Assessing learning
How can classroom-based teachers assess students’ competencies in numeracy?

Moses Ngware, PhD
Presentation

• Why assess?
• The approach
• Results
• Conclusion and implications
Why Assess?

- Numeracy assessment research shows various ways to measure numeracy (Reyna et al., 2009).
  - Eg. some assessment tools use personal perceptions of a person’s numerical abilities (Fagerlin et al., 2007)

- But why assess? Teachers assess their students with a view to track:
  - progress,
  - provide feedback,
  - assess student competency levels, and
  - evaluate the achievement of curriculum.
How do you fulfill the purposes of assessment

(1) A numeracy tool should reflect the math curriculum outcome areas

(2) Assess the range of student numeracy abilities

(3) However, the quality of a test is determined by it's psychometric properties, and not what the test items look like
The Approach ..... (1)

(1) Assessment characteristics

– Addresses key learning areas
– Degree of difficulty (simple) – item location
– Item fit (in theory, items should fit the
  TCC/ICC curve)
– Fairness and discrimination in test use (DIF)
– Competence levels/benchmark against
  which to interpret test scores.
Characteristics of test A

- A pool of 100 items of grades 1, 2 & 3 developed
- Items grouped into curriculum outcome areas and assigned to either Test A or B each with 45 items

Tests A & B pre-tested. Scores in Test A more normally distributed

Test A selected for final study with minor revisions

Curriculum mapping by subject specialists, assessment specialists, project staff/AKF and researchers

The Approach ..... (2)

(2) Assessment development process
## The Approach ..... (3)

<table>
<thead>
<tr>
<th>Contents</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Total Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-number activities (9%)</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Whole Numbers (18%)</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Fractions (4%)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Addition (13%)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Subtraction (11%)</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Multiplication (4%)</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Division (4%)</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Measurement (Length, Mass, Capacity, Money, Time) (24%)</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Geometry (11%)</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Items</strong></td>
<td><strong>16</strong></td>
<td><strong>19</strong></td>
<td><strong>10</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
The Approach ..... (4)

- 7 informal settlements (slums) from 6 major towns in Kenya
- Low cost, formal private and government primary schools within slums and within a radius of 1km from slum
- 1 stream of G3 randomly selected
- 7,648 standard 3 pupils (48% girls)
The Approach ..... (5)

• We use Rasch procedures to show:
  – degree of difficulty (simple)
  – Item fit and person location
  – fairness and discrimination in test use

• Some Rasch requirements:
  • Items have equal discriminating power
  • Minimal guessing
  • NB: Rasch model provides diagnostic information on how well items measure what they are supposed to measure

• Competence levels/benchmark against which to interpret test scores
Fit and location of numeracy Items
Grouping the numeracy items

Q16: Add 1-digit numbers with total not exceeding 20
Q28: Identify the days of the week in correct order
Q21: Apply subtraction of 3-digit numbers without borrowing
Q33: Interpret data presented in a simple table
Level 4
- Recognize geometrical shapes within larger shapes
- Interpret data presented in a simple table
- Subtract 4-digit numbers with borrowing • Convert days to weeks
- Place the value of a digit on a 4-digit whole number

Level 3
- Summarize multiple addition of same number by multiplication
  that is, \( N + N + N = N \times 3 \)
- Apply division of 2-digit numbers with 1-digit number (involving multiples of 9)
- Multiply single digit numbers • Subtract 3-digit numbers without borrowing
- Apply addition with carrying over (up to 2-digit numbers)
- Divide 2-digit numbers with 1-digit number (involving multiples of 6)
- Divide 1-digit numbers with 1-digit number (involving multiples of 3)

Level 2
- Rank quantities or sizes in increasing or decreasing order
- Add numbers without carrying over
- Subtract numbers without borrowing (up to 2-digit numbers)
- Recognize common shapes (oval)
- Work out missing numbers in a series involving multiples of 10
- Associate units contained with the capacity of a container
- Associate metre rule with measurement of length

Level 1
- Identify values of coins
- Identify what side of a scale balance has more weight
- Recognize container with larger capacity
- Identify numbers of 100s, 10s and 1s in a 3-digit number
- Add 1-digit numbers
- Match numbers to objects (<10)
- Count objects less than 10
Distribution of numeracy scores

- **Level 1 (L1)**: 9.6%, 5.2%
- **Level 2 (L2)**: 27.7%
- **Level 3 (L3)**: 57.4%

Number of Students
Conclusions and implications

- Only 3 items did not fit and will be dropped – good fit and item difficult
- Item and person parameters (level of difficult and attainment levels of pupils) had a good fit
- The tool did not discriminate by gender
- Competence levels – about three-quarters of pupils in competency levels 3 & 4. Does this match the NAC competency levels?
THANK YOU

@mngware