeracy

Domain One

Degrees of sophistication

Formative \( \longrightarrow \) Mathematical \( \longrightarrow \) Integrative Phases

Domain Two

(adapted from Coben, 2006)
Conceptualising adult numeracy: new directions

- Numeracy operates in two discursive domains characterised by different degrees of use value and exchange value. Combining Maguire and O’Donoghue’s (2003) conceptual framework with these domains offers a way of organizing competing definitions and locating frameworks, standards and curricula (Coben, 2006)

- Integrative definitions of numeracy have influenced recent pedagogical frameworks and standards

- Constructivist views of learning have been influential (i.e., learners actively construct knowledge by integrating new information and experiences into what they have previously come to understand)

- A broad range of research is relevant
Use value and exchange value are both necessary in a knowledge society

50% of UK employers are dissatisfied with the basic numeracy of UK school leavers

Many firms see a grade C or above in mathematics and English at GCSE as a benchmark of employability. But in 2007 barely half (55.2%) hit that standard in mathematics

(CBI, 2007)

We need to see numeracy in terms of both social practices and skills
What about the adults?
Research on adults’ mathematics life histories

- The *brick wall* – the point at which mathematics stopped making sense
- The ‘significant other’ – someone perceived as a major influence on the person’s maths life history
- The *door* – marked ‘Mathematics’, locked or unlocked, which people have to go through to enter or get on in a chosen line of work or study
- *Invisible maths* – the mathematics someone can do, but which they may not think of as maths at all, ‘just common sense’

(Coben 2000)
Professional/practical issues to be – and being – addressed in NZ and elsewhere

• How to find out what adults can actually do mathematically, how they use and understand mathematics, how it features - or might feature more productively - in their lives

• How to
  – organise provision
  – teach, learn and assess for adult numeracy
  – recruit, prepare and professionally develop adult numeracy teachers and managers
  – design population surveys

• Who are
  – teachers, learners, non-participants…?
Practical solutions

• Rigorous, humane ‘use-inspired basic research’ (Stokes, 1997) linked to sustainable development of the field

• International comparisons and collaboration
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<tr>
<th>Research in Pasteur’s quadrant (Stokes, 1997)</th>
<th>Considerations of use?</th>
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<tr>
<td>Research is inspired by…</td>
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<tr>
<td>Quest for fundamental understanding</td>
<td>No</td>
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<tr>
<td>Yes</td>
<td>Pure basic research (Bohr)</td>
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Use-inspired basic research on adult numeracy

- Broad focus on mathematics in a range of different settings
- Engaging with adults’ diverse:
  - mathematics life histories
  - purposes for learning
- Addressing social exclusion
- Broad focus on numeracy content
- Integrated approach to numeracy and mathematics education, discrete and integrated with other subjects
- Aim to maximise progression for learners, staff development for practitioners, new knowledge and deeper understanding for all
- Teacher researchers fully integrated into research teams
- International perspective, including
  - ALM - Adults Learning Mathematics - A Research Forum [www.alm-online.net](http://www.alm-online.net) - ALM19 conference, New Zealand, 2012, hosted by NCLANA
  - USA Adult Numeracy Initiative
  - EMMA (European Motivational Mathematics for Adults) network [http://www.statvoks.no/emma/index_partners.htm](http://www.statvoks.no/emma/index_partners.htm)
  - Australia: surfing the adult numeracy wave - which crested in Australia in the 1990s (Coben, 2006)
Research-based teaching for numeracy

- Builds on the knowledge students bring
- Exposes and discusses common misconceptions
- Develops effective questioning
- Uses cooperative small group work
- Emphasises methods as well as answers
- Uses rich collaborative tasks
- Creates connections between mathematical topics
- Uses technology in appropriate ways

(Swan, 2006)

and

- Uses formative as well as summative assessment… There is firm evidence that formative assessment improves learning.

(Black & Wiliam, 1998)
connectionist teaching

PUFM positive attitudes

depth progress

critical numeracy
Some research recommendations from NZ

1. LNL teachers: A large-scale survey would provide useful baseline information for the future expansion of both initial and on-going professional development programmes. Any study should encompass whether tutors work with ESOL learners and/or teach numeracy. When investigating numeracy information would be useful on what they teach, what their professional development needs are; and their beliefs and perceptions of self-efficacy related to their own numeracy.

2. Authentic curriculum: it would be very useful to identify to what extent authentic curriculum is being incorporated into teaching across the variety of contexts of LNL provision in New Zealand, and analyse issues around its use and the opportunities this approach offers us.

3. Learner-focused longitudinal research: a longitudinal, intensive study of approximately 20-30 learners over two years (with the expectation of 5-10 dropping out over that period) could provide information about what learners believe they learn, how their LNL skills progress and what they believe has helped and hindered them. A case study approach would also provide a rich description of additional programme factors, for example, effective recruitment, attendance patterns, barriers to participation, and learner progression on to other outcomes in work and education.

(Benseman, et al., 2005)
Sustainable research for positive development

Let’s make the most of opportunities for research to get results and make a positive difference for New Zealanders

What will you do?
References

Coben, D. (2006). Surfing the adult numeracy wave: What can we learn from each other in the UK and Australia? In M. Horne & B. Marr (Eds.), Connecting Voices in Adult Mathematics and Numeracy: Practitioners, researchers and learners. (pp.82-87). Melbourne: ACU/ALM
And much more besides… see NZ Literacy Portal http://www.nzliteracyportal.org.nz/
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