Does Calling it 'Morgan's Way' Reduce Strategy Generalization?

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Importance of Generalization

Person-Presentation Harms Generalization

- Presenting strategies as belonging to a specific individual (*person-presentation*) can harm transfer (Riggs, Alibali, & Kalish, 2015; 2017)
  - Strategies evaluated as less generalizable (Riggs et al., 2017)

Person-presentation
Here is **Morgan's strategy**:

vs.

Strategy-label
Here is the **multiplicative strategy**:

Benefits of Person-Presentation

- Intended to enhance educational materials
  - Found in U.S. middle-school math textbooks (Riggs et al., 2015)
  - Common when presenting multiple strategies in Japanese middle-school textbooks (Rittle-Johnson, 2019)
- In line with best practices in math instruction
  - Class discussions of student-generated examples (NCTM, 2014)
  - Teachers encouraged to use names (NCTM, 2000)

Comparison and Explanation Aid Generalization

- Comparison
  - In math, comparing worked examples supports transfer and flexibility (Rittle-Johnson & Star, 2007; Star & Rittle-Johnson, 2009)
  - Focus on problem structure instead of surface features (Gentler & Medina,1998; Gick & Holyoak, 1983)
- Explanation
  - Prompts to explain worked examples aid learning (Chi et al., 1994)
  - Broadens conditional knowledge (Chi et al., 1989; Siegler & Chen, 2008)

Research Question

Does person-presentation harm generalization when used with effective learning techniques in a classroom context?

Current Study

- Tested impact of person-presentation during regular classroom instruction
- Algebra I teachers used supplemental curriculum during a multi-week unit on linear equation solving
  - Students compared and explained strategies presented either with or without characters and their names

Method

- Participants
  - Five 9th grade Algebra I teachers and their 168 students from 2 schools in suburban Massachusetts
- Design
  - Person-presentation condition (*n* = 76 students)
  - Strategy-label condition (*n* = 92 students)

Supplemental curriculum

- 9 Worked example pairs
  - Which is better?
  - Which is correct?
  - Why does it work?

Person-presentation Condition

Which is better?

Riley and Gloria were asked to solve $5(n + 6) = 2(n + 6) + 6$.

Riley's way

$5(n + 6) = 2(n + 6) + 6$

$5n + 30 = 2n + 12 + 6$

$5n + 30 = 2n + 18$

$-2n \quad -2n$

$3n + 30 = 18$

$-30 \quad -30$

$\frac{3n}{3} = \frac{-12}{3}$

$n = -4$

First, I distributed.

Then I moved the variable to one side of the equation.

I subtracted from both sides.

I divided by 3.

Here's my answer.

Gloria's way

$5(n + 6) = 2(n + 6) + 6$

$5(n + 6) = 2(n + 6) + 6$

$-2(n + 6) \quad -2(n + 6)$

$\frac{3(n + 6)}{3} = \frac{6}{3}$

$n + 6 = 2$

$-6 \quad -6$

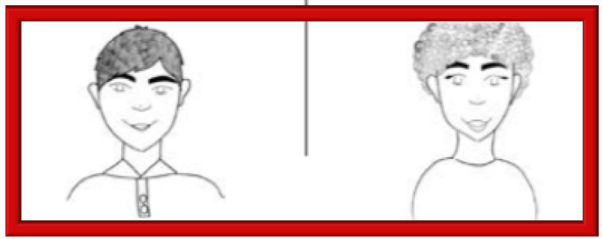
$n = -4$

First, I subtracted the quantity $2(n + 6)$ from both sides.

Then I divided by 3.

I subtracted from both sides.

Here's my answer.



