

# TEACHING MULTIPLICATIVE WORD-PROBLEM SOLVING TO A STUDENT WITH AUTISM SPECTRUM DISORDER



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## Introduction

- Last decades: growing interest in teaching mathematical problem solving to students with learning difficulties.
- Several studies focus on students with autism spectrum disorder (ASD), who often exhibit deficits in key cognitive skills required for problem solving: working memory, executive functions, etc.
- Most research focuses on simple arithmetic word problems involving addition and subtraction. Little research has been conducted on teaching students with ASD to solve problems involving multiplication and division (Polo-Blanco et al., 2022).
- We test the effectiveness of the COMPS methodology in teaching a student with ASD and intellectual disability to solve multiplicative word problems.

## COMPS methodology

- Conceptual model-based problem solving (COMPS) deploys equation-like, conceptual model diagrams that emphasize algebraic expressions of relations, to improve students' problem-solving competence (Xin, 2012).
- COMPS applied to multiplicative word-problem solving:

Problem type	Sample word problem	Conceptual model diagram
Equal groups (EG)	I have 6 pieces of candy in each bag. If I have 3 bags, how many pieces of candy do I have?	
Multiplicative comparison (MC)	Luis has 6 pieces of candy. Pedro has 3 times more candy than Luis. How many pieces of candy does Pedro have?	
Cartesian product (CP)	I have 4 T-shirts and 2 slacks. How many different combinations can I wear in all?	

## Research questions

- 1) Is the COMPS approach effective in teaching multiplication and division problems to a student with ASD?  
Will improvement in problem-solving performance ...
- 2) ... be generalized to two-step problems?
- 3) ... transfer to real-life situations?
- 4) ... be maintained over time?

