Why Content-Specific Expertise Matters: Identifying, Measuring, and Developing Mathematical Knowledge for Teaching

Yasemin Copur -Gencturk

Science of Teaching Math

OVERVIEW

- Background
- Content -specific Knowledge
- Content -specific Learning
- Content -specific Equity
- Discussion

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Background

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Background

Enhancing Teacher Capacity

Improving Student Learning & Belonging

Research Interest

Content-specific Knowledge for Teaching

Identification & measurement of the knowledge and skills key to teaching mathematics.

Content-specific Learning Opportunities

Identification & development of effective learning opportunities for teachers to develop expertise.

Content-specific Equity

Identification and removal of barriers in teaching and learning mathematics to ensure all students excel in math.

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Welcome to STM

The Science of Teaching Math (STM) is a research group that focuses on teachers' acquisitions of knowledge and pedagogical skills and the transfer of these skills in to their practice, with special attention to issues of equity. STM also works to identify critical learning opportunities that are key to developing teachers' knowledge and skills and which teacher- and teaching-related issues will help eliminate inequities in the mathematics classroom.

To get in touch with the team, please feel free to reach out below.

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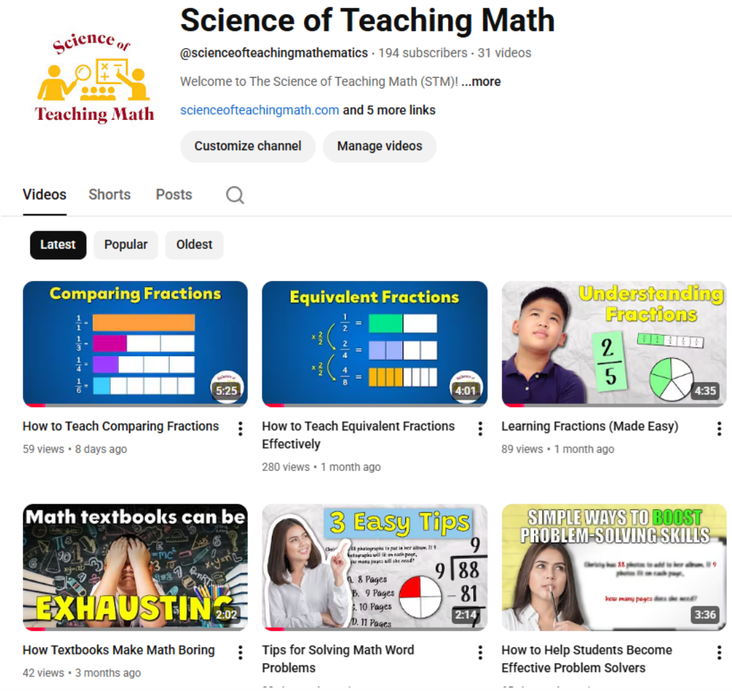

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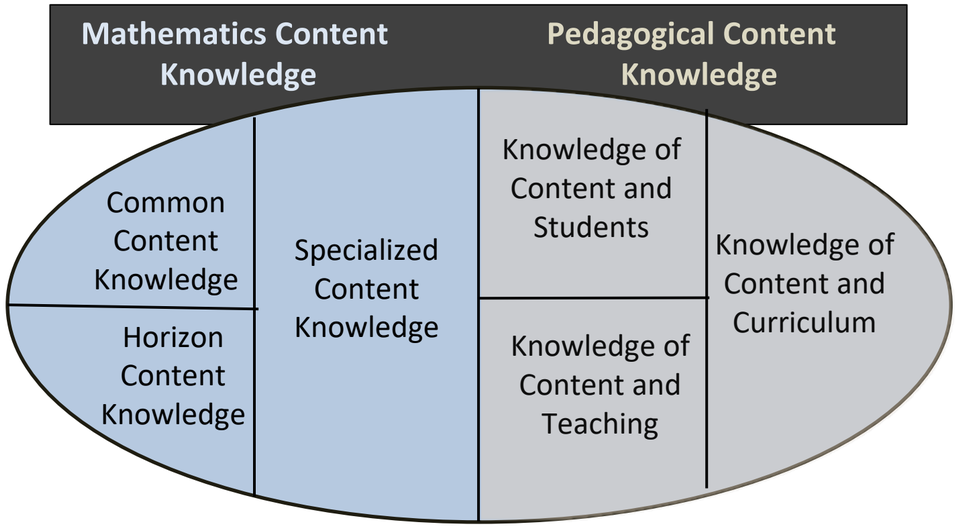
Content -specific Knowledge



Copur-Gencturk, Y. (2015). The effects of changes in mathematical knowledge on teaching: A longitudinal study of teachers' knowledge and instruction. Journal for Research in Mathematics Education, 46(3), 280-330. https://doi.org/10.5951/jresematheduc.46.3.0280.

Content-Spe

Identificatio
knowledge a
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Copur-Gencturk, Y., Tolar, T., Jacobson, E., & Fan, W. (2019). An empirical study of the dimensionality of the mathematical knowledge for teaching construct. Journal of Teacher Education, 70(5), 485-497. https://doi.org/10.1177/0022487118761860.