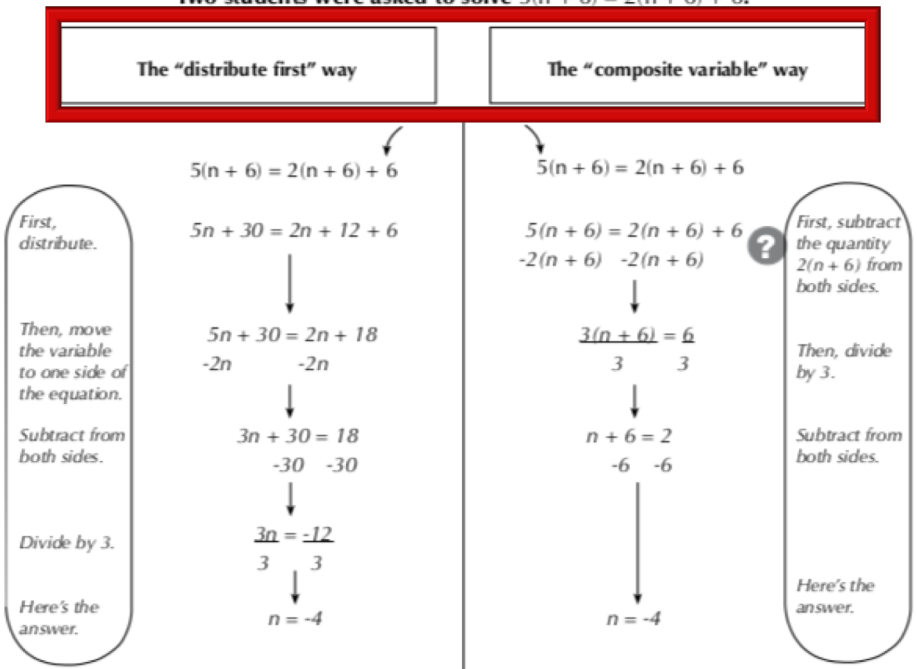
How did Riley and Gloria solve the equation?

Which method is better? What are some important differences between Riley's method and Gloria's method?

Which is better?

Strategy-label Condition

Two students were asked to solve $5(n + 6) = 2(n + 6) + 6$.



No Illustrations

How did the students solve the equation?

Which method is better? What are some important differences between the "distribute first" method and the "composite variable" method?

Generalization Ratings

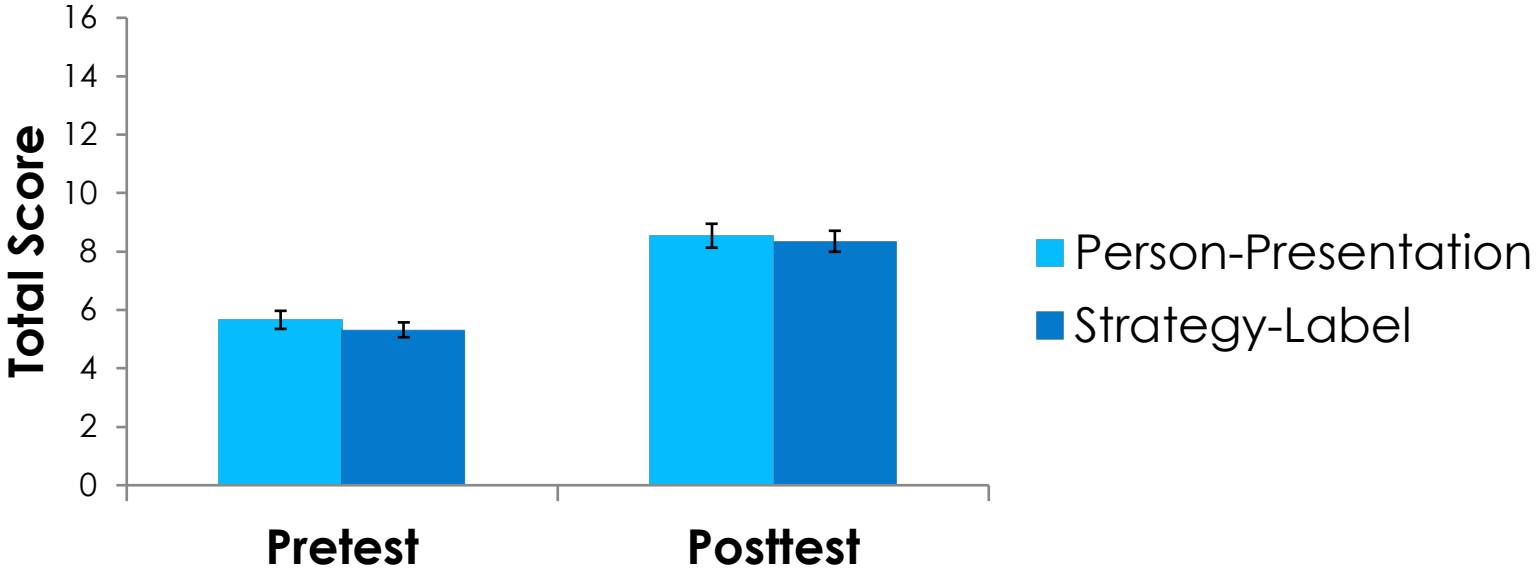
- After comparing and explaining each strategy, rated generalizability
  - How likely would you, another high school student, and a teacher be to use the strategy in the future?

