

Teacher Beliefs Surrounding Comparison in Algebra Instruction



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Introduction

- In mathematics education, comparing and discussing multiple solution strategies is a recommended instructional method in countries throughout the world. Teachers are encouraged to have students share, and doing so improves student learning (e.g., Durkin, Star & Rittle-Johnson, 2017).
- One key type of comparison is **comparing two correct strategies** for solving the same problem, with the goal of learning when and why one strategy is more efficient or easier than another strategy for a given problem type (Rittle-Johnson & Star, 2007).
- Another important type of **comparison is between a correct and an incorrect strategy**, with the goal of understanding and avoiding common incorrect ways of thinking (Durkin & Rittle-Johnson, 2012).
- However, teachers use these techniques infrequently and struggle to implement them well (e.g., Stein, Engle, Smith, & Hughes, 2008).
- Teaching practices are influenced by teachers' beliefs, and these beliefs also impact students' attitudes and learning (e.g., Chavez et al., 2015).

Current Study.

- Better understand high school teachers' beliefs about instruction on multiple strategies, focusing on their beliefs about comparison to more efficient strategies and to incorrect strategies.
- Explore their beliefs before and after their participation in a year-long intervention on supporting comparison and discussion of multiple strategies in Algebra I.

Method

We conducted interviews to examine how teacher beliefs differed *before* and *after* participating in a year-long intervention on supporting comparison and discussion of multiple strategies in Algebra I.

Participants: Sixteen Algebra I teachers across four schools in Massachusetts and New Hampshire participated. These schools had an average of 17% of students receiving free and reduced price lunch. 5% of students at participating schools were African American, 6% were Hispanic, and 77% were white.

Teachers were interviewed prior to being introduced to the curriculum materials (*pre-PD*) and again at the end of the year (*exit interviews*).

Interview Procedure: Interviewers used a structured protocol including the questions:

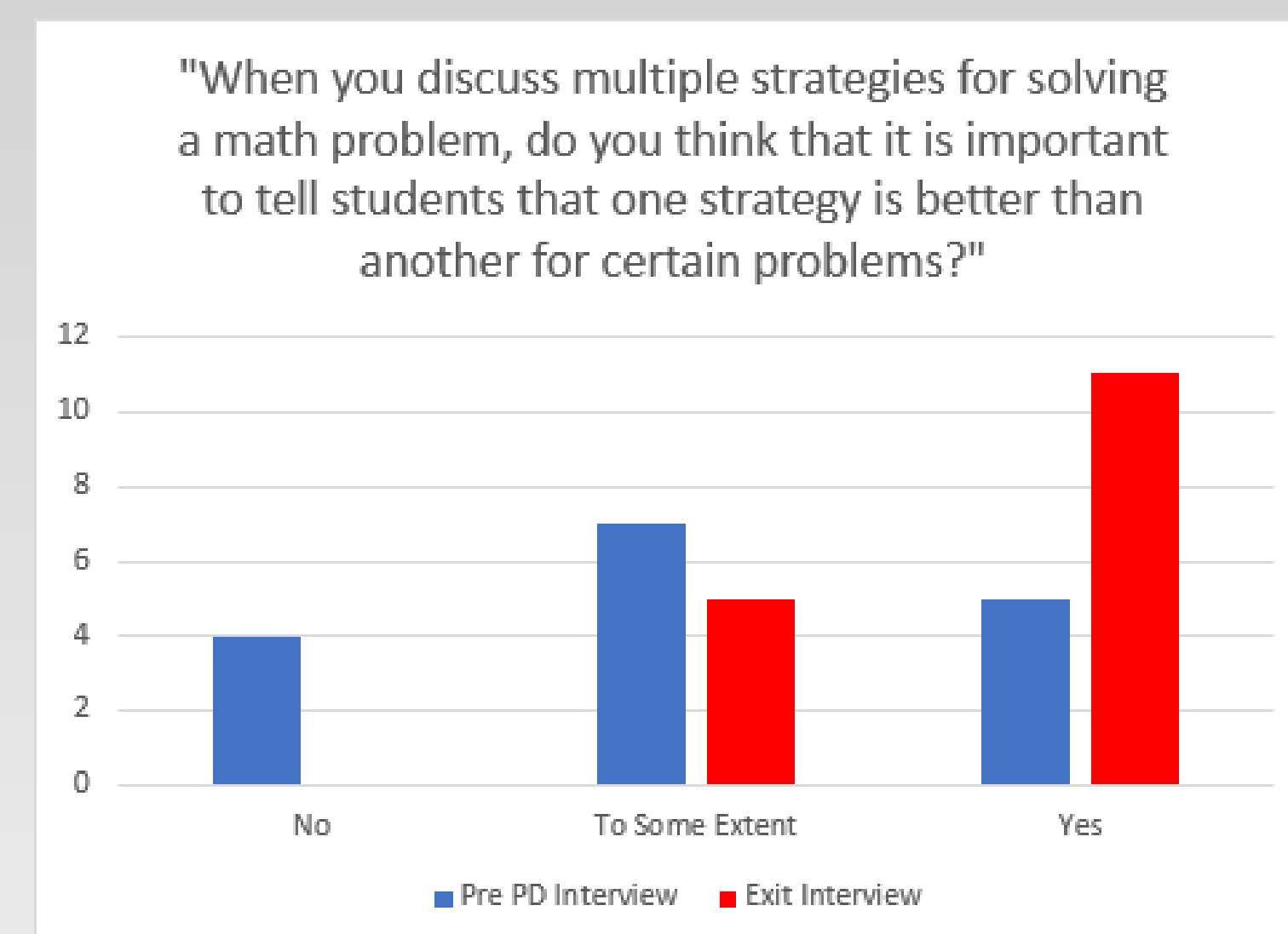
- "When you discuss multiple strategies for solving a math problem, do you think that it is important to tell students that one strategy is better than another for certain problems? Why or why not?" and
- "Do you think it's valuable to ask your students a correct way to solve a problem and an incorrect way to solve the same problem? Why or why not?"