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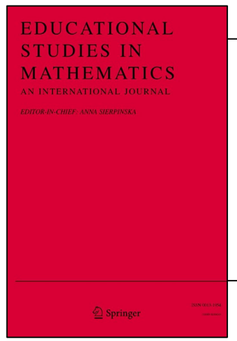
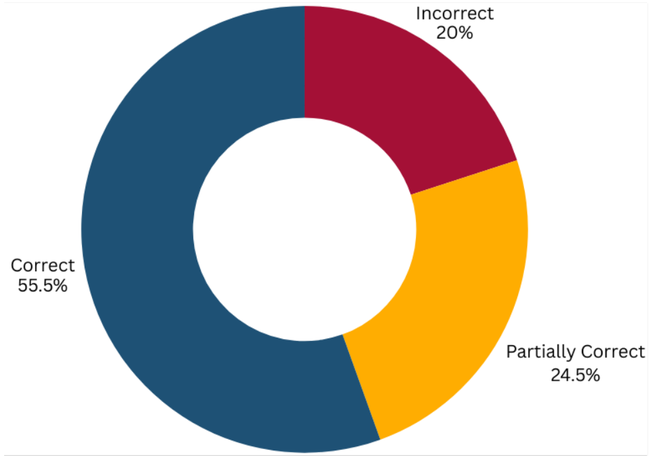
Content -specific Knowledge

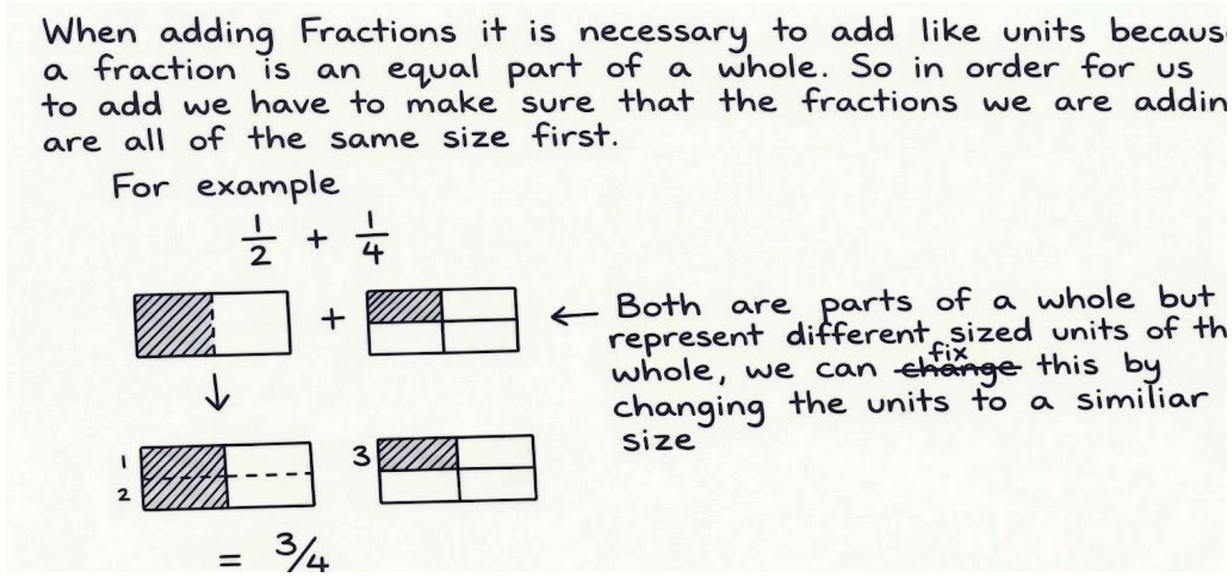
1 Conceptual Understanding



Copur-Gencturk, Y. (2021). Teachers' conceptual understanding of fraction operations: Results from a national sample of elementary school teachers. *Educational Studies in Mathematics*, 107(3), 525-545. https://doi.org/10.1007/s10649-021-10033-4.

You must have a common denominator and create equivalent fractions, otherwise your answer will not be correct.





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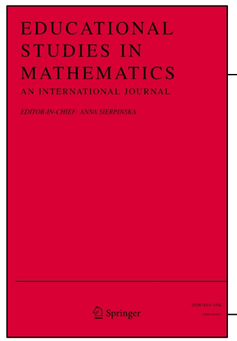
Content -specific Knowledge

1 Conceptual Understanding



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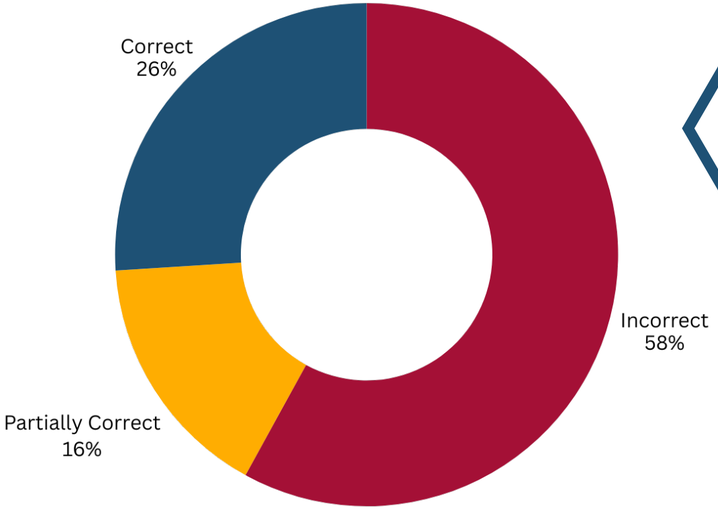
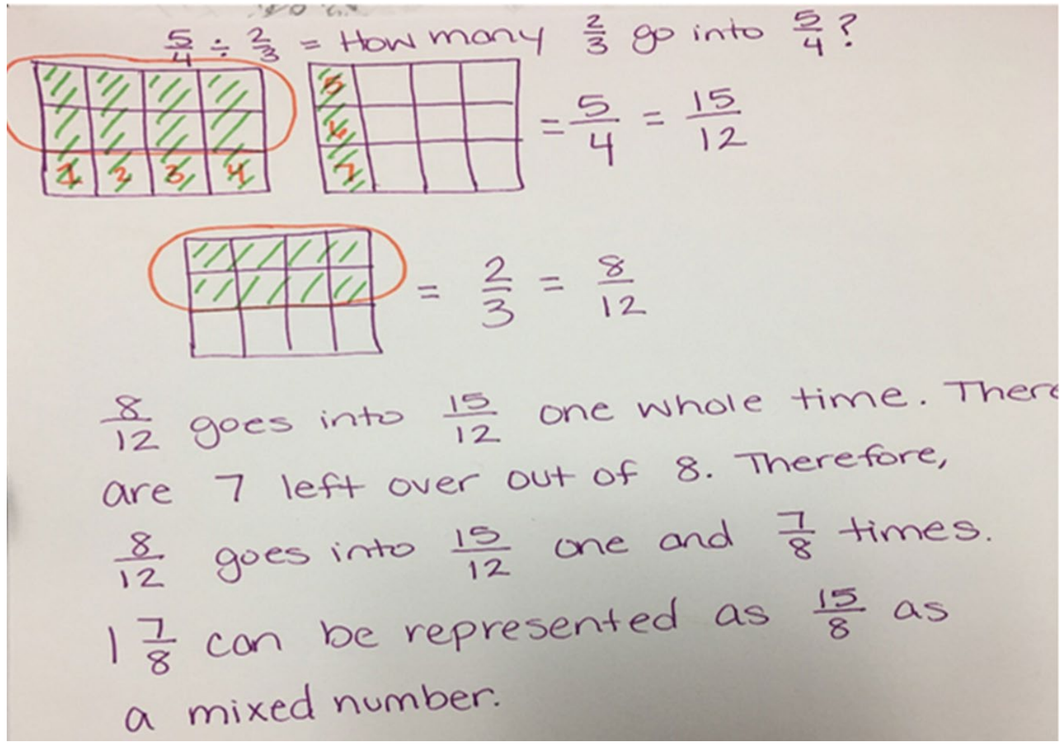
Sorry, Ms. Bryson. You and I are in the same boat of procedural understanding and not conceptual.





