Improvisation in Teaching and Teacher Learning

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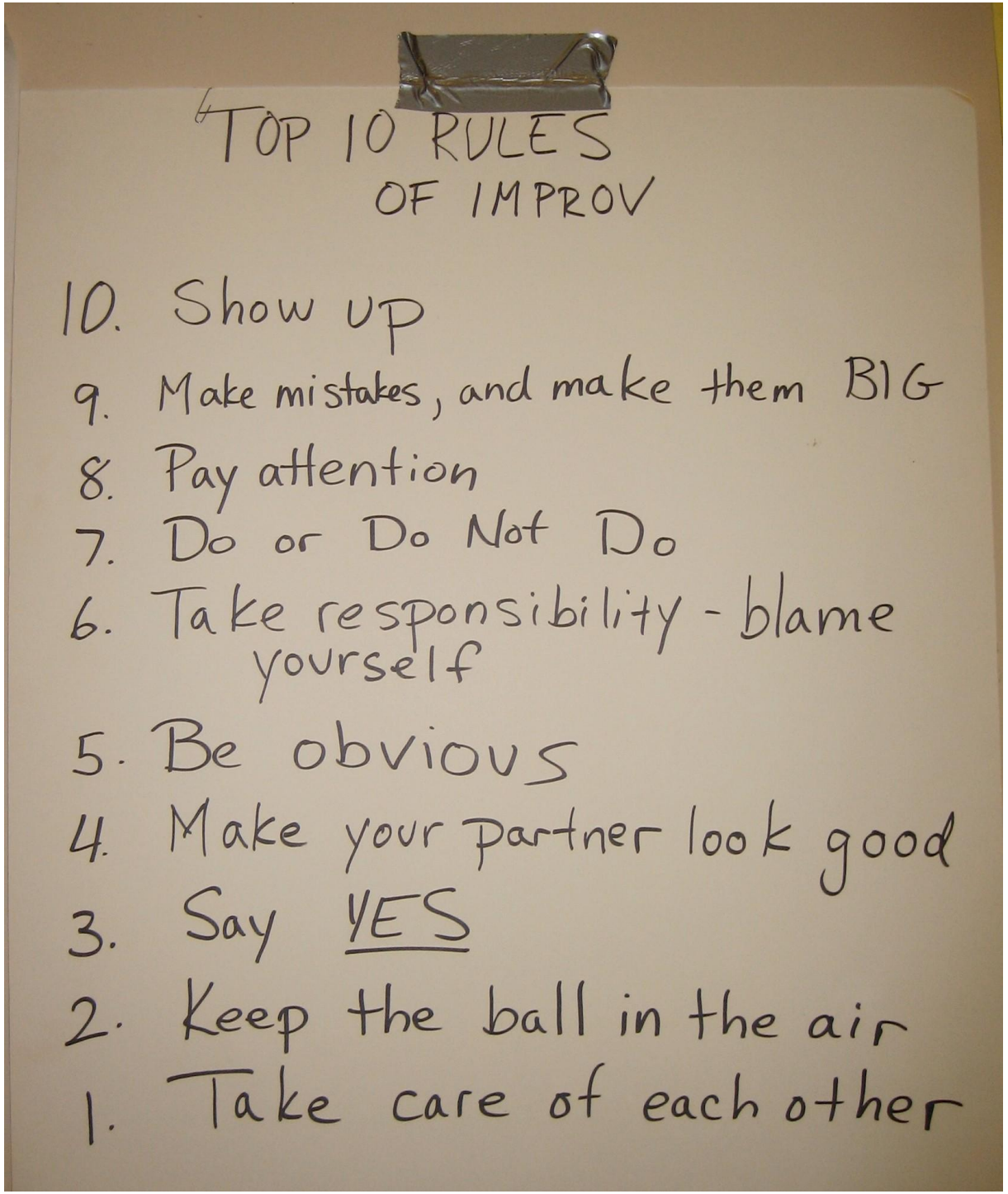
NSF

Four--part presentation

- Experience improvisation “games”
- Hear Bridging Story
- Experience Bridging “teaching games”
- See research results

Discussion welcome throughout.