Transcripts were analyzed, and teacher responses to the two questions mentioned above were grouped into "Yes", "No", or "To some extent" categories.

Results

Beliefs about Comparison to More Efficient Strategies

1) There was a fairly even distribution across response categories during *pre-PD* interviews. During *exit interviews*, teachers generally saw value in this type of comparison.



2) Many teachers' beliefs regarding the importance of efficiency-focused comparisons changed after a year of using the supplemental curriculum that emphasized this type of comparison.

		Exit Interview		
		No	To Some Extent	Yes
Pre-PD Interview	No	0	2	2
	To Some Extent	0	2	5
	Yes	0	1	4

3) Teachers who supported this type of comparison commented on the importance of efficiency.

"What is important is their ability to problem-solve. And later on in life they're gonna be working for a company or whatever where they – yes – will need to learn the most efficient way to do something – And that is of value."

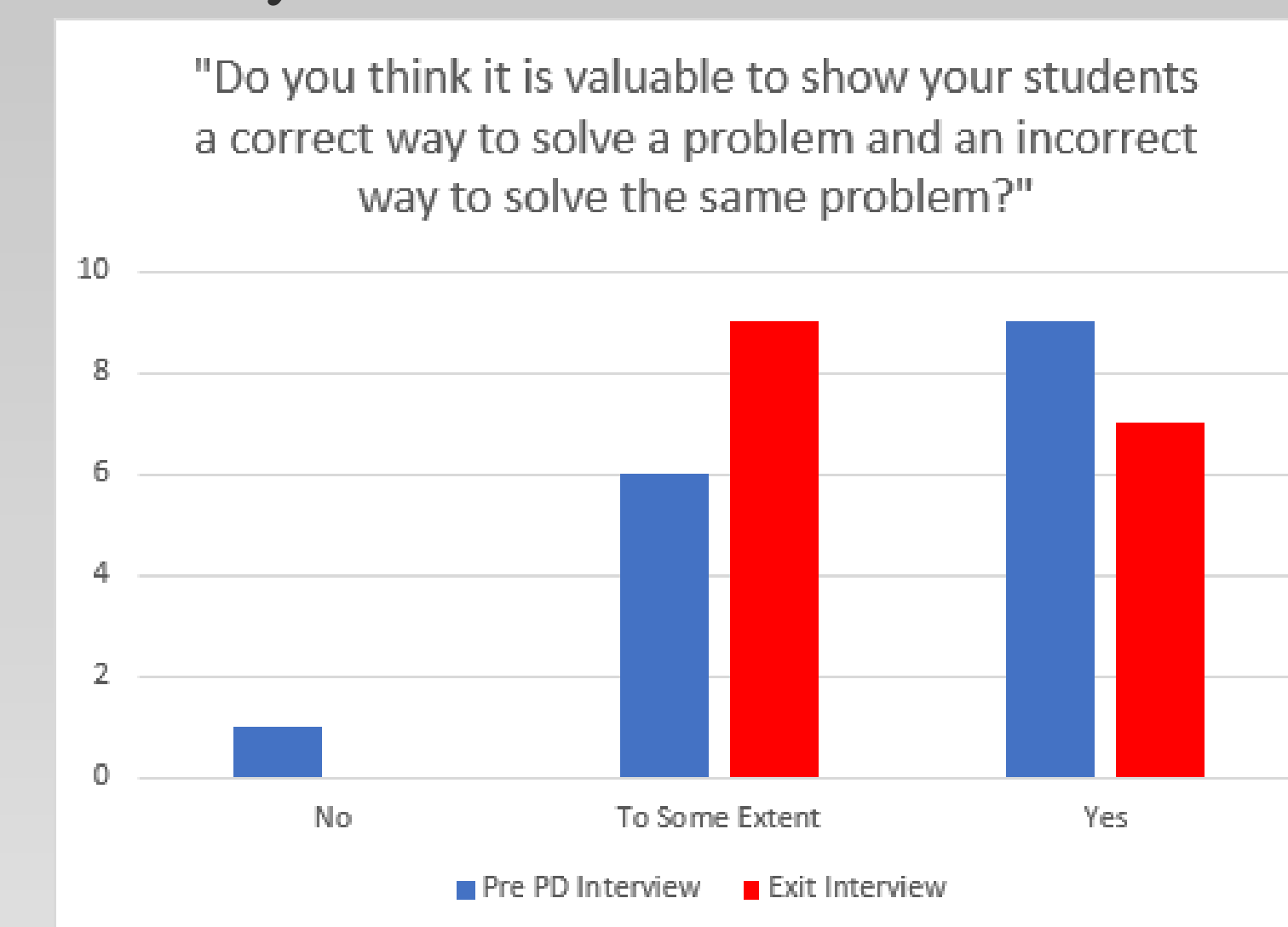
Beliefs about Comparison to More Efficient Strategies (continued)

4) Teachers who did not support it mentioned the importance of allowing students to solve problems however they feel comfortable.

"If you like multiplying by fractions, go for it. If you like dividing by a number, go for it, they're the same thing – it's what you're comfortable with."

Beliefs about Comparison to Incorrect Strategies

5) Teachers generally expressed value in this kind of comparison during *pre-PD* interviews. After using the curriculum throughout the school year, some teachers felt differently at their *exit interviews*.



6) Some teachers became more aware of and sensitive to the difficulties in utilizing this comparison type when using the curriculum.

		Exit Interview		
		No	To Some Extent	Yes
Pre-PD Interview	No	0	0	1
	To Some Extent	0	4	2
	Yes	0	5	4

7) Those who supported this type of comparison perceived it to aid students in avoiding the errors discussed, while those who did not support it expressed concern of students "latching onto" the wrong method.