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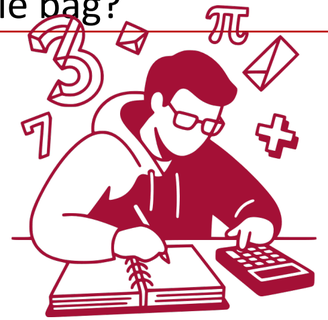
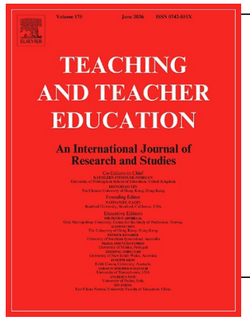
Content -specific Knowledge

Copur-Gencturk, Y., & Doleck, T*. (2021). Strategic competence for multistep fraction word problems: An overlooked aspect of mathematical knowledge for teaching. Educational Studies in Mathematics, 107(1), 49-70. https://doi.org/10.1007/s10649-021-10028-1.

Max, the Wonder Dog, ate $\frac{1}{4}$ of a bag of treats on Sunday. Each night after that, Max ate $\frac{3}{16}$ of the bag. How many nights (including Sunday) would it take to finish the whole bag?





Copur-Gencturk, Y., & Tolar, T. (2022). Mathematics teaching expertise: A study of the dimensionality of content knowledge, pedagogical content knowledge, and content-specific noticing skills. Teaching and Teacher Education, 114, 103696. https://doi.org/https://doi.org/10.1016/j.tate.2022.103696.

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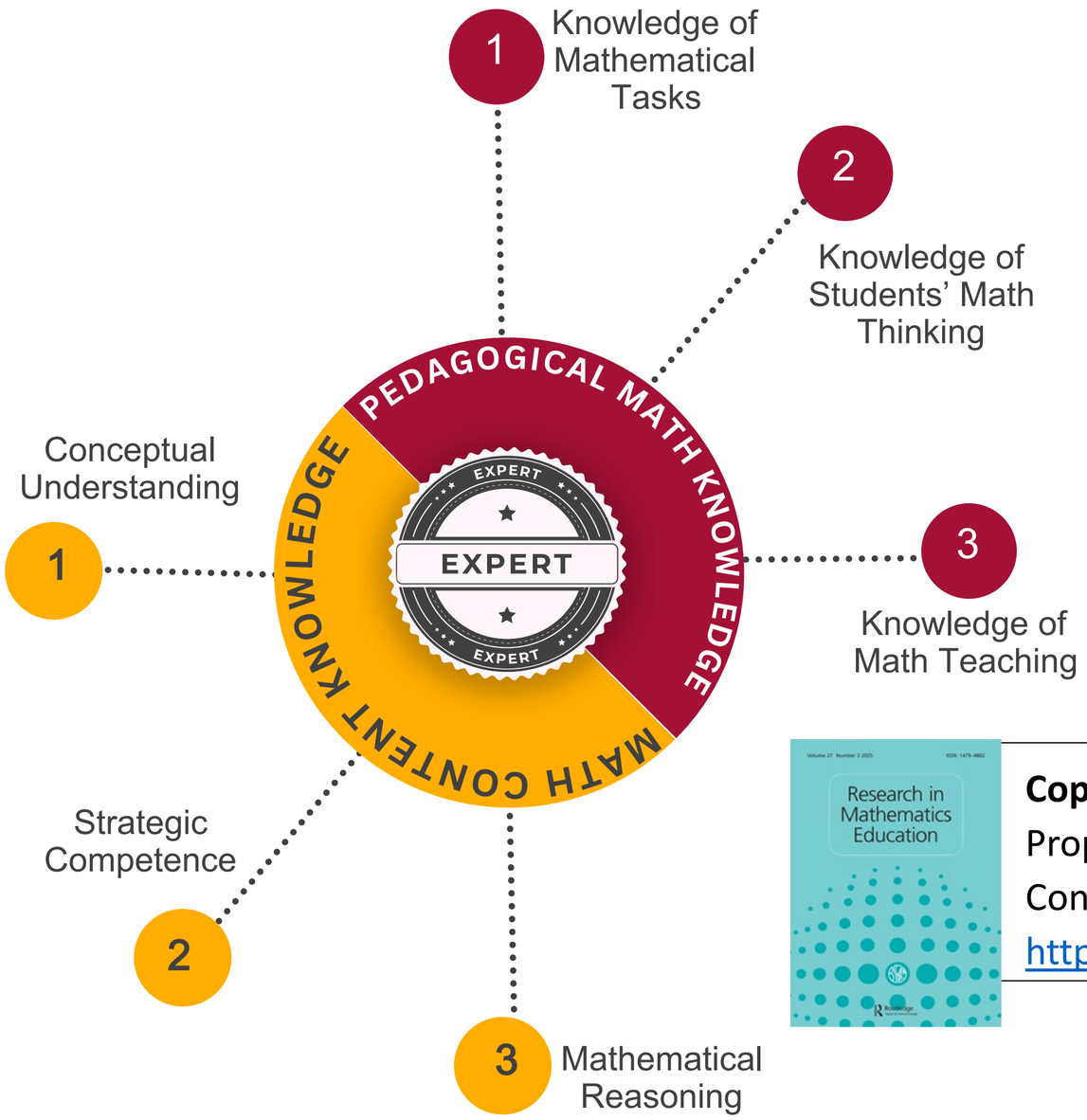
Content -specific Knowledge



