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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What is *Collaborative Math*?

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?

Score	English Post-test	Spanish Post-test
REMA-SV Raw Score	**8.64 (2.14)**	7.59 (2.34)
REMA-SV IRT Sum Score	**41.28 (5.54)**	39 (5.91)
WJ-AP Raw Score	**6.51 (2.21)**	6.13 (3.66)
WJ-AP W Score	**395.44 (14.42)**	366.10 (29.97)

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

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

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

Instrument	English	Spanish
REMA-SV Raw Score	8.64 (2.14)	7.59 (2.34)

- 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