

Effects of Singapore's Bar Model Method on second grade students' word problem solving performance

Judith Holbrook

Research Questions: What are the effects of Singapore's Bar Model Method on second grade word problem solving performance? How does the Bar Model Method change students' perceptions about word problems and mathematics ability?

Introduction

As a nation, the United States strives to improve student mathematics performance. The United States mathematics instruction has been referred to as *a mile wide and an inch deep*. To address this problem, the United States has adopted the Common Core State Standards of Mathematics (CCSSM). These standards were developed using scholarly research, comparisons to standards from high performing states and nations, and the findings from Trends in International Mathematics and Science (TIMSS) and conclude the United States mathematics curriculum needs to be more focused and coherent in order to increase student achievement. Word problems pose significant challenges to both students and teachers in the elementary setting.

This research was needed to find a research based instructional method or model to assist students in the goal of comprehending and successfully solving word problems.

Materials

- Singapore Bar Model Method
- California Common Core State Standards of Mathematics (CCSSM)
- 2nd Grade Common Core Standards State Flip Book

Methods

- Quasi-experimental design with a control group and a treatment group
- Quantitative performance pretest – posttest
- Likert-type Student Self-Assessment Survey pretest – posttest
- 52 Second Grade Students, six weeks

Theoretical Rationale: Jerome Bruner

Theory of Instruction, Stages of Intellectual Development and modes of representation that use concrete, pictorial, and abstract to create more effective learning.

Seminal Authors: Walter Kintsch and James Greeno (1985) and Richard Mayer (2002)