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IES Institute of Education Sciences

Copur-Gencturk, Y. & Ezaki*, J. (2025). Middle School Mathematics Teachers' Proportional Reasoning and its Relation to Their Content and Pedagogical Content Knowledge. Research in Mathematics Education. https://doi.org/10.1080/14794802.2025.2462930

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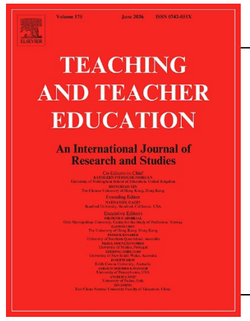
Research Interest



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Copur-Gencturk, Y., & Atabas, S*. (2024). A Microgenetic Analysis of Teachers' Learning Through Teaching. International Journal of STEM Education, 11(1), 29. https://doi.org/10.1186/s40594-024-00488-1.

Content-Specific Learning Opportunities

Identification & development of effective learning opportunities for teachers to develop expertise.

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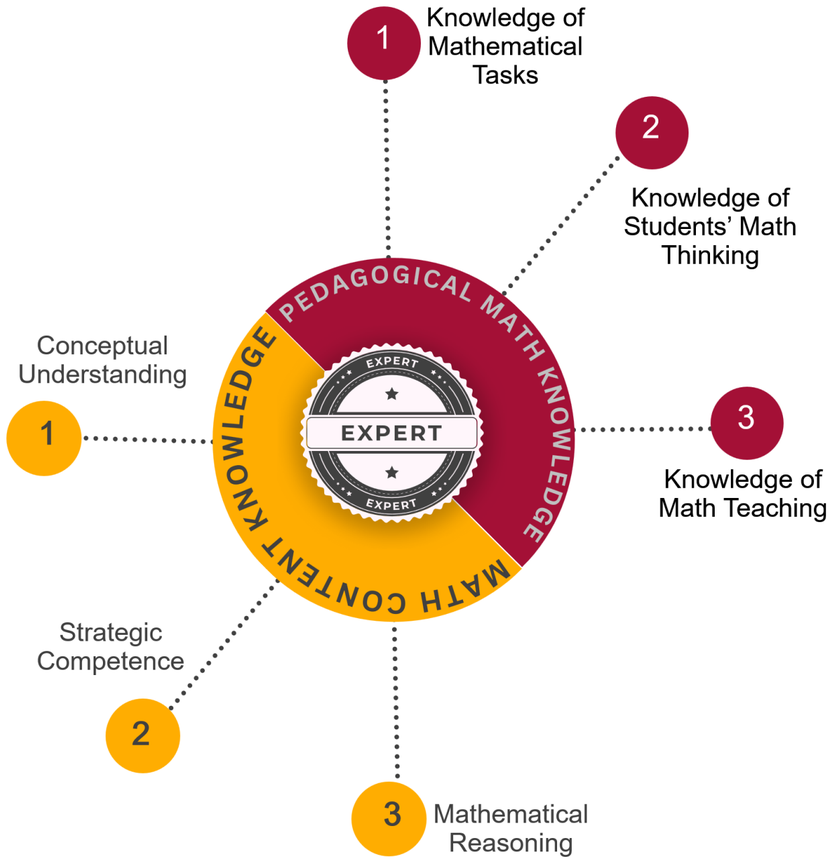
Research Interest



Content-Specific Learning Opportunities

Identification & development of effective learning opportunities for teachers to develop expertise.

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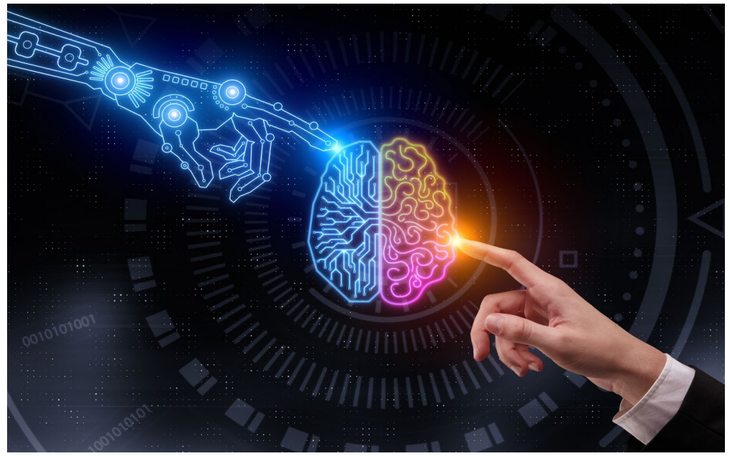
Content-specific Learning Opportunities

- CONTENT-FOCUSED
- EFFICIENT USE OF TIME
- EASY ACCESS
- FLEXIBLE SCHEDULE
- PERSONALIZED FEEDBACK
- LEARNING BY DOING



I-VIP
Intelligent Virtual Interactive Program
ONLINE MATH & TEACHING SYSTEM

AI as a Facilitator

IES Institute of Education Sciences

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Content-specific Learning Opportunities

1

CONTENT IDENTIFICATION

Identify the areas where teachers need professional support.