First, let’s do some improv…


TOP 10 RULES
OF IMPROV
10. Show up
9. Make mistakes, and make them BIG
8. Pay attention
7. Do or Do Not Do
6. Take responsibility - blame yourself
5. Be obvious
4. Make your partner look good
3. Say YES
2. Keep the ball in the air
1. Take care of each other

Improv Warm Up: Sound Ball

- Stand in a circle.
- One person throws imaginary ball to another, making a sound.
- Person catching ball repeats sound. Throws ball to another with a new sound.
- Repeat until done!

Improv Game: Story Spine

- Take turns completing starters
- Say YES; build on what others say
- Read together when done.
- Decide on moral

Once upon a time... Every day...
But one day... Because of that...
Because of that... Because of that... Until finally...
Ever since that day...
The moral of the story is…

What could these have to do with
teaching mathematical argumentation?

Bridging Mission

To help teachers in distressed school districts foster classroom mathematical argumentation among their middle school students.

By Building Bridges Between . . .

Teacher Professional Development Activities

And Classroom Practice

Mathematical argumentation is a *conversation* with 3 parts.

Conjecture

Someone makes a mathematical statement, best guess, but we don't know for sure

Justification

Together, we figure out: is it true or not?

Conclusion

We agree: it is true OR
We don't agree: no, it's really this way…(new conjecture)

Classroom Mathematical Argumentation

CONJECTURING

SARA All perfect squares are similar.

TEACHER Why? JUSTIFYING

SARA Because they are all the same. Their lengths and the widths are equal. So if you reduce any square, if you reduce the proportion or ratio, it becomes 1 by 1.

TEACHER I don't know what you mean.

SARA Okay. So let's see. If one of our squares is 3 inches by 3 inches, then the fraction will be 3… uh, okay… 3 is to 3 as 2 is to 2 or whatever. And if you reduce either or both of those, they reduce down to 1.

TEACHER Are you telling me by definition if I reduce or increase the length of one side, the other sides will automatically increase or decrease proportionally? Is that what you're trying to tell me? Because I understand that. Because it's my words. <Teacher laughs.>

SARA It's just like…okay. Let's see.

TEACHER Let me ask. Basically I'm saying you have not convinced me all squares are similar.

EMILY Um, well, it's a perfect square because if you have one of our squares, the smallest one is 2 ½ inches by 2 ½ inches, and it's, like, even on both sides. So we just make all the squares the same, like 18 by 18, 2 ½ by 2 ½. So they are similar, all the squares.

TEACHER Because?

•
•
•

CONCLUDING

TEACHER So are you telling me if you have 2 ratios, 20 ratios, or there are 100 ratios, and they all simplify to 1, they are equivalent?

GREG Yes. TEACHER Cool.

Why Is Argumentation Important?

- Common Core Practices
- Provides students opportunities to construct their own knowledge
- Is a 21st Century STEM workplace skill
- Is authentic mathematics

Can be an antidote to the procedure-laden curriculum

Bridging Theory of Change

MKT + small set teaching moves + flexible use

can result in

Beginning---level teaching for argumentation

Core Elements of Bridging Model

- Working within policy constraints
- Addressing math knowledge for teaching (MKT)
- Providing structure
  - Simple math argumentation framework
  - Curriculum materials
- Teaching moves
- Adapted improvisation and theater techniques
  - Improv teaching games
  - Script read---throughs
  - Rehearsals

MKT

Premise: MKT is necessary but not sufficient

- Argumentation as a mathematical practice
- Structure of argumentation
- Sociomathematical norms of argumentation
- Content about which to argue

Categories of teaching moves

- Open ended questions
- Closed ended questions
- Involving others
- Summarizing
- Concluding by _____

Our ″Bridge″ to Clas

Teaching Moves in Suppo

- Smallest chunk of behavior aimed at a purpose
- Develop a repertoire of teaching moves to facilitate arg

ORCHESTRATING

INVOLVING OTHERS

BY

SARA All perfect squares are similar. SARA

TEACHER Why? EACHER

OPEN-ENDED QUESTION

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TEACHER Because?

CLOSED-ENDED QUESTION

TEACHER So are you telling me if you have 2 ratios, 20 ratios, or there are 100 ratios, and they all simplify to 1, they are equivalent?

GREG Yes.

ELICITING CONCENSUS

TEACHER Cool.