Figure 1- Performance Pre and Posttest by Class

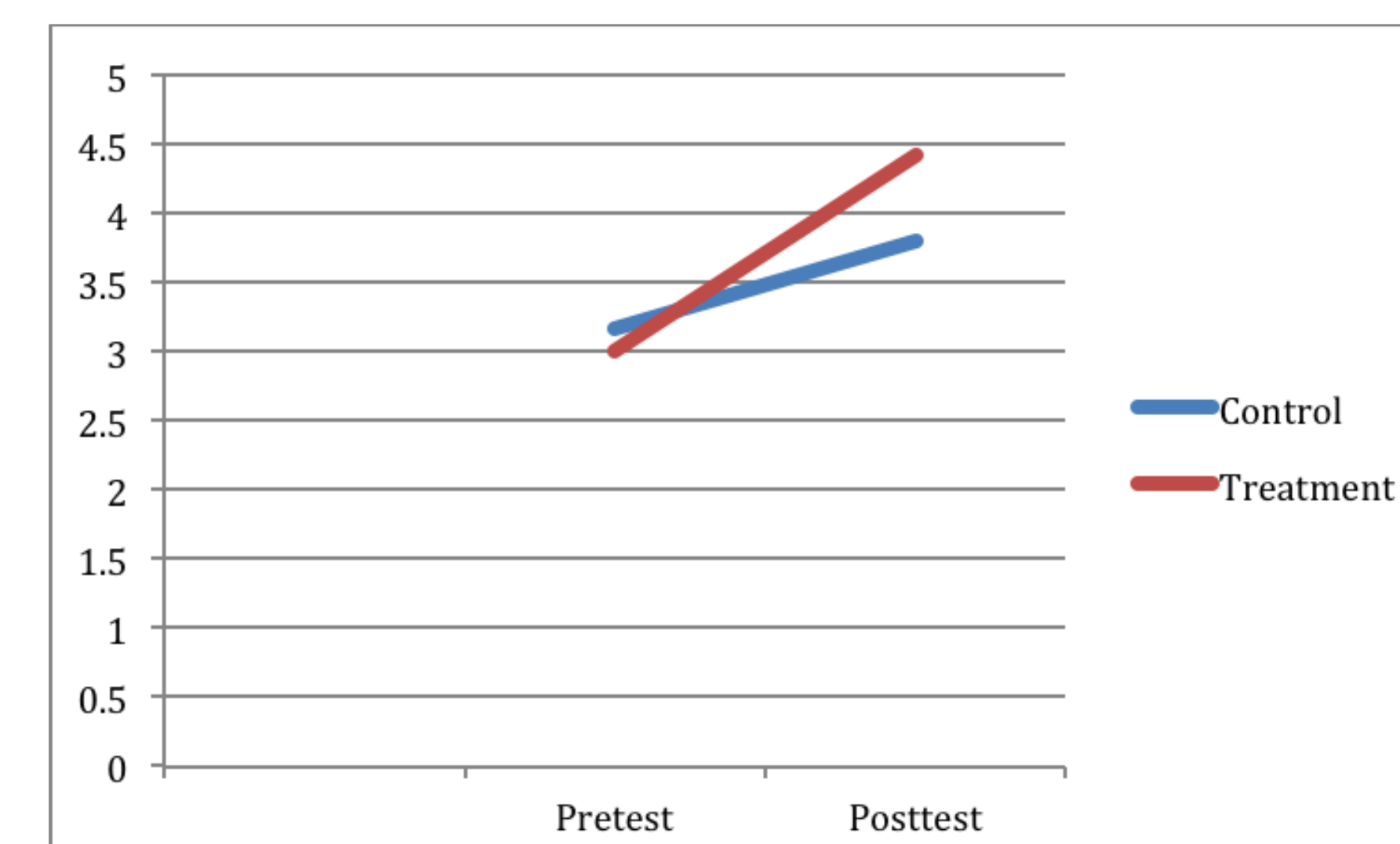


