Strengthening the N in LLN – Why Addressing Numeracy Skills is Crucial

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Strengthening the N in LLN

KERRY MILLARD

YOU'RE RIGHT; BY JOVE!
The DECIMAL POINT IS IN THE WRONG PLACE.

The square root of 9 is 3.
A) True.
B) False.
C) Who cares?
Strengthening the N in LLN
The N in LLN

Injury Hotspots
Slips, trips and falls

Table:
- Slips: 7%
- Trips: 1.3%
- Falls: 12%
- Fingers, hands, wrists: 46%

See over the page for some safety solutions.
PROCESSING INSTRUCTIONS
1. Product to be held in Blast Chiller no less than 12 hours before slicing.
3. Check internal temperature. The optimum internal temperature of logs before slicing should be between 0 to +4°C. If above 4°C, move to Blast Freezer for 30 to 60 minutes. When temperature is satisfactory, return product to Shingled Meat Room & record on ‘Temperature Control Check Sheet’.
4. Fit logs on slicer (end of logs may need trimming to get gripper to hold).
5. Check weight of slices as per procedure 5-09-07.
6. The net weight of 7 slices should be between 100 and 105 grams.
7. Adjust slices if net weight is outside those specifications.
8. Place 7 slices in the moulded bottom film on Tiromat machine.
9. Avoid meat contacting the sealing edges of the film.
10. Place loose packs in the plastic bin (remove sliced product and re-package).
11. Assemble the box for Roast Beef, place 8 labelled packs and fold the box.
12. Place folded box inside the tape machine.
13. Stack boxes on the pallet and move to Despatch Chiller.

QUALITY CHECKS
• Log internal temperature before slicing: 0 to 4°C
• Net weight: 100-105 grams
• Slice thickness: approx. 2mm
• Unit size: approx. 105mm
• Unit per package: 7 slices
• Correct use by date (refer to daily use by date listing)
• Correct label positioning – visual inspection
In workplaces we use:

- Measurement, including of areas/volumes
- Numbers in all forms – whole, fractions, decimals, percentages
- Quantities – rates, \$/m, \$/m^3 etc
- Ratios
- Statistics – tables, graphs, averages
- Geometry and shapes
- And yes, we do use algebra!

L&N in the 21st Century

Not just low level skills – a continuum from low level (beginning primary school) through to a very high level – up to Uni levels.

Not just the 3 R’s of basic reading, ‘riting and ‘rithmetic

Work and life in the 21st Century demands higher level L&N skills.
PISA – the Programme for International Student Assessment
- carried out with a random sample of 15 year old students from a random sample of schools, every 3 years
- last assessment was in 2012 and major domain was mathematical literacy
- focuses on mathematical, reading and scientific literacy
- administered in pen and paper with an optional computer based assessment (Australia did both formats)

PIAAC, the Programme for International Assessment of Adult Competencies is an international survey of adult skills in:
- literacy, numeracy and problem solving in technology-rich environments
- ABS conducted this household survey in Australia in 2011-12
- Australia over samples and surveys a representative random sample of 15 – 74 year olds
- the survey can be done by pen and paper or computer
- participants answer a significant number of background questions which, together with the survey data, provide the potential for rich analysis

But what do we know about Australians’ N skills
But what do we know about Australians’ N skills

In PISA: 19th out of 65 countries in numeracy (just above the mean). Compared to literacy where we are 14th and significantly above the mean.

In both literacy and numeracy in PISA Australia has significantly declined since 2003.

In PIAAC: 13th out of 23 countries in numeracy (just below the mean). Compared to literacy where we are 4th and significantly above the mean.

In literacy in PIAAC there has been a small improvement since 2006, but a decline in numeracy.

Why the difference between literacy and numeracy?
But what do we know about Australians’ N skills

In relation to PISA, the results for example, mean that 44% of the students tested in numeracy do not meet the Australian minimum proficiency level (and 36% in reading) as identified in the Measurement Framework for Schooling in Australia (ACARA, 2013) as representing a “challenging but reasonable expectation of student achievement at a year level, with students needing to demonstrate more than the elementary skills expected at this level”
.. and in relation to equity groups ...

Students in remote areas are much more likely to be achieving at a lower level than students in either provincial or metro areas.
More than three-quarters of Indigenous students are not achieving at the Australian minimum proficient standard, compared to about 40% of non-Indigenous students.
My reflections on PISA (& PIAAC)

- Schools generally do NOT prepare students for maths in the real world – but students do need numeracy/mathematical literacy. When, where and how can they learn those skills?
- School maths does not connect or relate to the world outside the classroom or the curriculum (even when it says it should – except sometimes in rare courses like VCAL)
- In countries like Australia there are BIG differences between the written, taught and assessed school maths curriculum and the actual maths skills of 15 year old students.
- Numeracy/mathematical literacy needs to be taught – look at the frameworks and the complexity schemes for indicators of what the issues are for T&L and what aspects should be incorporated into T&L
- Context is important, as is the ability to excavate the maths from the context and to understand the maths and apply it to a context and then to reflect on the results (formulate/employ/interpret)
Proportions of persons in Literacy and Numeracy in PIAAC. Total Australian population aged 15-74 years.
Some PIAAC results

Literacy Performance by Labour Force status

Numeracy Performance by Labour Force status
Some PIAAC results

Percentage at Levels 3, 4 & 5 by age

Proportions of persons in Literacy and Numeracy levels 3, 4 and 5 in PIAAC by age. Total Australian population aged 15-74 years.
Some PIAAC results

Proportion at literacy Level 3 or above, By occupation: 2011–12
Some PIAAC results

Proportion at literacy Level 3 or above, By industry—2011–12
But what do we know?