1	2	3	4	5
Very Unlikely	*Somewhat Unlikely*	*Neutral*	*Somewhat Likely*	*Very Likely*

Assessment

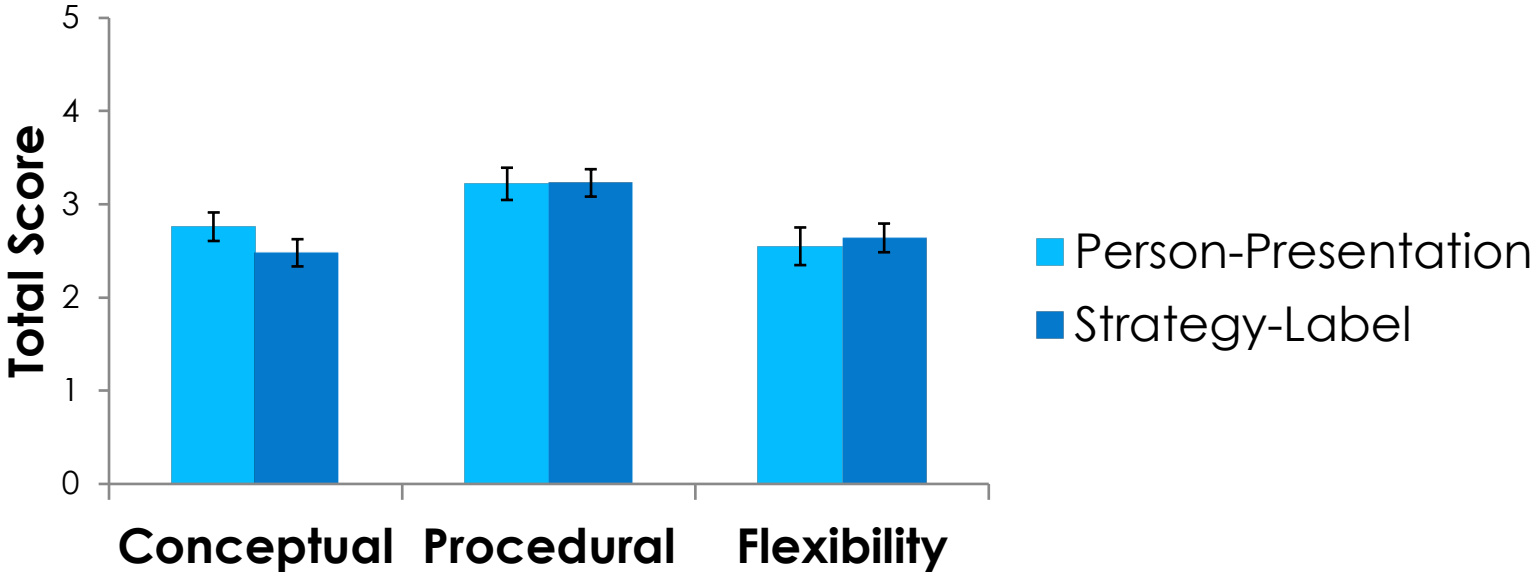
- Developed 16-item assessment (α = .78)
  - Conceptual Knowledge
    - Identify equivalent equations
  - Procedural Knowledge
    - 45 = 2(x + 8) + 7(x + 8), solve for x
  - Procedural Flexibility
    - On a timed test, which would be the BEST way to solve the problem below?

