Evaluation of Supplemental Math Intervention in a Montessori Context

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Background

Number Rockets is a tutor delivered math intervention program for 1st grade.

- A randomized control trial of Number Rockets found significant improvements in math computation and concept and application skills for 1st graders (Fuchs et al., 2005).
- Number Rockets tutoring was associated with improvements in math achievement for at-risk 1st graders (Fuchs, et. al., 2013).
- Rolfus and colleagues (2012) completed a large scale effectiveness trial for Number Rockets across 76 schools. Tutors were trained community members, not educators. Tutoring participants demonstrated higher scores on broad measures of math achievement.

While evidence exists to support the effectiveness of Number Rockets, no studies have examined transportability of the program to diverse educational settings. Given that the Montessori method of instruction involves in a student directed rather than teacher directed learning, research on Number Rockets outcomes in a Montessori setting is needed.

Research Question: Does Number Rockets result in positive math outcomes for students when implemented in the context of a Montessori educational setting?

Design and Methods

Setting and Participants

Participants were from cross age classrooms of 1st to 3rd graders at a local Montessori school. Traditional Montessori materials are used for classroom math instruction.

- Three 1st graders (two boys) and two 2nd graders (two girls)
- All students scored in the at-risk range on the school's fall math screening assessments

Procedure

- Trained university students delivered 28 group sessions (45 min) over a 13 week period (3 days/week; tutor to child ratio = 3:5) following Number Rockets scripts
- 45 minute lessons first taught a numeracy concept: 1) identifying and writing numbers, 2) identifying more and less, 3) sequencing numbers, 4) identifying more than, less than, and equal to, 5) skip counting by 10s, 5s, and 2s, and 6) place value; students then practiced math fact flash cards with a partner
- Instructional approaches included modeling, practice opportunities, corrective feedback
- Instruction modeled concepts via Concrete (beans, base ten blocks) → Representational (pictures) → Abstract (numbers, mathematical symbols)
- Points were provided for on task behavior and correct responding; prizes were earned when a student maximized his/her point sheet
- Sessions were video-recorded; fidelity to intervention steps ranged from 75-100%

Data Collection

- A single-subject AB methodology was used to evaluate intervention outcomes. Baseline was determined from fall math screening scores on AIMSweb Tests of Early Numeracy (TEN; Clarke & Shinn, 2002).
- AIMSweb TEN are General Outcome Measures. They are timed and validly represent a student's fluency with early numeracy concepts. The measures are predictive of later math performance and effective screeners for math delays (Baglici, Codding, & Tryon, 2010).
  - *Oral Counting:* Count orally for 1 minute starting from one; score is the number of consecutive numbers counted correctly
  - *Number Identification:* Name as many numbers as possible from a worksheet
  - *Quantity Discrimination:* Identify the larger number from a pair of numbers; score is the number of correct discriminations per minute
  - *Missing Number:* Identify a missing number in a string of three consecutive numbers; score is the number of correct numbers named per minute
- Intervention progress was monitored once every two weeks.
- Goals were to meet Tier 1 Default Cut Scores by Winter of 1st grade; which approximates performance at the 35th percentile

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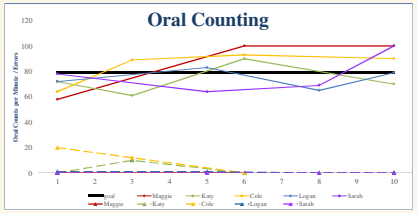
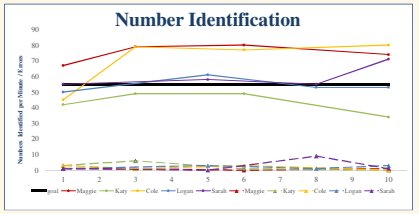
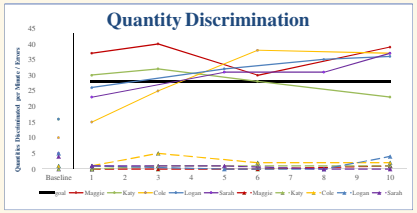
Results



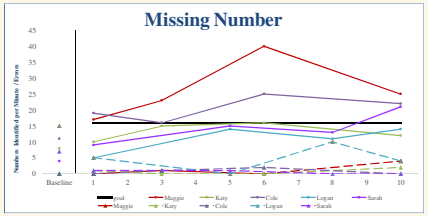
- Baseline data did not exist for Oral Counting
- 4 students showed an upward trend for counting fluency
- 4 students were at or above the goal line by Winter
- Errors decreased to zero for all students



- Baseline data did not exist for Number Identification
- 4 students increased Number Identification fluency
- Accuracy improved for Katy and Cole; remained the same for Maggie and Sarah; Logan was variable



- All students improved relative to baseline
- 4 students showed an upward trend for Quantity Discrimination fluency
- Katy showed no growth
- 4 students scored above the goal line by Winter
- Accuracy increased for Sarah and Logan



- All students improved relative to baseline
- 4 students showed an upward trend for Missing Number fluency
- 2 students consistently performed above goal
- Sarah scored above the goal by Winter and accuracy improved
- Katy's performance remained the same; Logan's performance varied

Discussion

- Results provide initial support for the use of Number Rockets as an intervention in a Montessori setting.
- There is a ceiling effect for AIMSweb TEN. Students reach a limit on how fast they can count or identify numbers in one minute. This effect is likely seen in Cole, Maggie, and Sarah's data as reflected in their initial growth and then plateau in scores.
- Despite a ceiling effect for fluency measures, students' accuracy in responding continued to improve. Informal observations of accuracy during intervention were consistent with outcome data.
- Katy did not respond to the intervention. Academic engagement and behavior challenges were evident during intervention, which may have contributed to lower overall performance. This was despite the behavior incentives provided within the program.
- Logan showed variability in performance throughout duration of intervention. During progress monitoring, he often demonstrated challenges with attention and concentration, which was associated with higher rates of inaccuracy and lower scores.

Implications

- Improved student outcomes in math are noteworthy given that no effort was made to match the math language of the intervention with the language and materials used in Montessori classrooms.
- Given that AIMSweb TEN are General Outcome Measures, increased student performance on these measures suggest a generalization of the Number Rockets intervention targets to broader assessments of early numeracy.
- Unfortunately, the AB methodology prevents us from inferring a causal relationship between intervention participation and improved math outcomes. Further, no baseline data existed for two measures and only one baseline data point existed for two measures.
- It is possible that the improved student outcomes were related to other variables (classroom instruction, practice at home) that occurred currently with intervention.
- Future research should employ more rigorous single case methodology. Additional math outcomes, such as knowledge of math facts should also be examined. Finally, the social validity of the intervention with Montessori staff should be explored.