2

ACTIVITY DEVELOPMENT

Create activities that will help teachers learn the targeted content.

3

SETTING EXPECTATIONS

For each activity, determine what the learning objectives are.

4

SCAFFOLDING

Create hints to help teachers master expectations set for each activity.

5

FEEDBACK

Revise and finalize the activities based on the feedback received from teachers and educators.

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Content-specific Learning Opportunities

Activity

7 ft by 10 ft
17 ft by 20 ft
27 ft by 30 ft
37 ft by 40 ft

The dimensions of four rectangle is given. Which rectangle looks more like a square? Explain your thinking.

Expectations

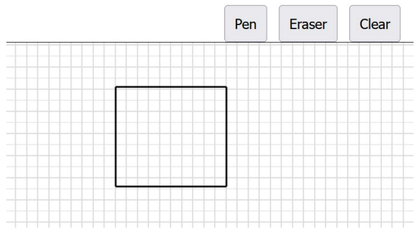
Correct Answer
Correct Reasoning

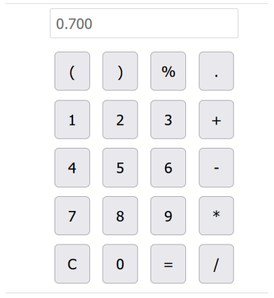
Hints

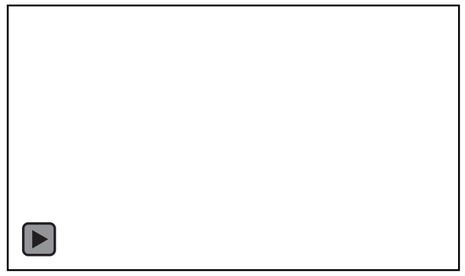
Conceptual
Hands-on
Concrete/Direct

Summary

Key ideas covered in the activity







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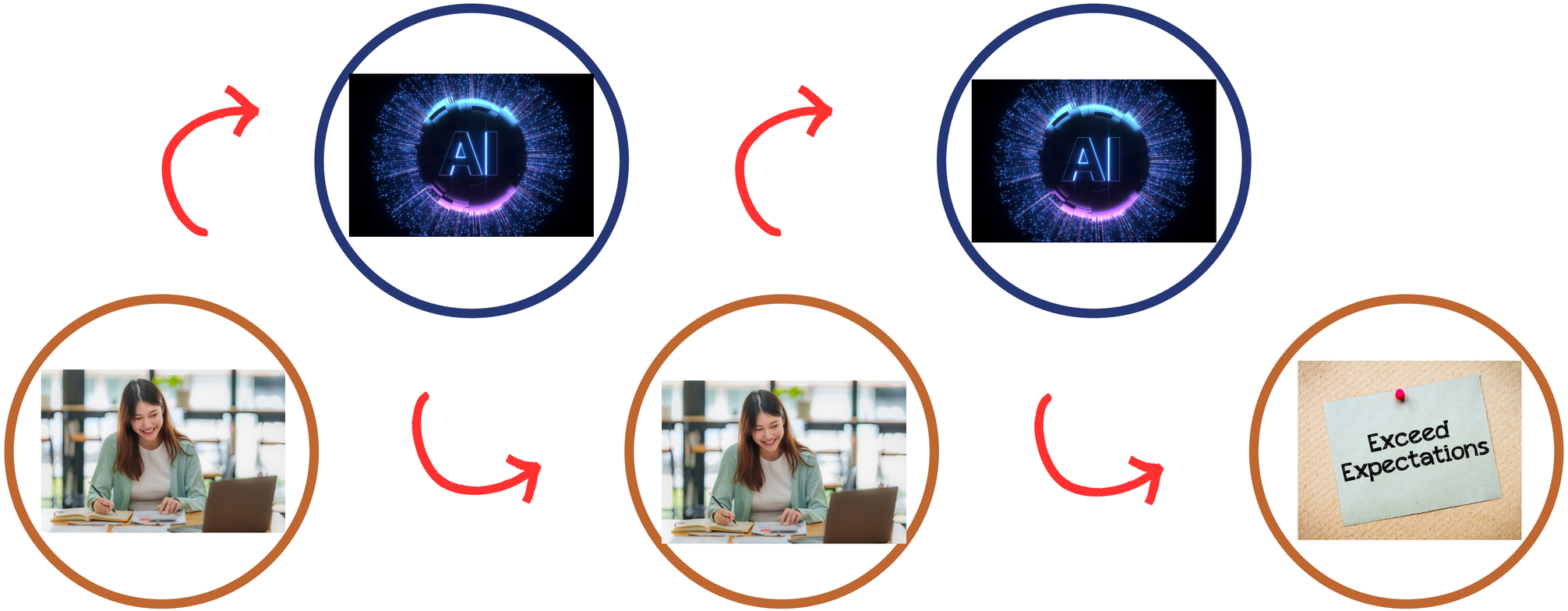