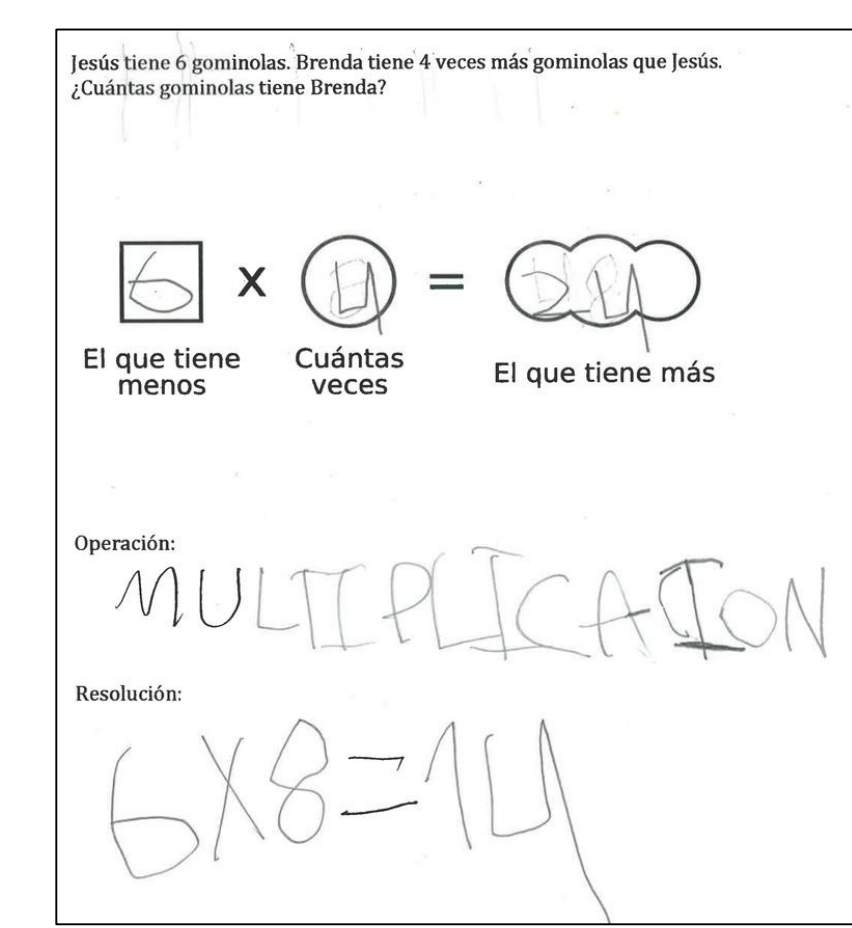
## Methodology

- **Method:** Single-case, multiple-baseline across behaviors design. One-step equal groups, multiplicative comparison and Cartesian product problems, each of which was addressed as a separate behavior.
- **Participant:** 14-year old male ASD-diagnosed student, diagnosed with ASD at the age of 6, rated as severely autistic on the Childhood Autism Rating Scale, IQ of 54 on the WISC-V.
- **Dependent variable:** the student's ability to successfully solve the three types of multiplication and division word problems. Indicators: explicit identification of the required arithmetic operation (1 point) and correct performance of the operation to find the numerical answer (1 point).
- **Independent variable:** the COMPS-based problem-solving intervention conducted for each type of problem.
- **Design and data collection:** 31 sessions as weekly extracurricular activities. Instructor with 20 years of teaching experience.
  - 5 experimental stages: baseline, training (3 types of problem), follow-up, maintenance (5 weeks after training), generalization (2-step problems). Training sessions include *story grammar* and *problem stages*, following the DOTS (detect, organize, transform, solve) checklist (Xin, 2012).
  - 2 final sessions in a domestic context (transfer to a real-life situation): The student is given a recipe for one person and is asked to rewrite the quantities for 2 and 3 persons.