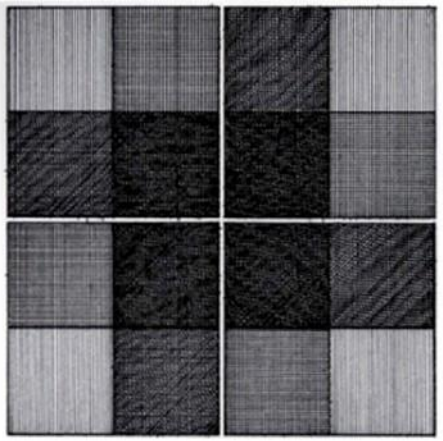
Working Within District Constraints

- Modest goals for shifts in practice
- Time frame: 3 – 8 day initial workshop
- Limited follow up in researched version

In ideal case, more follow up, sessions distributed, mixed with other models such as coaching

Curriculum Materials

Rectangles in the Coordinate Plane



Sol LeWitt, Drawing Series—Composite, Part I-IV, #1-24, A+B(detail), 19
Estate of Sol LeWitt/Artists Rights Society (ARS), New York.

Making Rectangles II

In this activity, use only rectangles that have sides parallel to the axes.

1. Draw an x- and a y-axis and label the units. Do not put the origin in the middle of the page!

2. Draw 4 rectangles in different places on the coordinate grid. Label the vertices.

3. Look at the coordinates of the vertices for each rectangle. Look for patterns. Describe the patterns that you see, using words and symbols.

4. Make conjectures from your descriptions. Use "If...then..."

Flexible use through Improv

Premise: teaching is improvisational

- Teaching games
  - Constrain semttig
  - Set task
  - Provide structure yet…
  - Room for customization/improvisation

Improv Methods for Developing Teaching Moves

- Improvisational theater—actors work cooperatively to spontaneously create their own coherent scenes
- ″Collaborative emergence″ (Sawyer) – relevant to both the classroom and improvisational acting
- Use in PD – not the classroom (yet!)
- Borrow and adapt some methods from improv training
  - Create a non---threatening and playful environment to support teachers' experimentation
  - Develop a toolkit of teaching moves through a series of ″teaching improv games″

Types of Improv for Teaching

- Complete the script
- Teaching games
- Rehearsal

Professional Development Workshop

MKT (Proportionality / Coordinate Geometry)

- Introduce Conjecture—Justify—Conclude structure
- Student replacement units with an adult learner model
- Teachers experience argumentation

Bridging Pedagogy of Argumentation

- Teaching moves through Teaching Improv Games
- Planning for moves

Try it out:

Connecting improv and math argumentation

Let's generate conjectures

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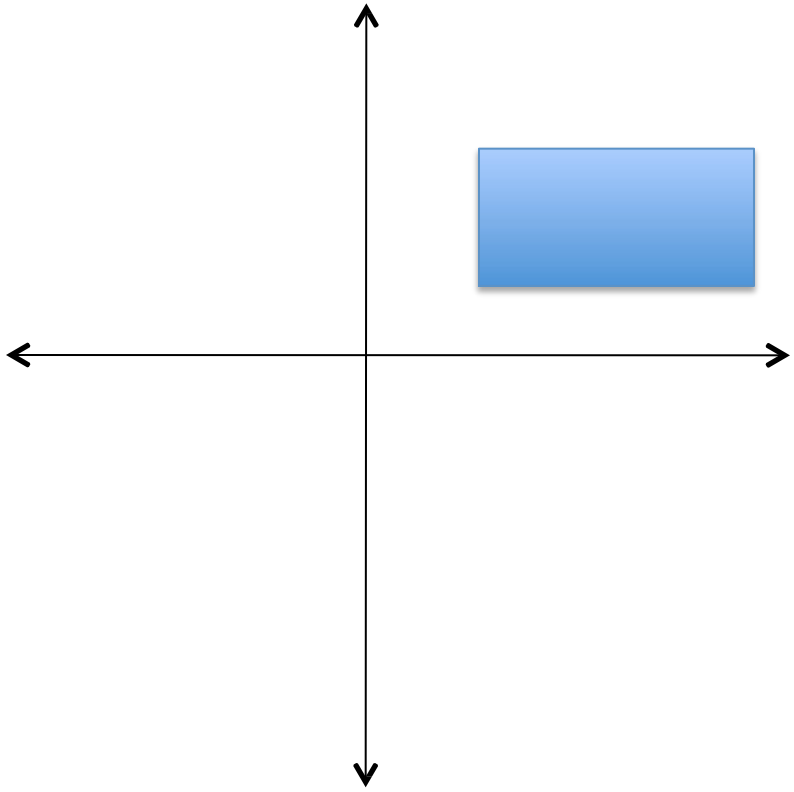
Teacher's conjecture

If you add one number to all x-coordinates and one number to all the y-coordinates of an RPA, then you have a similar rectangle.