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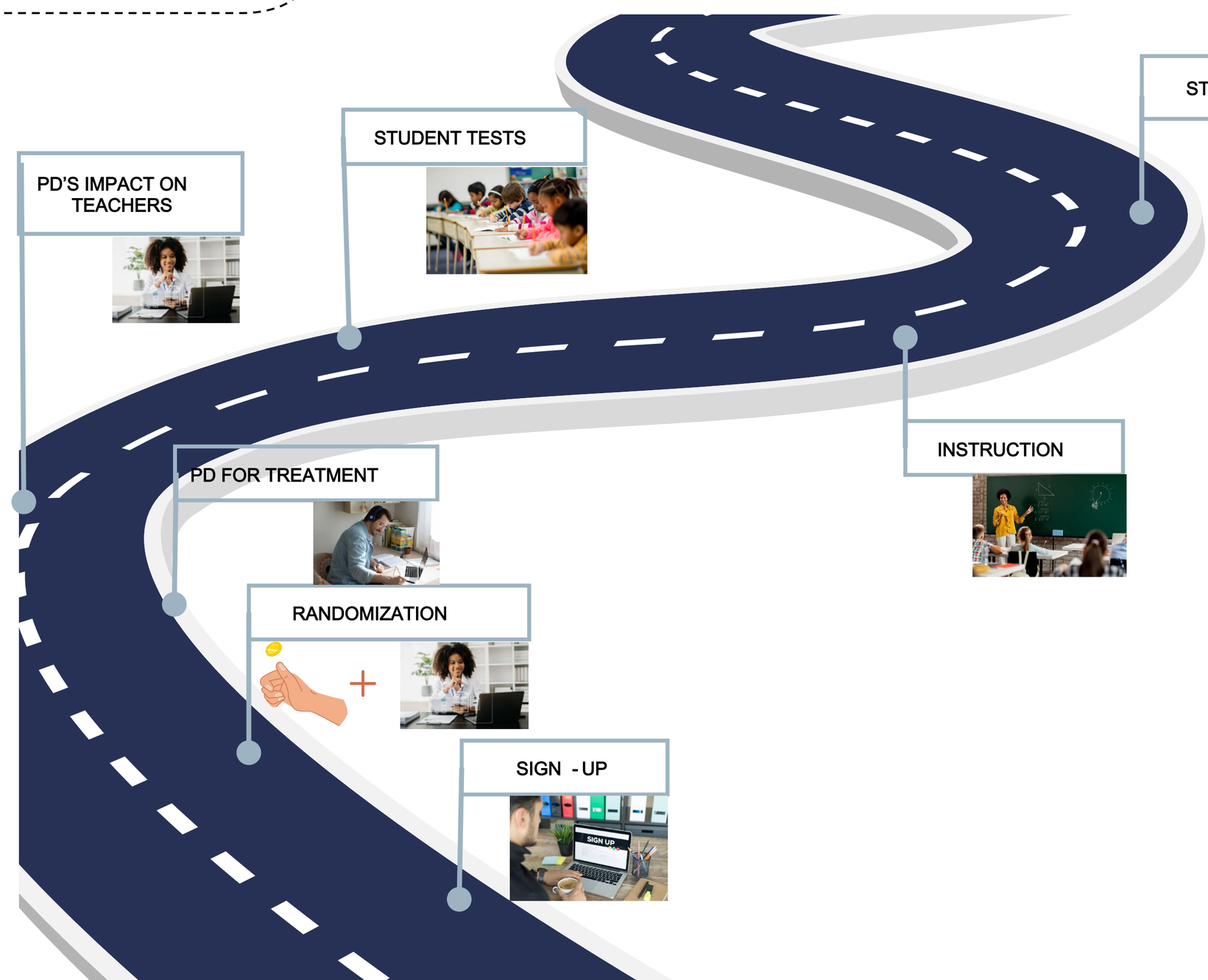

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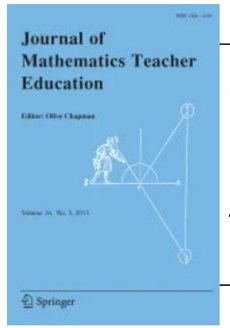

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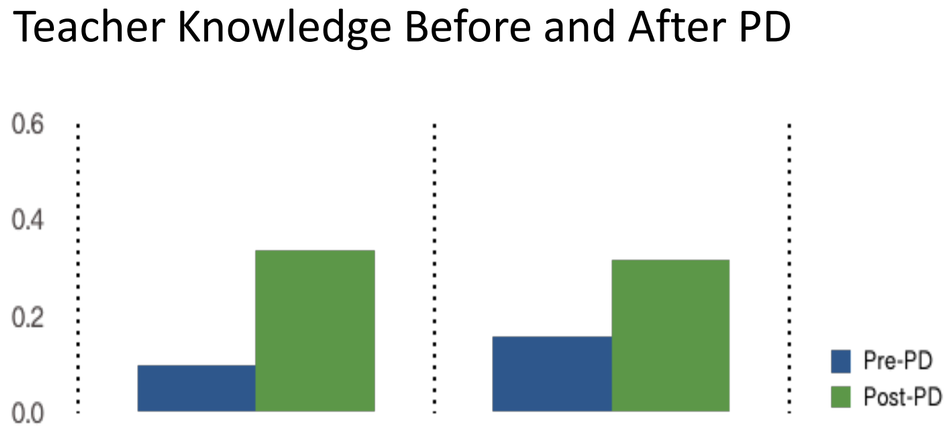

Content-specific Learning Opportunities

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3. 

There are 13 boys and 10 girls in the classroom. What is the ratio of boys to girls?

