Evaluating the promise of an early math program – Collaborative Math (CM):
Does the language of assessment matter and if so, in what ways?

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Collaborative Math is a one-year professional development (PD) initiative designed to help early childhood sites become centers of excellence in mathematics where quality early math instruction is fostered, celebrated, and sustained.
Presentation Research Questions

(1) Do DLL children tend to obtain higher scores in math in one language and if so, which one – English or Spanish?

(2) Are DLL children more likely to respond correctly to specific items in Spanish or English?

(3) How does a post hoc “conceptual score” of DLL children’s math compare to their Spanish and English score?

(4) Do children participating in CM do better in math in the spring of preschool?
Study Sample

- 28 Head Start centers (14 intervention vs 14 control); 84 classrooms
- Approximately 840 children participating in the larger study
  - 43% DLLs identified from parent-report of home language
- PreLAS language assessment used to determine which language to use to assess math abilities in the fall (pretest) and spring (posttest)
  - 67 did not pass the English language screener at pretest and were administered the math assessments in Spanish (19% of DLLs did not pass screener)
  - At posttest . . .
  - 58% (n = 39) of children who did not pass the screener at pretest passed the screener at posttest and had data for both assessments in both English and Spanish.
Sub-Study Sample

- 39 children with posttest scores in both languages
  - Mean age = 47.1 months (6.7)
  - 19 girls and 20 boys
  - 23 CM intervention students vs 16 control
Measures

- REMA-SV (Sarama & Clements)
  - 19 items
  - IRT sum score
  - Administered in English and Spanish

- Woodcock-Johnson Applied Problems subtest
  - Two different versions with norm references
  - Raw score (English/Bateria)
  - W score (English/Bateria)
1) Do bilingual children tend to obtain higher scores in one language and if so, which one?

<table>
<thead>
<tr>
<th>Score</th>
<th>English Post-test</th>
<th>Spanish Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>REMA-SV Raw Score</td>
<td>8.64 (2.14)</td>
<td>7.59 (2.34)</td>
</tr>
<tr>
<td>REMA-SV IRT Sum Score</td>
<td>41.28 (5.54)</td>
<td>39 (5.91)</td>
</tr>
<tr>
<td>WJ-AP Raw Score</td>
<td>6.51 (2.21)</td>
<td>6.13 (3.66)</td>
</tr>
<tr>
<td>WJ-AP W Score</td>
<td>395.44 (14.42)</td>
<td>366.10 (29.97)</td>
</tr>
</tbody>
</table>
1) Do bilingual children tend to obtain higher scores in one language and if so, which one?

- Children scored higher in English at post test
- Possible explanation
  - Most instruction occurred in English throughout the year so they learned mathematics in that language and therefore perform better
  - The majority (69%) of children had at least one teacher who provided Spanish language support in the classroom but we have limited data on language of math instruction and support.
2) Examining Specific Items (concepts): English vs Spanish

- Counting
- Numerals
- Subitizing
- Cardinality
- Shape
- Composition of number
## REMA Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Item Content</th>
<th>Core Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How high can you count?</td>
<td>Verbal counting</td>
</tr>
<tr>
<td>2</td>
<td>Which one has more?</td>
<td>Comparing number and sequencing</td>
</tr>
<tr>
<td>3</td>
<td>How many?</td>
<td>Subitizing</td>
</tr>
<tr>
<td>6B</td>
<td>Match the numbers to the grapes.</td>
<td>Numerals</td>
</tr>
<tr>
<td>7A</td>
<td>Count these bananas.</td>
<td>Counting</td>
</tr>
<tr>
<td>7B</td>
<td>How many are there altogether?</td>
<td>Cardinality</td>
</tr>
<tr>
<td>8</td>
<td>Make yours look just like mine.</td>
<td>Counting</td>
</tr>
<tr>
<td>9</td>
<td>How many am I hiding?</td>
<td>Composition of number</td>
</tr>
<tr>
<td>13</td>
<td>Place chips on top all the shapes that are triangles.</td>
<td>Shape</td>
</tr>
<tr>
<td>15</td>
<td>Can you make a triangle using some straws?</td>
<td>Shape</td>
</tr>
<tr>
<td>16</td>
<td>How many sides does this shape have?</td>
<td>Shape</td>
</tr>
</tbody>
</table>
2) Examining Specific items (concepts): English vs Spanish

• For all items where there was a difference in % of correct/incorrect responses, the difference favored English

• Some of the items where we saw higher differences:
  • Counting items such as Item 1 and 7a (on average counted higher in English)
  • Cardinality items which rely on counting pre-requisite such as item 7b and 9
3) How does a post hoc “conceptual score” of DLL children’s math compare to their Spanish and English score?

• If we count correct on either assessment, what would the child’s score be?

• How does this score compare to the Spanish and English score?
## Conceptual Score

<table>
<thead>
<tr>
<th>Instrument</th>
<th>English</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>REMA-SV Raw Score</td>
<td>8.64 (2.14)</td>
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</table>

- Conceptual Score was 8.92 (1.79), which is statistically higher than both the English and Spanish score.

- Spanish or English only scores may underestimate the math ability of DLL learners.
4) Impact of CM on math abilities/skills

- Used SAS PROC MIXED to estimate the impact of participation in CM on spring REMA and AP scores for each language (controlling for the effect of pretest in Spanish)
- No significant differences in performance between CM children and comparison group peers
Summary/Implications

- Children obtained higher post test scores in English, possibly in part due to the fact that instruction throughout the year is occurring in English.

- English and Spanish scores may underestimate the abilities of young DLLs who may use both languages as they learn and know some concepts in one language and others in the other language.
Future Directions

• More research needed to guide researchers working with DLLs as to how to make decisions about assessment protocols
• Need assessments developed and psychometrically equated for use with DLLs
• Exploration of conceptual scoring processes may be beneficial to really understand DLLs learning