Some reflections about mathematics and numeracy from PISA and PIAAC

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Some (personal) reflections based on my involvement in ALLS, PIAAC and PISA and as a long term adult numeracy teacher and trainer:

- the ability to be empowered to have the capacity to make considered decisions, whether they be on the spot decisions at a workplace or when out shopping, or following written instructions about a medical or health matter, or making decisions about financial matters, or understanding the implications of gambling, and more ..., all require good literacy AND NUMERACY skills.
- the results of all these surveys show that millions of teenagers and adults in both Australia and Canada do not have such literacy and numeracy skills and they are, potentially, disempowered.
- the data and results are NOT about rates of illiteracy or innumeracy, and don’t claim to be.
- life in the 21st century requires higher level LLN skills than ever before.

About PISA and PIAAC

- such international assessments are based on theoretical frameworks which have been backed up by empirical evidence – so the PISA and PIAAC frameworks are worth reading.
- both have Complexity schemes – a theoretical scheme to estimate/predict the difficulty of a numeracy/mathematical literacy problem.
- items go through a thorough and exhaustive quality assurance (QA) process before they get to be used
- same methodology behind PISA and PIAAC
- it is the items that are being assessed, not the learners/adults
- generous marking/coding
- items are very similar and most could appear in the other’s assessments, and the coverage is also similar (content/contexts/processes).

Some differences between PISA and PIAAC

- PISA has a stronger interest in student ability to show evidence of the use of more formal curriculum-based maths
- PIAAC starts at a lower level; PISA doesn’t go as low as PIAAC, but should – not enough “easy” items written and included
- complexity schemes: PISA – more formal and school focussed whereas ALLS/PIAAC is a blend of literacy and maths factors.
- background questionnaire data richer for ALLS/PIAAC – e.g. education/work/wages/etc so has richer research potential
- note that the levels do not match i.e., Level 1 PISA ≠ Level 1 PIAAC etc. Needs to be an equating study or equivalent to be done.
- for a more detailed analysis and comparison of the two measures (numeracy in PIAAC and mathematical literacy in PISA) see the recent 2014 OECD paper by Iddo Gal and myself.
PISA mathematical modelling process for Mathematical literacy (available in PISA Framework)

- assumes that when individuals use mathematics and mathematical tools to solve problems set in a real world context, they work their way through a series of stages:

**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**

- **Fundamental mathematical capabilities**: Communication; Representation; Devising strategies; Mathematization; Reasoning and argument; Using symbolic, formal and technical language and operations; Using mathematical tools
- **Processes**: Formulate, Employ, Interpret/Evaluate

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

- And let’s not forget the non-cognitive aspects which is where the above *Task Process Cycle* came from:
ALLS and PIAAC complexity scheme (details available in PIAAC Framework) is worth looking at:

And some thoughts about teaching and learning numeracy/math:

- 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?
- In countries like Australia (and Canada?) there are BIG differences between the written, taught and assessed school maths curriculum and the actual maths skills of 15 year old students.

- learning and knowing maths as an adult is NOT a hierarchal set of skills as per school based curriculum frameworks (and is it for school age children?)

- 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)

- gender is still a crucial issue in math that is not being addressed or targeted (in Australia at least).

**And as a finish**

Lynn A. Steen, probably the most articulate spokesperson for numeracy or “Quantitative Literacy”, 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.

### Some References