☐ a) 10 to 13 ☐ b) 23 to 13

☐ c) 13 to 10 ☐ d) 23 to 10

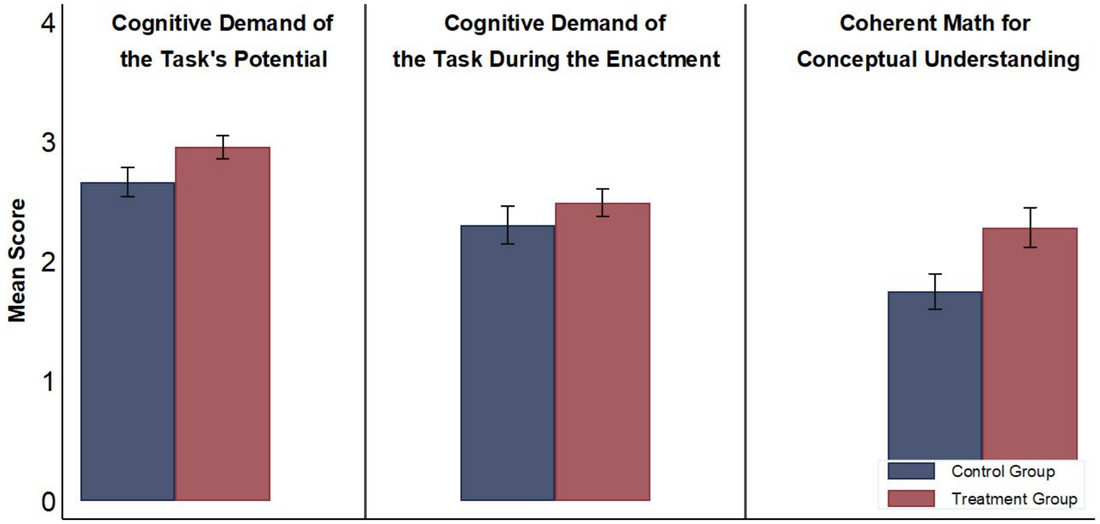
When Sam and his friends get together, Sam makes a fizzy orange drink by mixing orange juice with soda.

On Friday, Sam makes 7 liters of fizzy orange by mixing 3 liters of orange juice with 4 liters of soda.

On Saturday, Sam makes 9 liters of fizzy orange by mixing 4 liters of orange juice with 5 liters of soda.

1. Does the fizzy orange on Saturday taste the same as Friday's fizzy orange, or different?

   If you think it tastes the same, explain how you can tell.
   If you think it tastes different, does it taste more or less orangey? Explain how you know.



Content-specific Learning Opportunities

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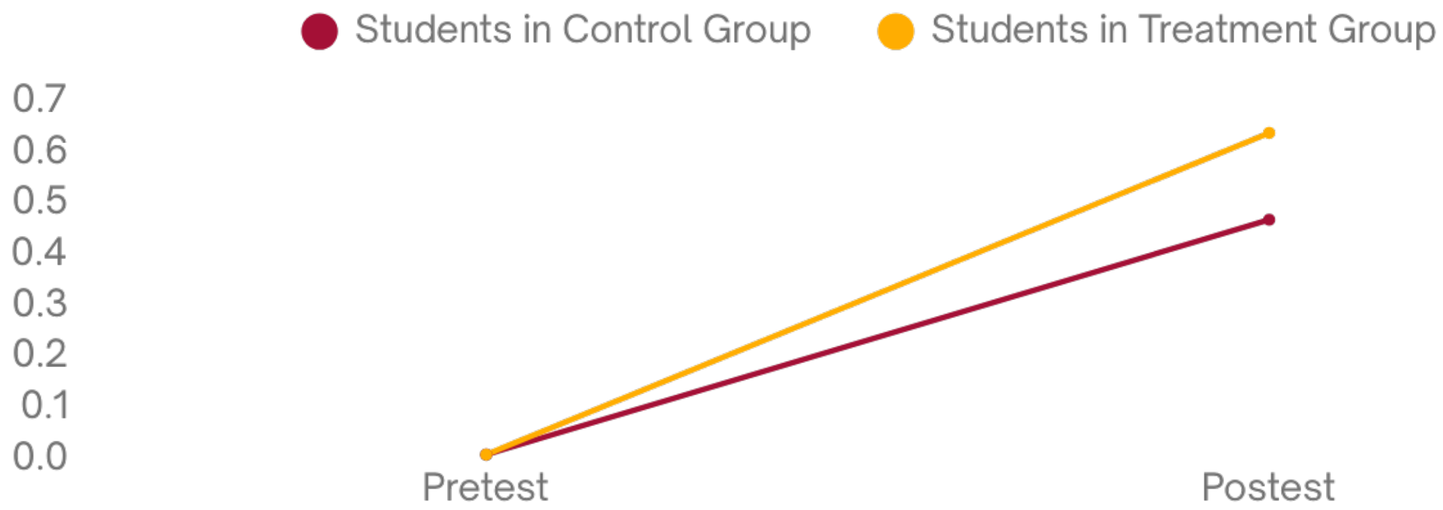
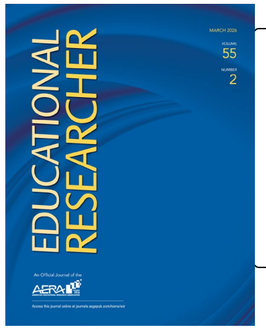


This impact is equal to 24 % of the average difference in math performance between 6 and 7 graders.

Content -specific Equity

Research Interest



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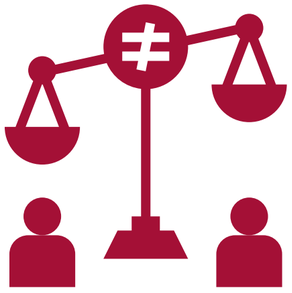
Content-specific Equity

Identification and removal of barriers in teaching and learning mathematics to ensure all students excel in math.



A B

The growing number pattern below follows a rule.
+1+2+3+4
3, 4, 6, 9, 13, ...

(a) Explain the rule.

