Promoting Mathematical Problem Solving and Explanation at Home: The Effects of Extended Homework Use

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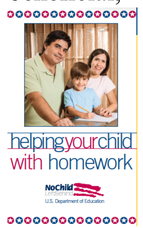
Background

- Prompting students to generate explanations as a means to make sense of new information (e.g., "**self-explanation**"; Chi, 2000) is a broadly endorsed learning activity.
- **Explaining to other people** may be even more beneficial, especially for children. Four-year-olds who explained correct solutions to their moms had greater problem-solving transfer compared to those who explained to themselves (Rittle-Johnson et al., 2008).
- **Homework** may provide a good opportunity children to generate explanations.
  - Van Voorhis (2011) found that **family involvement** in homework increased student motivation and achievement.



Goals

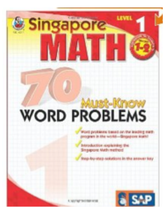
- Increase opportunities for children to make sense of problems and explain their mathematical thinking.
- Harness the benefits of both family involvement and explanation to improve word problem-solving accuracy.

Method

Participants. 60 2nd graders from four classrooms at a metropolitan elementary school in middle Tennessee.
- *Follow-up subsample* 29 2nd graders from one parent explain classroom and one independent explain classroom

Design & Procedure

- Homework content: Addition, subtraction and multiplication word problems from Singapore Math series.
- *Explain to Parent condition*
  Children independently solved problems and explained to their family partner.
- *Independent explain condition*
  Children independently solved problems and explained in writing.

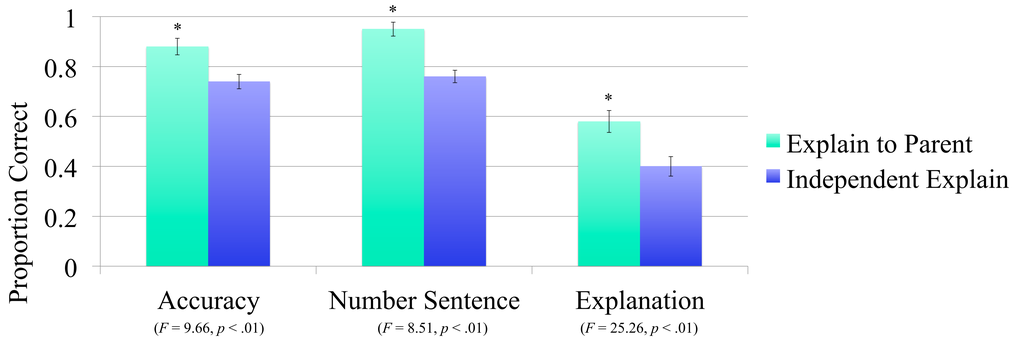


- Teachers reviewed homework problems in class.
- After study completion one classroom from parent condition continued using homework sheets

Assessment

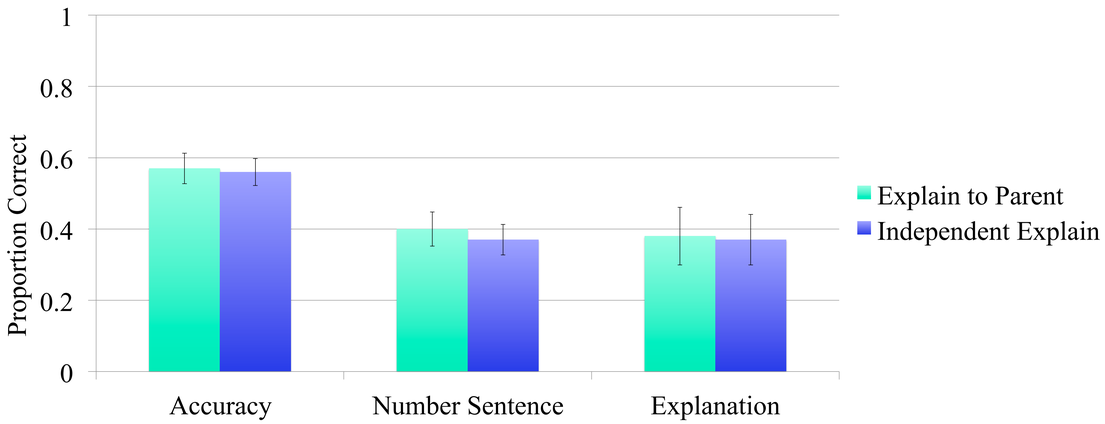
- Vanderbilt Story Problems 2 (Fuchs & Seethaler, 2008).
- Accuracy Coding: Children received 1 pt for providing the correct answer and 1 pt for providing the correct label. See sample HW (e.g., 15 *points*).
- Explanation Coding: Valid if student provided a correct explanation or procedure for a correct answer (1pt). See sample homework for a valid explanation.
- Number Sentence Coding: 1 pt for providing any correct number sentence for the word problem.
- At pretest, 2 conditions did not differ.