Figure 2 – Performance Test Results by Ability

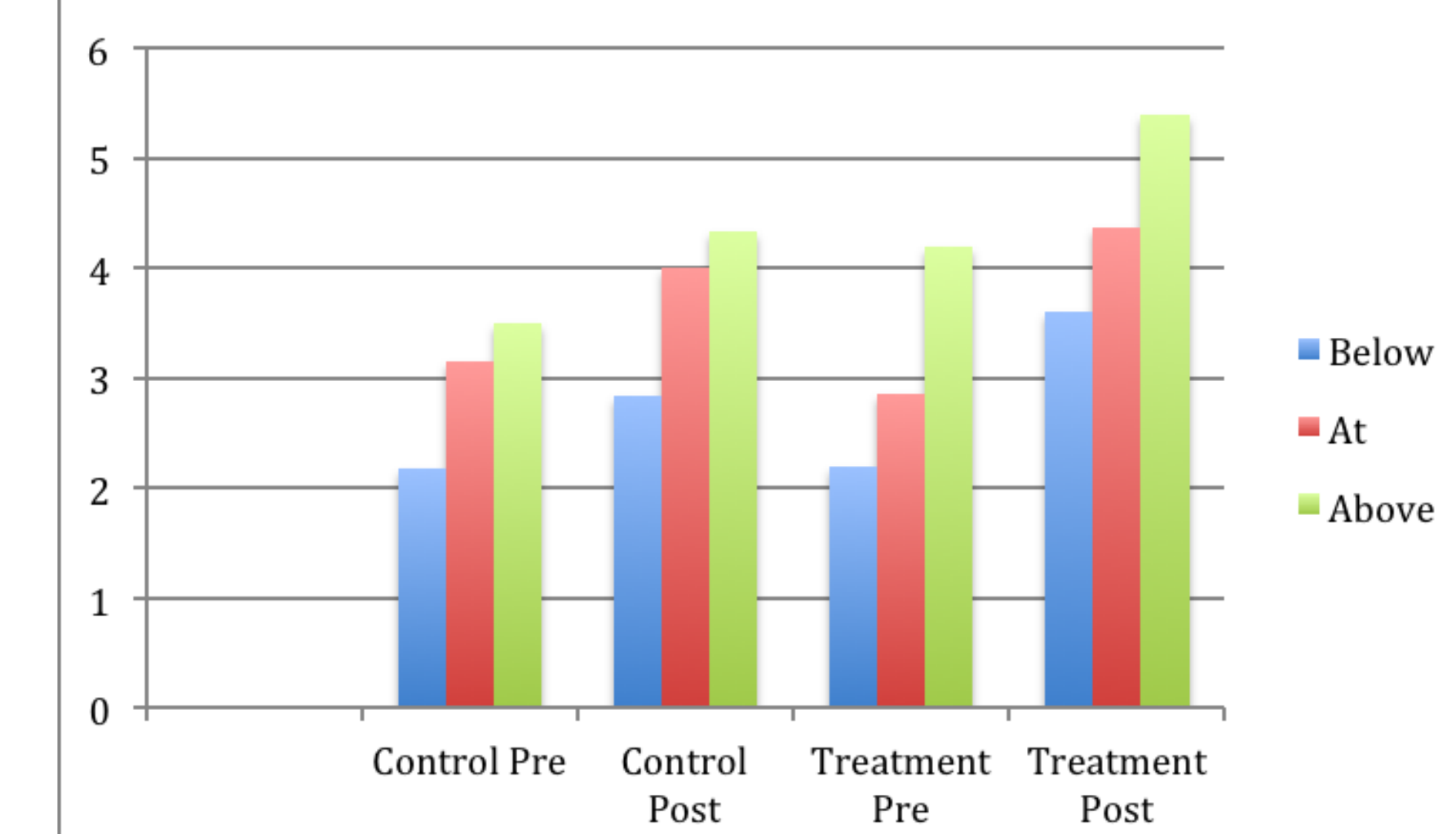
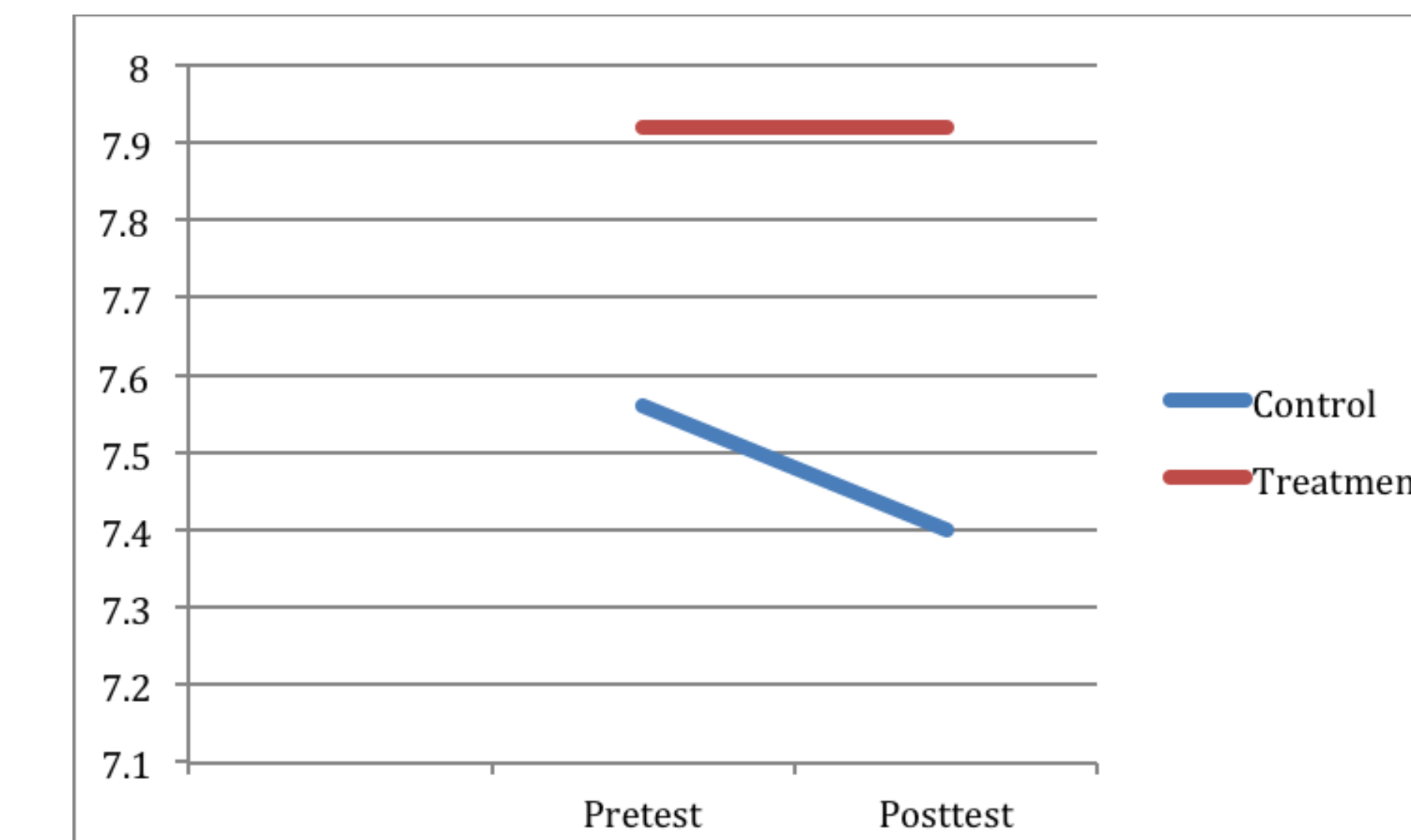