Two Teaching Games

- From Bridging workshops
- Played as a pair
- Explore purposes and use of types of questioning

Open-ended Questions

Purpose: Figure out what open---ended questions are good for.

One kind of question to use in facilitating argumentation.

RULES

- Team: Teacher, student, observer.
- Choose conjecture from cards.
- Student justifies.
- Teacher facilitates: Open-ended questions ONLY.
  - No yes/no; no information given.
- Observer makes sure rules are

Closed-ended Questions

Purpose: Figure out the role of giving information and asking yes/no questions.

These are also important in facilitating argumentation.

RULES

- Team: Teacher, student, observer.
- Choose conjecture from cards.
- Student justifies.
- Teacher facilitates: Closed-ended questions ONLY or give information.
  - No ″why″ questions
- Observer makes sure rules are

Questions

Open Ended

- Is that correct/incorrect?
- Did you understand that?
- What is the definition of…?
- Do you agree/disagree?
- What do you get if you…?
- Is it true that…?
- Have you considered that…?
- Do you need more clarification?

Closed Ended

- Why…?
- How do you know it's true?
- How do you know that…?
- Explain how…
- What is your evidence?
- What do you mean?
- Explain that another way.

Research Design and Results

Research Design: 2--Year Design Experiment Embedded in a Small Randomized Experiment

- Participants randomly assigned to Treatment / Control groups
- Each summer, a 2-week workshop:

	Week 1	**Week 2**
Treatment	MKT	Bridging Pedagogy: Teaching Moves & Planning
Control		Vertical Coordination

  - During the school year, all teachers teach with the 4-day replacement unit
  - We observe and videotape these units

Hypotheses

Hypothesis 1: From pre--workshop to post-workshop, teachers in both the Treatment and Control groups will show growth in MKT.

Measure: MKT assessment pre/post workshop

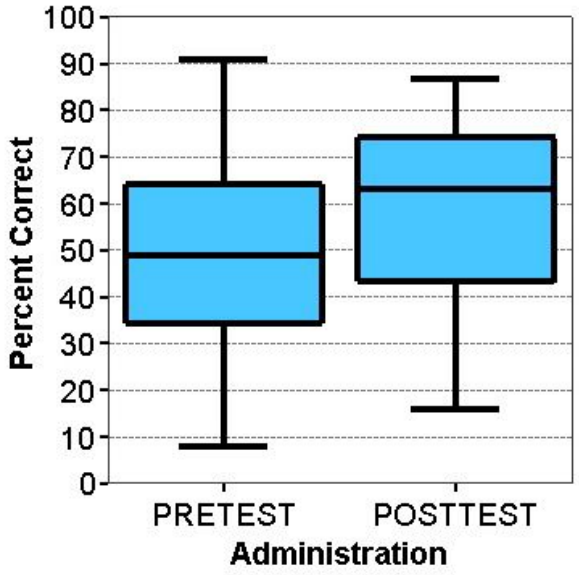
Hypothesis 2: There will be more argumentative talk in the classroom discourse of the Treatment teachers.