Student Learning



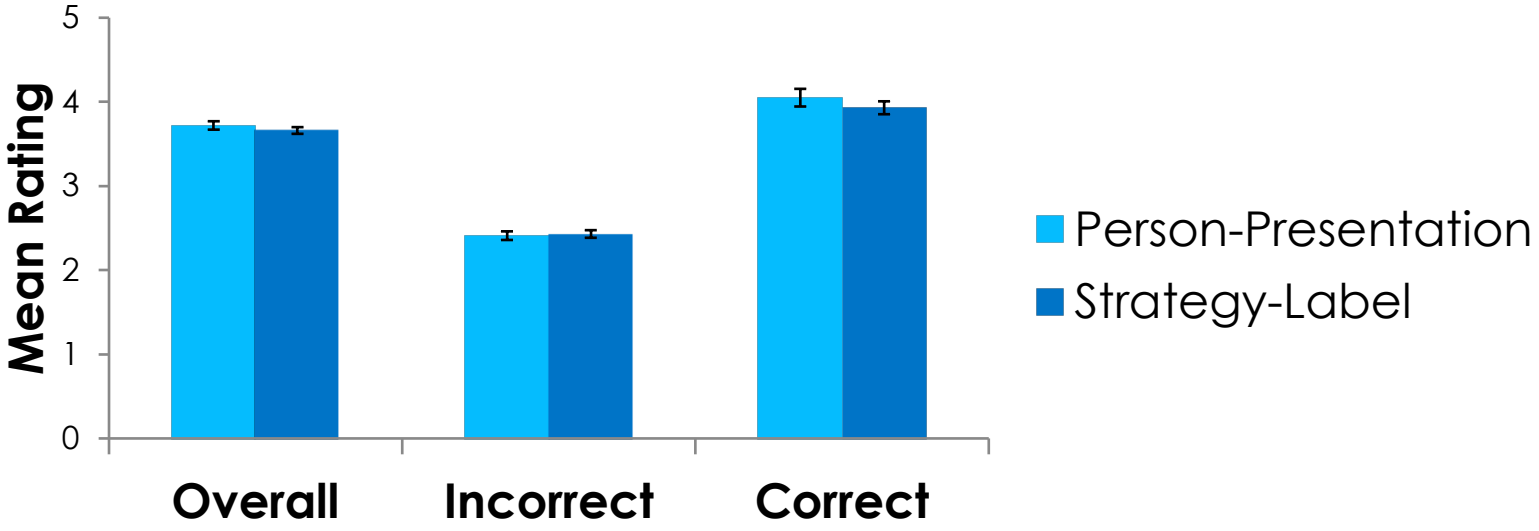
No differences in posttest scores after controlling for pretest scores, $F(1, 165) = .003$, $p = .96$, $\eta_p^2 < .001$

Student Learning



No differences in posttest scores by knowledge type, *p*'s > .27

Generalization Ratings



No differences in generalization ratings, *p*'s > .10

Results Summary

- No negative (or positive) effects of person-presentation on learning
  - Including conceptual, procedural, and flexibility sub-scores
- No negative (or positive) effects of person-presentation on evaluations of generalizability of strategies

Discussion

- Possibility that comparison and explanation played a protective role
  - Both guide attention to important problem features and away from surface features (Gentner & Medina, 1998; Siegler & Chen, 2008)
- Expansive framing helps students develop generalizable knowledge (Engle et al., 2011; 2012)
  - Integrated throughout unit, multiple strategies and characters

Limitations

- Could not control for teacher differences
- Broader assessment
  - Less focused on transfer of strategy to specific problem types

Conclusion

- Findings reduce concerns about the potential negative effects of person-presentation on knowledge generalization
  - When effective instructional supports were in place
  - Integrated into classroom instruction

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