Figure 3 – Pretest and Posttest Results of Student Self-Assessment Survey



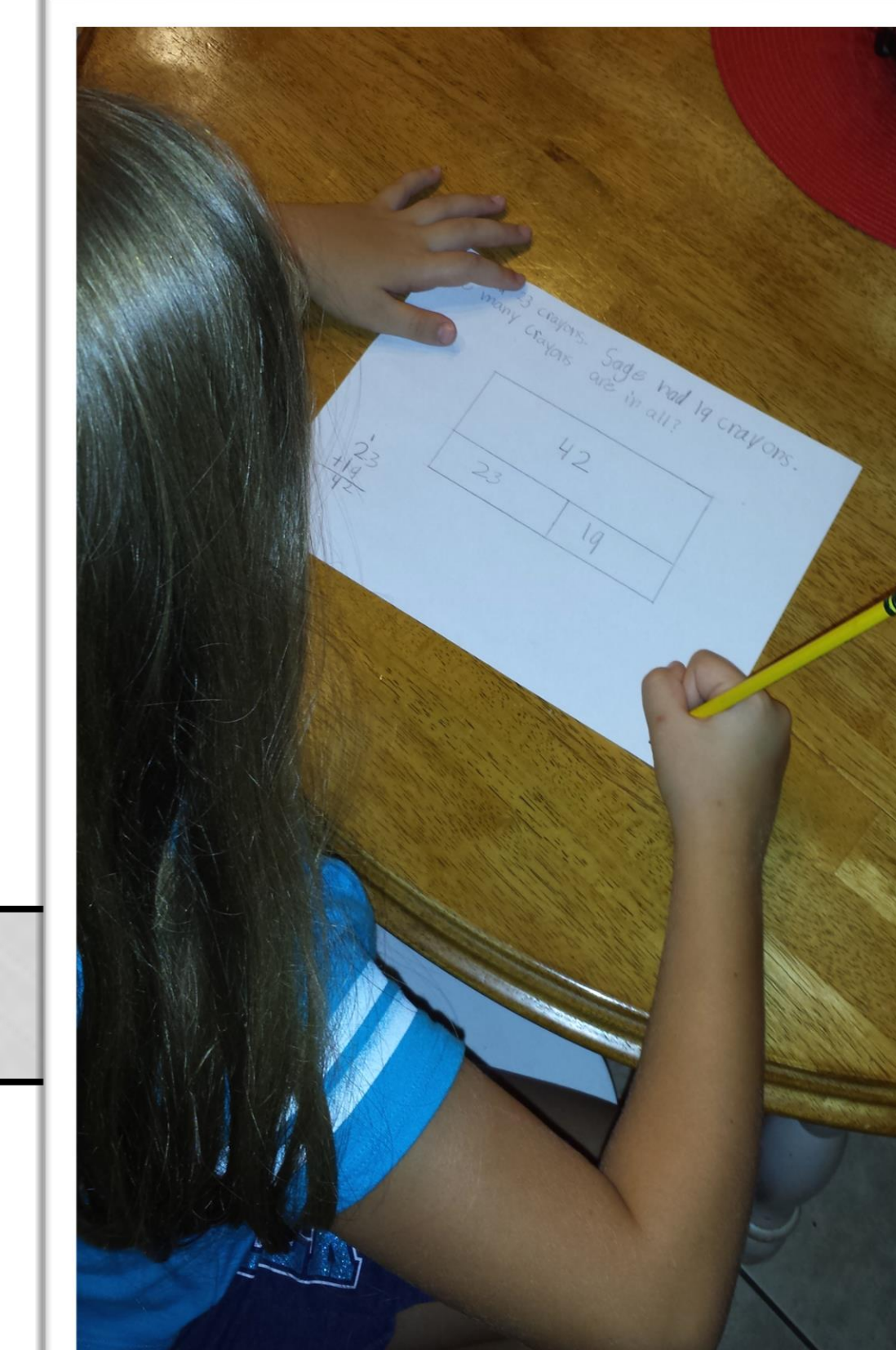
Results

Figure 1 shows the quantitative statistical data results of the six-item word problem pretest and posttest by class. The data indicates the treatment group achieved statistically significant word problem performance growth over the control group.

Figure 2 shows the performance test results by student ability. All three ability groups from both classrooms had an increase in performance from pretest to posttest. The treatment At Grade Level female group achieved the largest growth.

The treatment class's word problem posttest showed that the students drew the correct bar model pictorial 82% of the time and an incorrect drawing 18% of the time. The problems with the correct drawing produced the correct operation 100% of the time. Eighty-four percent of the time the correct drawing produced a correct answer and 16% of the time the problem the operation was correct but a calculation error was made. Incorrect drawings produced a correct answer 19% of the time and an incorrect answer 81% of the time.

Figure 3 The results of the posttest Student Self Assessment Survey display the treatment groups' affect did not go down after the treatment while the control group did decrease in student favorable feeling about mathematics, word problems, and their own mathematic ability.



Interpretations

The results for the word problem performance test show a statistically significant increase for the treatment class.

- similar finds to literature review studies
- young children appear to benefit by visual representations in problem solving
- pictorial stage provides a bridge between concrete and abstract (Bruner) especially in most second grade students who are ready to move beyond concrete but are not yet ready for abstract representation
- At Grade Level treatment group achieving the greatest growth.
- their stage of development.
- When sorting for gender, females in the treatment group realized the largest performance increase on the word problem test (28%) compared to the female control group (10%).
- correlate with the student survey
- Females less confident in mathematics and just guess
- Requiring all students with the visual model could be one possible interpretation for the female students larger growth in performance

Implications

The statistically significant performance growth made by the treatment group and a correctly drawn model leading to the correct mathematical operation 100% of the time shows the correlation of this pictorial bridge between concrete and abstract for all students.

- visual representations enhance students' abilities to understand mathematic concepts as now required by the CCSSM
- Teachers need to know developmental stage (consistent with Bruner) of student to ensure they are ready for this bar representing pictorial stage to effectively teach word problem solving

Recommendations

- Need effective instructional strategies for educators to help students
- pictorial representation stage should be added to standard mathematic instruction especially in the younger grades
- Studies necessary in other schools and elementary settings
- research should broaden its focus to compare the Bar Model Method to other pictorial representations and computer representations to establish a range of research-proven techniques

Literature Themes

- Problem Solving Word Problems
- Schematic Representations
- Bar Model Method

Bar Model Take Away Example

Fred has 83 worms in a bucket for fishing. If he uses 48 of the worms how many will still be in the bucket?

83 Worms	
48	?