Measure: Coding of argumentative discourse

Hypothesis #1: Teachers Grew in their MKT

Year 1

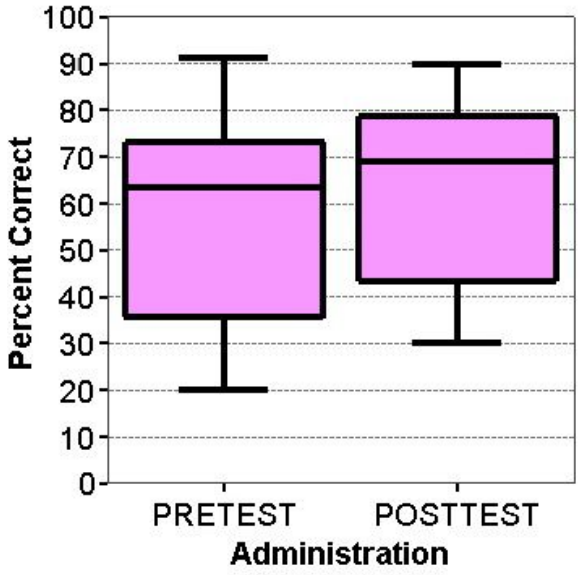
Proportionality Across the Strands



t(23)=4.2, p<0.001, ES=0.5

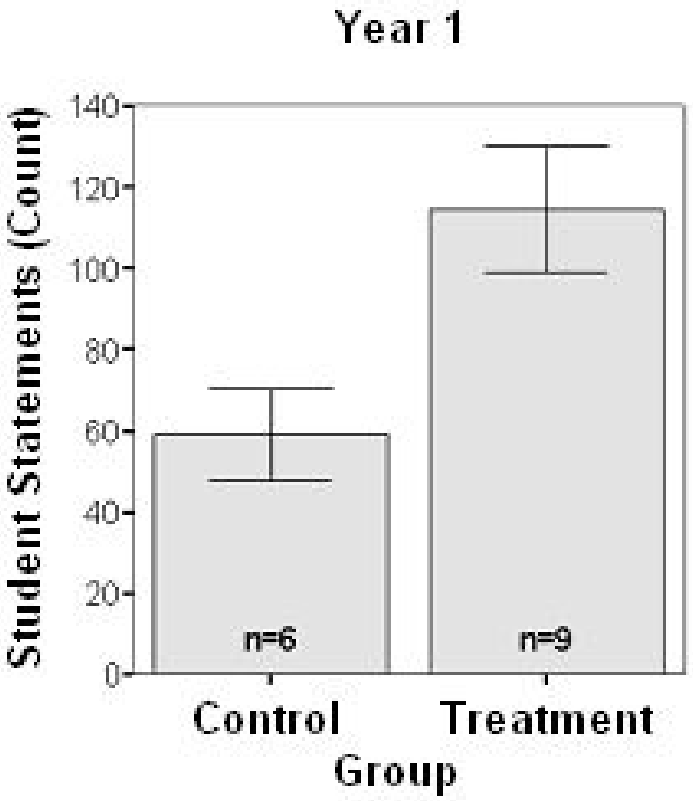
Year 2

Coordinate Geometry



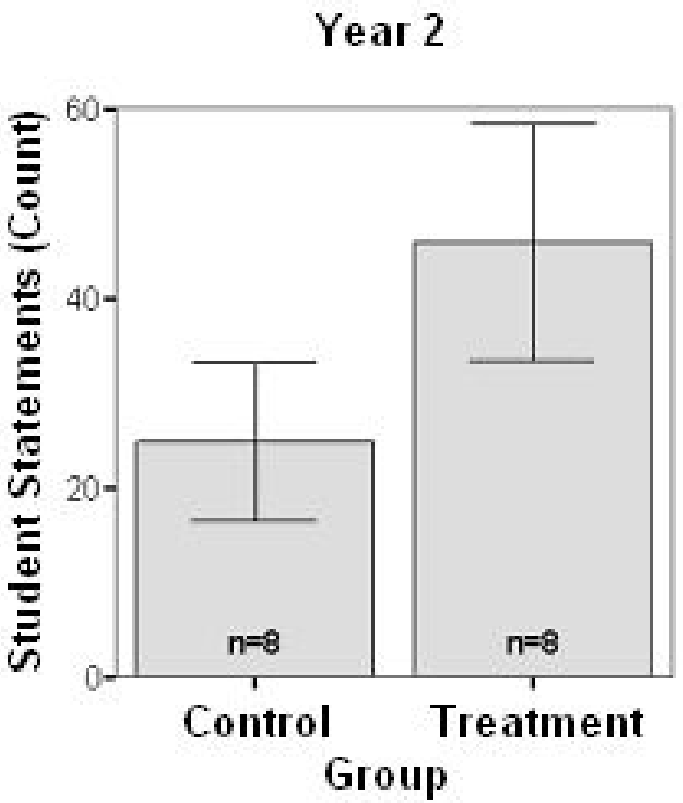
t(20)=4.5, p<0.0001, ES=0.3

Argumentative Discourse in Treatment Classrooms Approximately **Double** that in Control Classrooms