Adults were asked to look at a photograph containing two cartons of coca cola bottles (changed to water bottles for PIAAC) and give the total number of bottles in the two full cases.

This was a **Pre-Level 1** item:
*Tasks at this level are set in concrete, familiar contexts where the mathematical content is explicit with little or no text or distractors and that require only simple processes such as counting, sorting, performing basic arithmetic operations with whole numbers or money, or recognizing common spatial representations.*

1.1 million Australians aged 15-74 years of age are operating at this level.
But what do we know?

Adults were asked to look at the petrol gauge image. The task states that the petrol tank holds 48 litres and asks the respondent to determine how many litres remain in the tank. A range of answers are allowable as correct.

This was a **Level 2** item:
*Tasks in this level require the respondent to identify and act upon mathematical information and ideas embedded in a range of common contexts where the mathematical content is fairly explicit or visual with relatively few distractors. Tasks tend to require the application of two or more steps or processes involving, for example, calculation with whole numbers and common decimals, percents and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.*

About 3.6 million Australians aged 15-74 years of age could NOT answer this question.
PIAAC research

Based on three cycles of international assessments of adult literacy and numeracy skills (IALS, ALLS and PIAAC), the research indicates, amongst a number of other findings, that people with higher LLN skills are significantly more likely to:

- be employed
- participate in their community
- experience better health
- engage in further training
- earn more on average

As well:

- each extra year of education improves L&N skills
An example of the analytic potential of PIAAC this graph shows that adults with high proficiencies in literacy and in numeracy are much more likely, compared to those with lower skills, to report good health, to be employed, to have higher earnings, and to have positive social dispositions and take part in community life.
Some research is indicating numeracy can play a more important role than literacy in both human and social capital terms.

Another example is the Byrnner and Parsons research from the UK that indicates that for women, while the impact of low literacy and low numeracy is substantial, low numeracy has the greatest negative effect, even when it is combined with competent literacy. ... Poor numeracy skills make it difficult to function effectively in all areas of modern life, particularly for women. (Bynner & Parsons, 2005, p. 7)
But what do we know?

Numeracy performance is much lower than literacy!

Note: These are working at ACSF levels – not exit levels.
Implications for VET and work

- N more than L&L is at the core of being able to participate effectively in VET training and the workplace.
- There WILL be significant N problems in learners participating in education/training/work and in undertaking higher level qualifications.
- For some workplaces and in VET certificates and for Higher Ed courses the N requirements will be at the higher end of the scale (ACSF levels 4 and 5).
- Gender issue is significant.
- Numeracy is often the poor (and lost) cousin in the L&N equation.
- Numeracy is not just about sums – it is about using and applying maths in a context.
- Numeracy is often invisible or not recognised.
Implications for VET and work

The AiG Survey of Workforce Development Needs 2012

Chart 3: Impact of low literacy and numeracy on business

- Inadequate completion of workplace documents or reports: 21.1%
- Time wasting: 17.7%
- Material wastage: 11.5%
- Recruitment difficulties: 8.3%
- Financial miscalculations: 6.8%
- Ineffective work teams: 6.7%
- Not applicable: 6.6%
- Staff unable/unwilling to take on new work: 6.4%
- Non-compliance: 6.3%
- Staff lack confidence: 5.2%

Percentage of respondents
Measurement activity

Measurement - arm spans

- Hands on and personal
- Start measurement with length:
  - Length uses all the common metric prefixes, other measures don’t
  - Visual – easier to learn and to estimate
- Use guess/estimate/measure approach
- Use benchmarks, e.g. Handspan ≈ 20 cm, 1 litre liquid ≈ 1 kg

See Tina’s latest WELL Numeracy Measurement resource:
http://oggiconsulting.com/resources/
Joe measures the depth of a road to be filled with asphalt. It is 225 mm deep (= the compacted thickness).
He knows that the loose thickness needs to be 20% more than the compacted thickness.
How high must the “loose” asphalt be prior to compacting by the roller?
What did you need to do to solve the problem?
Numeracy issues

Solving a numeracy problem:
Step 1: Understanding the problem – reading and interpreting the \textbf{real world} – reading/listening – excavating the maths out of the context – a \textbf{literacy} related activity. Look at the words/terms used too: “compacted thickness”
Step 2: \textbf{Doing} the \textbf{maths} – calculating / estimating / measuring / acting in some way or ways
Step 3: Putting it back into the \textbf{real world} to make it work, interpreting the maths and communicating it to others. More \textbf{literacy}.

