



Mathematical Problem Solving for Students with Disabilities

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Introduction

- The General Curriculum Access Lab, the lab behind this project, aims to improve the academic success of students with developmental disabilities, including autism spectrum disorder and intellectual disability. Through evidence-based practices like scholarly writing, literature reviews, and intervention research, we support educators and families while serving our community and advancing the field of special education. Christian and Madison serve as research assistants and play pivotal roles in various tasks for the progress of the projects including transcriptions, data formatting, software storage restructuring in addition to other responsibilities.
- We are iteratively developing, refining, and evaluating a math problem solving intervention for secondary students with extensive support needs (e.g., intellectual disability, autism, multiple disabilities) using peer-mediated modified schema based instruction (MSBI).
- In past studies, the data had resulted in a functional relation between MSBI and an increase in problem-solving skills. Some research was implemented during COVID years so not all students were able to reach mastery by the end of the program so the current study is investigating a similar relationship (Root et al., 2022).
- While we use MSBI to help students in middle school achieve mastery in mathematical word problem solving, one of the long-term aims is that students will apply step-by-step problem-solving skills that will help them in their future pursuits.

Procedure

Participants were given a screening task to determine if they met eligibility criteria. Screening tasks included: (a) counting with one-to-one correspondence; (b) receptive and expressive identification of single- and double-digit numbers; (c) receptive and expressive identification of mathematics symbols (i.e., percent, fraction, multiplication); (d) using a calculator to complete addition, subtraction, multiplication, and division calculations and write solutions; and (e) solving word problems.

Teacher training - First, teachers were asked to watch a video that provided background information on the research timeline, MSBI, and the specific goals and process of the study. Next the researchers provided individual 1-hr trainings in person, during which they explained the specific procedures.

Baseline - During each baseline probe, students were provided with 5 worksheets that each displayed one of the problem types in a word problem, three schema options, manipulatives, a calculator, and writing utensils.

Intervention - After three introduction sessions, intervention sessions used a model, guided practice, and independent practice format. To progress into the next instructional phase, students had to demonstrate mastery of critical steps in 3 consecutive problem-solving sessions.

Generalization - After two problem types (e.g. equal groups and multiplicative comparison), students moved into "Mystery Level" discrimination units where they had to discriminate between problem types before solving the problems.

Maintenance - Maintenance sessions will follow baseline procedures and will be conducted 1-2 weeks after the last intervention phase.

Preliminary Results

The positive effects of researcher delivered MSBI have demonstrated in previous research. In addition to measuring the effect of MSI Curriculum on multiplicative word problem solving skills for students with extensive support needs, this current iteration of a teacher-delivered intervention will include various student and teacher social validity measures to determine the extent to which the goals, procedures, and outcomes of an intervention or study are acceptable, meaningful, and relevant to the stakeholders involved, such as students, teachers. (Relevance and feasibility in real life settings.)

Teachers will complete post-intervention surveys, interviews, and participate in focus groups to make improvements. Students will complete social validity surveys and post-intervention interviews. Students with extensive support needs can learn to do math and need to be provided with opportunities to do so.

References

- Gilley, D., Root, J., Saunders, A., Cox, S., & Bryan, C. (2023). Peer-Delivered Modified Schema-Based Instruction in Word Problem-Solving for High-School Students with Intellectual Disability. *Research and Practice for Persons with Severe Disabilities*, 48(4), 167-185. <https://doi.org/10.1177/15407969231200413>
- Root, J. R., Cox, S. K., & McConomy, M. A. (2022). Teacher-Implemented Modified Schema-Based Instruction with Middle-Grade Students with Autism and Intellectual Disability. *Research and Practice for Persons with Severe Disabilities*, 47(1), 40-56. <https://doi.org/10.1177/15407969221076147>
- Witzel, B., Myers, J., Root, J., Freeman-Green, S., Riccomini, P., & Mims, P. (2024). Research Should Focus on Improving Mathematics Proficiency for Students With Disabilities. *The Journal of Special Education*, 57(4), 240-247. <https://doi.org/10.1177/00224669231168373>

Abstract

This study focuses on the use of teacher-delivered Modified Schema-Based Instruction (MSBI), specifically in the subject of mathematics for students with intellectual disabilities and/or autism spectrum disorder. This study is a single-case multiple-probe across participants design. The goal of this research is to provide young individuals with disabilities a high-quality educational experience in mathematics in order to foster independence and enhance societal well-being.

The study involves a refined structure of MSBI, moving away from the traditional one-on-one researcher-led format to a teacher-delivered model within a small group setting, promoting real-world applicability within standard classrooms. The research methodology incorporates assessments at various stages in order to make accommodations and modifications within the intervention, as necessary.