Statistically Significant

$p < .05$; Effect size = 1.4

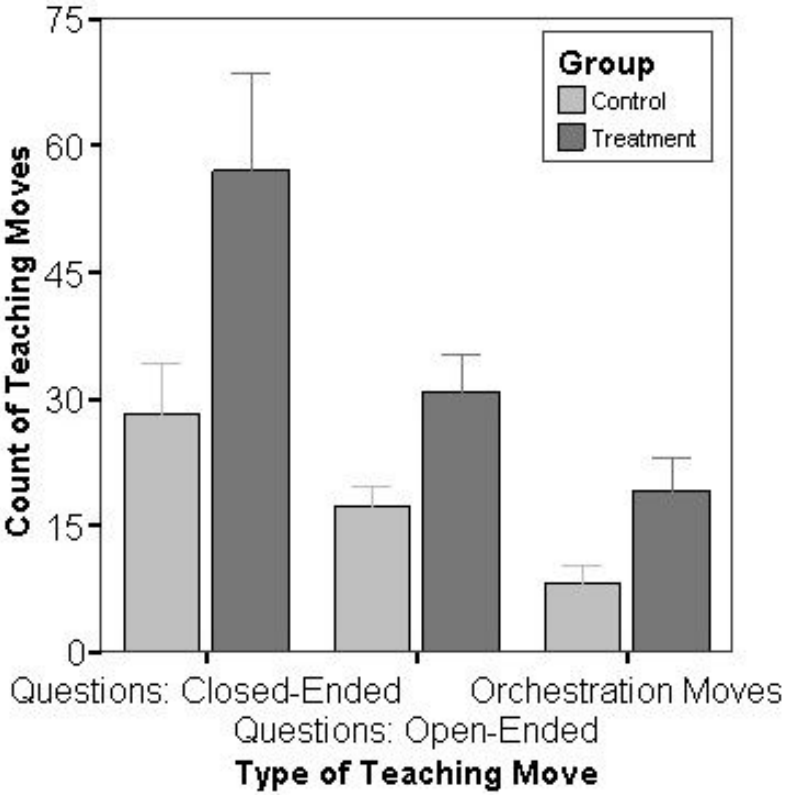


Marginally Significant

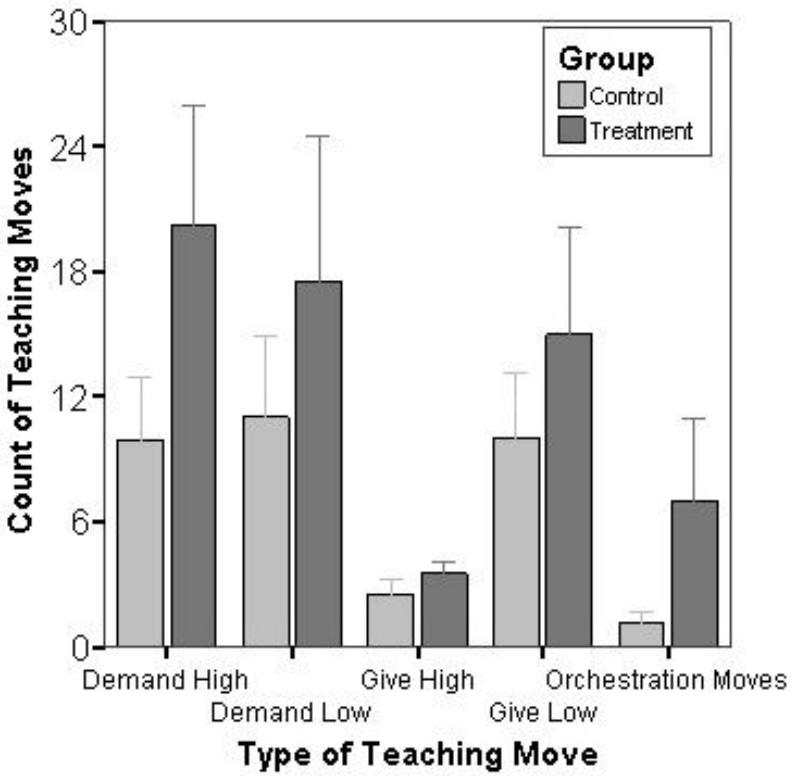
$p = .18$; Effect size = .7

Treatment Teachers Made More Teaching Moves to Support this Argumentative Talk

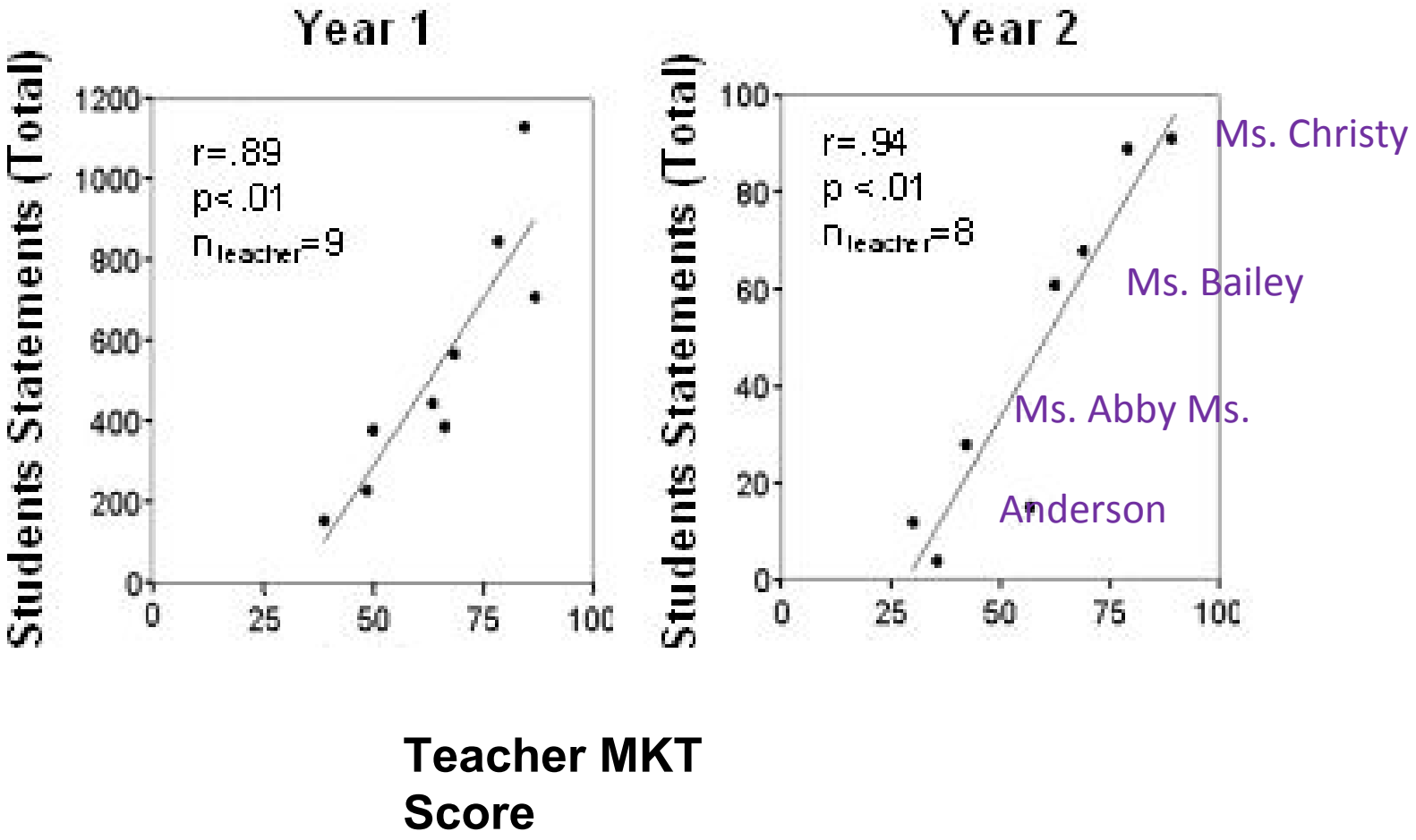
Year 1



Year 2



Teachers with Stronger MKT Supported More Argumentative Talk



Bridging Can Be Used…

- As “starter” for a longer sequence of PD focused on Common Core practice standards (+ content).
- Over several separate sessions, staging moves over time.
- Integrated with coaching where coaches know types of moves and can provide advice on when to use and how.

Conclusions and Future Directions

- Bridging has preliminary success as PD for argumentation.

  How can we expand the reach of the PD to other areas of the mathematics curriculum?

- MKT materials seemed to have some effect alone. How can we build on that success?

- Improv shows promise as a way to help teachers gain mastery over the improvisational nature of their job.

  How can we build on that success?

  How can we use similar methods with students?

- MKT is necessary for sustaining argumentation. this

  How do teachers use their MKT with students to make happen?

  How can we support teachers who struggle with content knowledge?