13
-9
4

your adding 1 every time. 1+3=4+2=6+3=9+4=13

Question # 1 Connor

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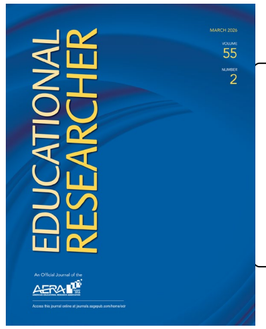
Content -specific Equity



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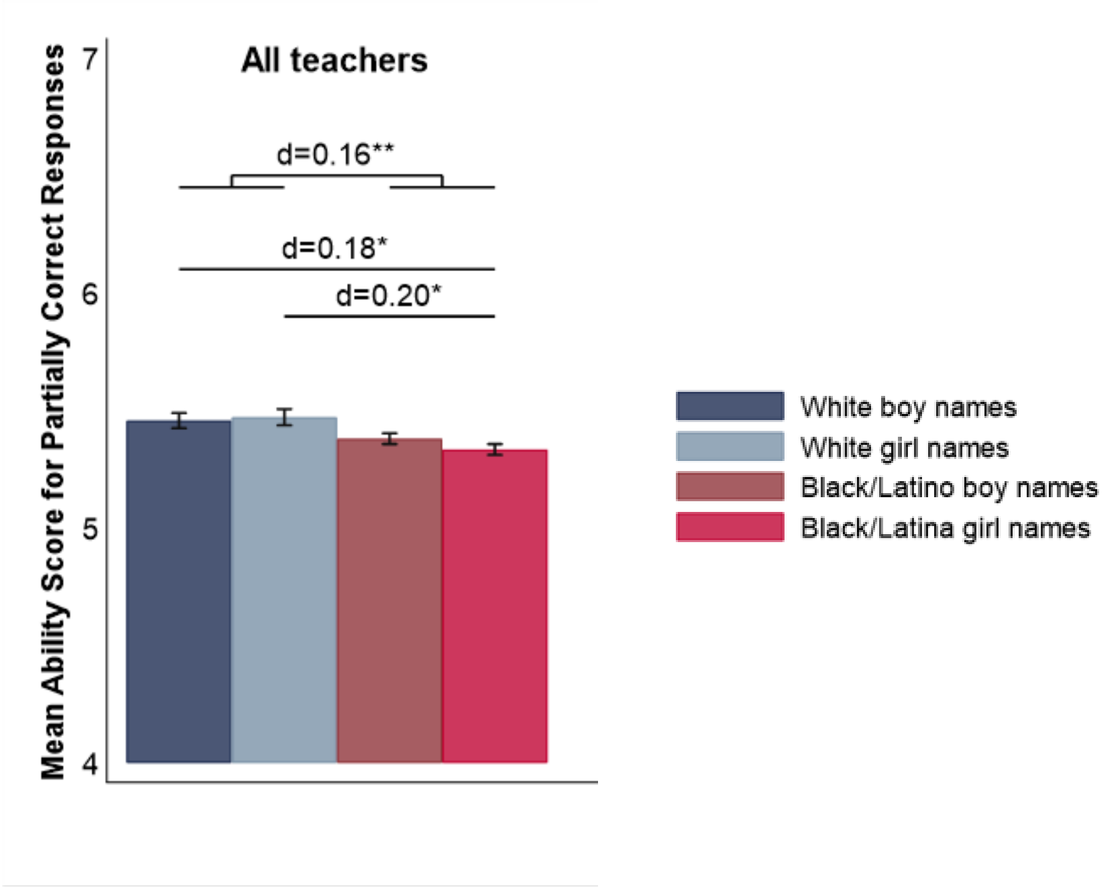

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Content -specific Equity

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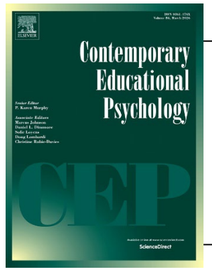

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Question # 1 Tanisha

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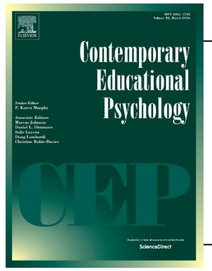

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Content -specific Equity

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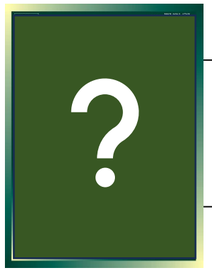

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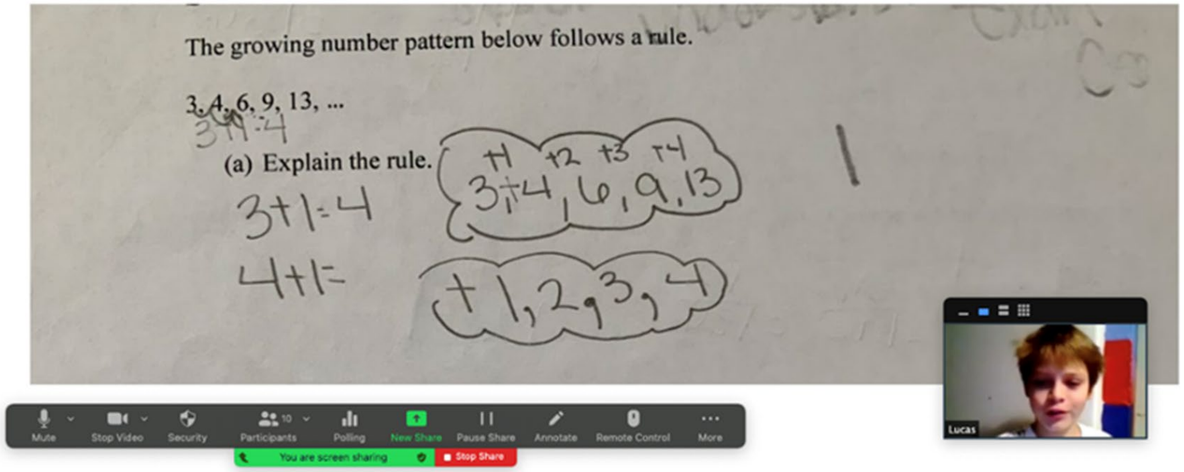

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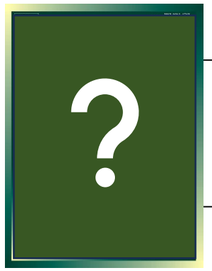

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Thank You

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