The primary emphasis of the intervention is on multiplicative word problems, including equal group, multiplicative comparison, unit rate, ratio, and proportion problems. Through this research, we aim to contribute to a more inclusive and effective educational environment, broadening opportunities for diverse learners in the field of mathematics education.

Graphics

Teacher Data Sheet

Unit	EG	MC	UR	RA	PR	TP	CP	MP	OP	AP	IP	CP	MP	OP	AP	IP
Investigation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Formed?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Date	10/1	10/2	10/3	10/4	10/5	10/6	10/7	10/8	10/9	10/10	10/11	10/12	10/13	10/14	10/15	10/16

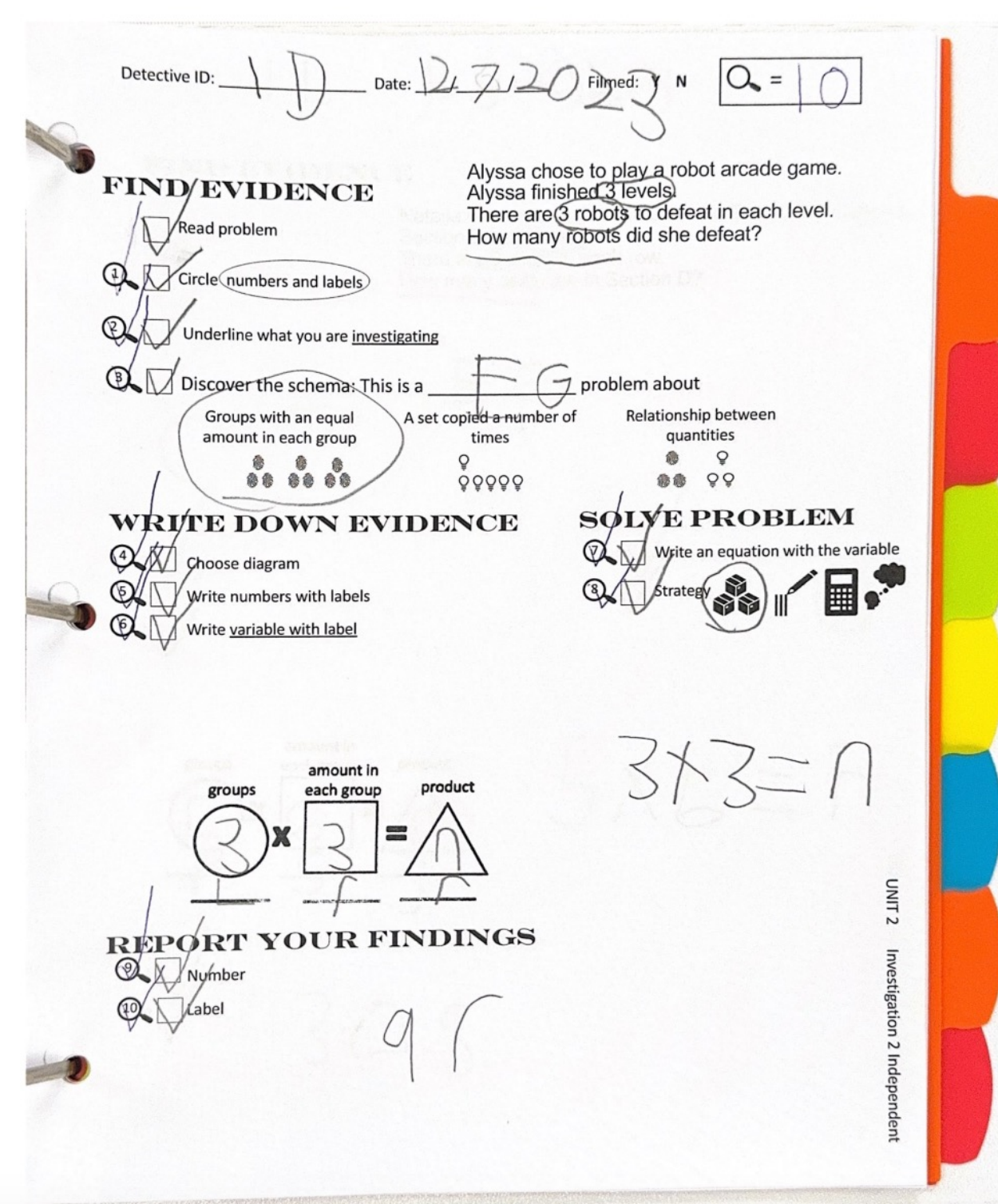
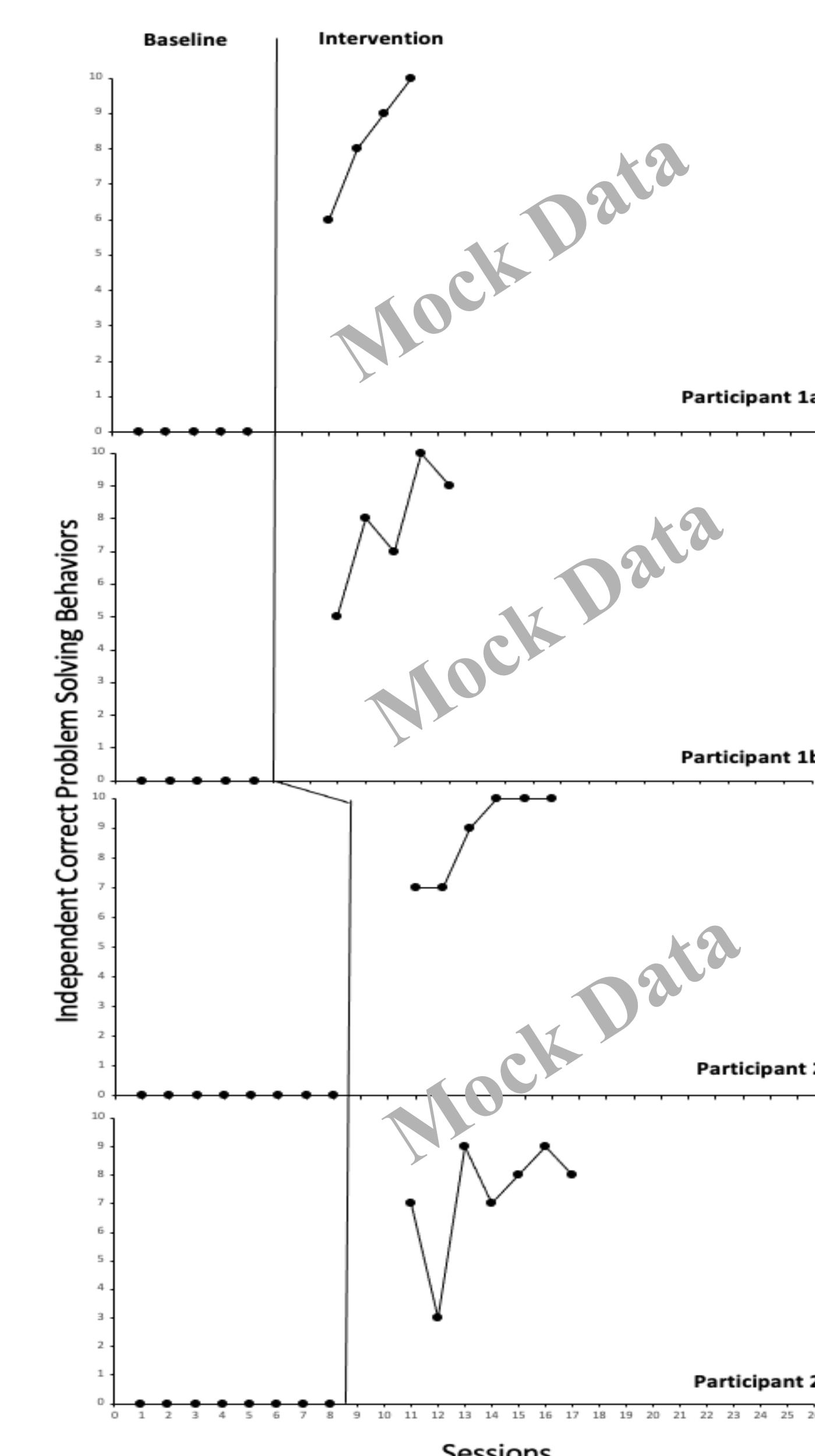
Expected Student Response

Item	10	9	8	7	6	5	4	3	2	1
10. Write label for solution (what is being investigated)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9. Write correct solution (number)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8. Circles strategy used to solve problem (multiplication, division, calculation, or mental math)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Write equation with correct numbers, operation, variable, and equal sign	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6. Write variables with label in correct position on diagram (what is being investigated)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5. Put all numbers with labels in correct position on diagram	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Select correct diagram	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Write correct problem type and circle correct reason	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Underline only what is being investigated	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1. Circle all numbers with labels	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	10	9	8	7	6	5	4	3	2	1

Scoring procedures: 1. Mark independent correct answers with / 2. Circle total number of independent correct answers

MATH SCENE INVESTIGATIONS PILOT 2023-2024

Mock Data



Student EG Independent Practice Worksheet