"I think error analysis is definitely useful. Students should be able to identify mistakes. I think the timing of it is really important. If I'm just introducing material, the last thing I want to show them is how not to do it, because they're going to look at that and they're going to remember that and that puts almost like a negative spin on their understanding... So it's very useful, but you have to time it well."

Discussion

- Overall, teachers found more value in efficiency-focused comparisons after using the curriculum throughout the school year. All teachers who did not support this type of comparison at the pre-PD interview supported it more after a year of using the curriculum.
- Our results are promising that teachers' beliefs about using comparison to more efficient strategies can be changed if teachers have a curriculum supporting them to do so.
- Teachers' beliefs about comparison to incorrect strategies were not changed in the same way beliefs about comparison to more efficient strategies were. Over 30% of teachers became more cautious about using comparison to incorrect strategies over the year, even though research suggests that such comparison can be useful when introducing material as well (e.g., Durkin & Rittle-Johnson, 2012).
- Our results indicate that more support is needed for teachers to feel comfortable using comparison to incorrect strategies effectively at varying points during a lesson.
- Further exploration is needed to better understand differences in how teachers were impacted by the use of the supplemental curriculum.

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Acknowledgements

This research was supported by a grant from the National Science Foundation (DRL 1561286). The ideas in this poster are those of the authors and do not represent official positions of the funding agency.

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