This cycle is represented in the ACSF and in PISA and PIAAC frameworks
Numeracy issues

And how did you calculate the 20%?

\[ \frac{20}{100} \times \frac{225}{1} \]
And what about \( P = 6g + b \)?
Numeracy issues

- Numeracy is often the poor (and lost) cousin in the LLN equation
- Numeracy may have a stronger impact than literacy
- Numeracy is not just about sums (or playing with algebraic expressions) – it is about using and applying maths in a context
- Numeracy is often invisible or not recognised
- Gender in ALLS: 47.5% of males are at levels 1 or 2; 57.6% of females are at levels 1 or 2. A difference of over 10%!
- And is the bar set lower for maths/numeracy?
Teaching numeracy

Challenge in real world context

Mathematical content categories: Quantity; Uncertainty & data; Change & relationships; Space & shape
Real world context categories: Personal; Societal; Occupational; Scientific

Mathematical thought and action

Mathematical concepts, knowledge and skills
Fundamental mathematical capabilities: Communication; Representation; Devising strategies; Mathematisation; Reasoning and argument; Using symbolic, formal and technical language and operations; Using mathematical tools
Processes: Formulate, Employ, Interpret/Evaluate

Diagram:
- Problem in context
- Formulate
- Evaluate
- Interpret
- Results in context
- Mathematical problem
- Employ
- Mathematical results
Teaching numeracy

Think about the Task Process Cycle

Rethinking Assessment model developed what we called the Task Process Cycle for adult numeracy in 2003 (Marr, Helme & Tout):
Teaching numeracy

- Teach in context – connect to the real world – use real texts and real situations – use relevant and interesting topics and themes (the world is rich in maths) to engage students
- Use a problem solving, investigative, open-ended approach (can utilise the value of the internet)
- Use different strategies and activities – cater for different learning styles – support and encourage students’ ways of doing
- Encourage team work
- Make the maths skills explicit – teach how to excavate them from the text/context
Teaching numeracy

- Scaffold and model – support the learners
- Assess appropriately using the above approaches – use technology: blogs, digital photos, movies & stories, webpages, posters, project materials and outcomes, journals & diaries
- Use individual, small and whole group activities
- Connect language and maths – talk maths - crucial
- Build confidence – have fun and success!
- Throw out text books!
And to finish, why do this ...

A drum of petrol containing 480 litres was shared between 5 drivers. The first driver took \( \frac{2}{3} \) of the contents of the drum, the second took \( \frac{1}{4} \) of what was left, and the remainder was shared equally between the last three drivers. How many litres did each of the remaining drivers receive?

Four horses cost as much as 3 cows, 4 sheep as much as 2 horses, and 3 lambs as much as 1 sheep. How many cows could I exchange for 40 lambs?

How I see math word problems...
If I have 4 pencils and you have 7 apples how many pancakes will fit on the roof? Purple, because aliens don't wear hats.
The Gotemba walking trail up Mount Fuji is about 9 kilometres (km) long.

Walkers need to return from the 18 km walk by 8 pm.

Toshi estimates that he can walk up the mountain at 1.5 kilometres per hour on average, and down at twice that speed. These speeds take into account meal breaks and rest times.

Using Toshi’s estimated speeds, what is the latest time he can begin his walk so that he can return by 8 pm?
Lynn A. Steen, probably the most articulate spokesperson for “Quantitative Literacy” in the US, states that:

"...numeracy is not the same as mathematics, nor is it an alternative to mathematics. Today's students need both mathematics and numeracy. Whereas mathematics asks students to rise above context, quantitative literacy is anchored in real data that reflect engagement with life's diverse contexts and situations.

Monash University professor of mathematics education Peter Sullivan:

“AUSTRALIAN students could be dropping out of maths because it is taught in a way that does not relate to the real world, according to a maths academic. Monash University professor of mathematics education Peter Sullivan said the custom of teachers demonstrating a mathematical procedure and then setting repetitious practice was boring and restrictive. "Effective mathematics teaching involves presenting students with important and engaging tasks, which students can explore and decide on their own problem-solving strategies," Professor Sullivan said.”

http://research.acer.edu.au/aer/13/
Q and A

List of numeracy resources
Further information

PISA and PIAAC

For further information on PISA visit http://www.acer.edu.au/ozpisa/pisa-australia

The OECD website for PISA is: http://www.oecd.org/pisa/

The OECD website for PIAAC is: www.oecd.org/site/piaac/

PIAAC reports are available from: www.oecd.org/site/piaac/publications.htm

For the details of the Australian PIAAC results go to the ABS website at: www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4228.0Main+Features12011-12?OpenDocument

PIAAC conference videos: vimeo.com/album/2571591. The two key overview videos are these two:


A recent (May 2014) analysis of the Australian PIAAC data has been done by the Productivity Commission: www.pc.gov.au/research/staff-working/literacy-numeracy-skills

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Some references

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