Performance on Homework



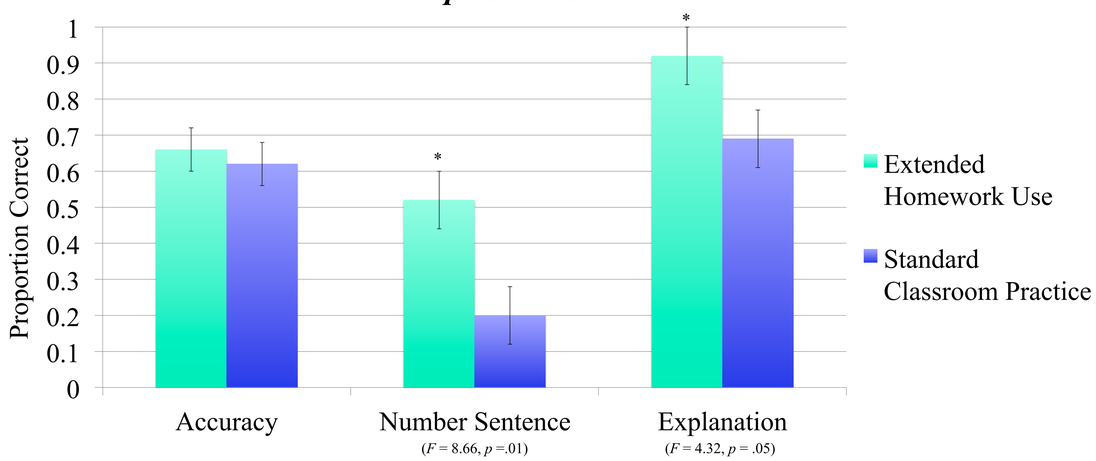
Controlling for pretest word problem-solving accuracy, homework accuracy (r = .30, p = .03) and explanation scores (r = .24, p = .08) were predictive of posttest accuracy.

Posttest Results



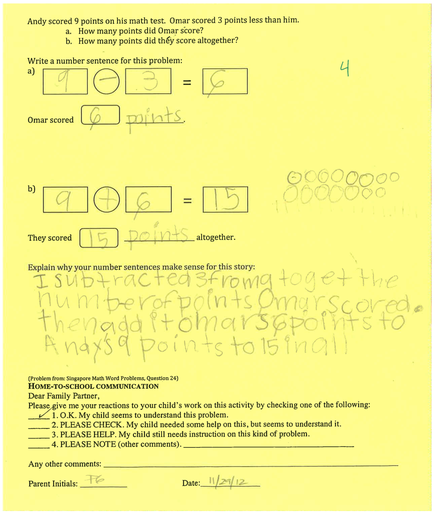
No reliable difference at posttest. Most children struggled to provide valid explanations on two problems. However, students who explained to family partners were more likely to attempt an explanation on the posttest (44% of children in independent explain did not attempt to explain vs. 24% in explain to parent).

Follow-Up Test Results



Extended homework use improved valid explanations and use of correct number sentences. No significant difference for word problem accuracy.

Sample Homework


Andy scored 9 points on his math test. Omar scored 3 points less than him.
a. How many points did Omar score?
b. How many points did they score altogether?

Write a number sentence for this problem:
a) 9 − 3 = 6 (4)
Omar scored 6 points

b) 9 + 6 = 15
They scored 15 points altogether.

Explain why your number sentences make sense for this story:
I subtracted from to get the number of points Omar scored. then added Omar's 6 points to Andy's 9 points to 15 in all

(Problem from: Singapore Math Word Problems, Question 24)
HOME-TO-SCHOOL COMMUNICATION
Dear Family Partner,
Please give me your reactions to your child's work on this activity by checking one of the following:
__✓__ 1. O.K. My child seems to understand this problem.
____ 2. PLEASE CHECK. My child needed some help on this, but seems to understand it.
____ 3. PLEASE HELP. My child still needs instruction on this kind of problem.
____ 4. PLEASE NOTE (other comments). _____
Any other comments: _____
Parent Initials: FE Date: 11/29/12

Summary

- Requested family involvement improved accuracy, explanation quality, and correct number sentences on homework, which were predictive of performance on an in-class posttest.
- However, requested family involvement did not reliably lead to better posttest performance, although it did increase attempts to provide an explanation.
  - In line with past research, family involvement seemed to impact student motivation to explain (VanVoorhis, 2011).
- For the follow-up subsample, extended use of the weekly homework assignments significantly improved children's use of valid explanations and correct number sentences. Still, extended homework use did not significantly impact word problem accuracy, compared to standard classroom practice.

Discussion

- Teachers considered the in-class review of the homework to be a particularly helpful learning activity. However, due to the large variability across classrooms on how this review was handled, we are limited in our ability to draw conclusions from the data.
- The homework assignments provided a desirable situation for children to persevere in solving problems and explain their mathematical thinking, helping teachers and students meet new Common Core State Standards.
- Future studies should further explore the role of explanation in weekly homework by specifically contrasting homework with and without prompts to explain.

References

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