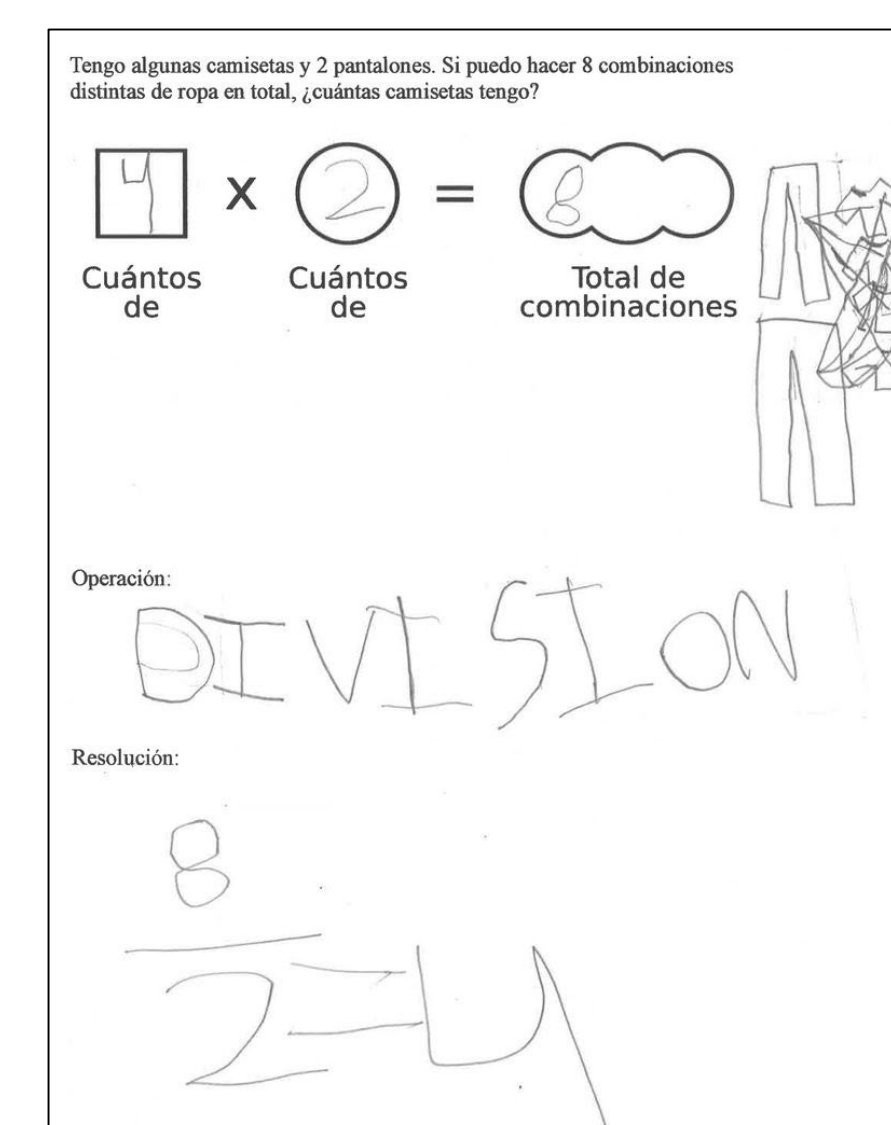
## Results



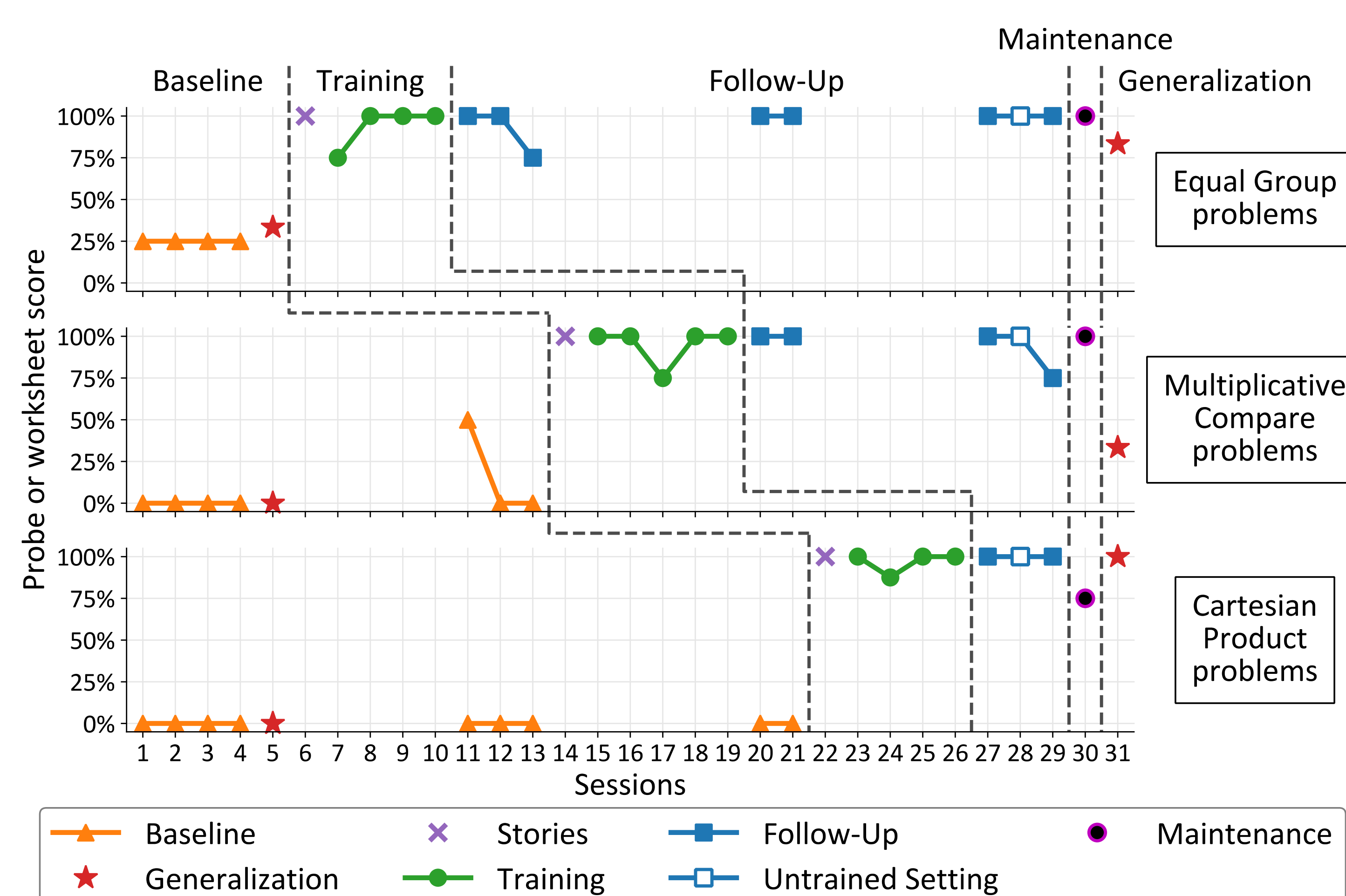
**Baseline:** Example of a correct resolution of an EG problem involving a multiplication.



**Training:** Difficulties in identifying the operation. Students writes "multiplication" but applies summation in the resolution in an MC problem.



**Training:** correct resolution of a CP problem using the COMPS method and a modeling strategy.



- During the baseline sessions, the student was only able to solve EG multiplication problems using drawings and counting.
- Once COMPS training began, performance both in identifying as well as in carrying out the correct operations rose quickly to 100% for the three problem types, and remained over 75% during follow-up and generalization stages. During problem-solving training, the student also showed higher levels of concentration and interest.
- In the real-life situations, the student specified the amounts correctly both when multiplying and dividing, only requiring help with words such as "double" and "triple". He was highly motivated by the activity.

## Conclusions

- This study provides first-time evidence of the efficacy of COMPS methodology to help a student with ASD solve problems involving multiplication.
- A functional relationship was observed between COMPS instruction and improvement in the student's ability to solve multiplication division problems.
- The skills acquired were successfully transferred to real-life situations.
- The student was able to generalize what he learned, applying the knowledge to two-step problems, although improvement in the MC problems was lower than in the other two types.

## Bibliography

- Polo-Bianco, I., Van Vaerenbergh, S., Bruno, A., & González, M. J. (2022). Conceptual model-based approach to teaching multiplication and division word-problem solving to a student with autism spectrum disorder. *Education and Training in Autism and Developmental Disabilities*, 57(1), 31-43.
- Xin, Y. P. (2012). *Conceptual Model-Based Problem Solving: Teach Students with Learning Difficulties to Solve Math Problems*. The Netherlands: Sense Publishers.

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