Word Problem Solving in English Language Learners

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Introduction

Background

- **1 in 5** children in Canada speak an immigrant language at home (Statistics Canada, 2016).
- Children learn math through language but does language matter for math learning?
- The *Pathways Model* suggests that language uniquely contributes to the development of early numeracy skills (LeFevre et al., 2010)
- Language is implicated in both arithmetic (Sowinski et al., 2015) and word-problem solving (Fuchs et al., 2006)..

Questions

1. Are there differences in symbolic math skills and word-problem solving skills for first language learners and English language learners?
2. If there are differences, can we try to understand where children are struggling?

Method

- This study was a part of a large cross-cultural study (**the LLAMA project; L**anguage **L**earning **a**nd **M**ath **A**chievement).
- We compared symbolic math skills and word-problem solving skills of first language learners (FLL; *n*=52) to those of English language learners (ELL; *n*=26).

Children's First Languages:

- Participants were recruited from schools with a high population of English Language Learners in Ottawa. Children were in Grades 2 and 3 (M_{age} = 8 years, 4 months) and completed measures of:

Symbolic Number Skills
- **Number Comparison**
- **Number Ordering**
- **Arithmetic Fluency**

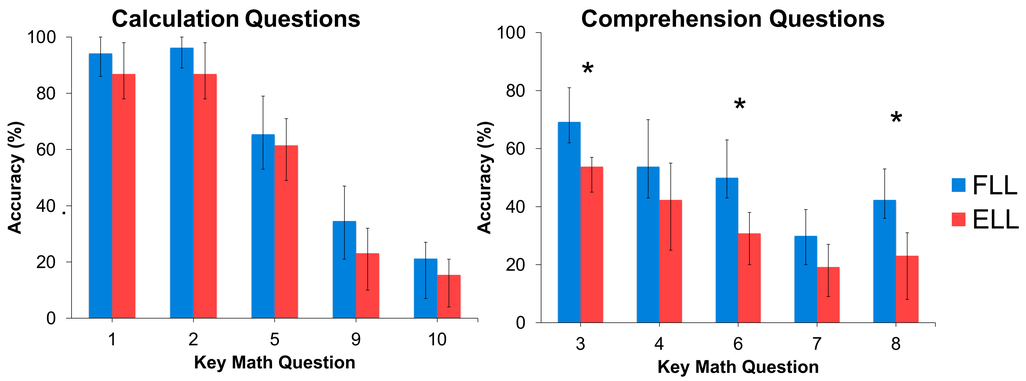
Math Word Problem Solving
- **Key Math** (the problem solving subset of a standardized Canadian test)

Results

- There were no significant differences in any of the symbolic number skills.
- However, English language learners performed significantly worse on the Word Problems than First Language Learners.
- An Item by Item analysis was conducted to identify any patterns in the mistakes that ELLs were making.
- We categorized problems based on the types of errors made. Problems were categorized as (a) comprehension problems or (b) calculation problems.

Note: Questions below were changed from the original test.

Item by Item Analysis



Calculation Questions

Question 1	Answer	% Correct (FLL)	% Correct (ELL)
Five rabbits and two rabbits are how many rabbits in all?	7	94.2%	86.9%

Question 5	Answer	% Correct (FLL)	% Correct (ELL)
Fill in the blank (5, 8, 11, 14, 17, __)	20	65.4	61.5

Question 10	Answer	% Correct (FLL)	% Correct (ELL)
This pizza delivery guy has six boxes. Each box has 12 pieces of pizza. How many pieces of pizza are there in all?	80	21.2%	15.4%

Comprehension Questions

Question 3	Answer	% Correct (FLL)	% Correct (ELL)
The cow looks like this and he is 7 years old. The cat is over here and she is 16. How much older is the cat?	9 years	69.2%	53.8%

Question 6	Answer	% Correct (FLL)	% Correct (ELL)
Brandon is 14 years old. Brandon is has been walking for 15 min at 9 km per hour. Brandon is going to the store. Which one of these is not needed to find out how long it will take Brandon to get to the store?	Brandon's Age	50.0	30.8

Question 8	Answer	% Correct (FLL)	% Correct (ELL)
Joel sits down for lunch and he counts his money. He only has four coins and they are worth 50 cents in all. What are the four coins?	5c, 10c, 10c, 25c	42.3%	22.1%

ELL and FLL children performed equally well on calculation questions, whereas English Language Learners performed worse on questions where language comprehension was necessary. This pattern was the same for both Grades.

Conclusion

1. There were no significant differences between ELLs and FLLs on any of the basic math measures.
2. English Language Learners performed worse on the Key Math and made more comprehension errors.
3. These finding suggest that word problems are more challenging for ELL students than FLL students and these extra challenges are likely related to language comprehension rather than to calculation.
4. As a result, when creating word problems teachers should think about the choice of words as well as avoid unnecessary words.

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