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# *Lesson Study in Florida: What we learned so far*

Keynote

Lesson Study NL Conference

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# Background

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Florida: First state to adapt lesson study as a teacher PD at the state level

Our Research project investigated

- *The variation in teachers' practices of math lesson study*
- *LS design features with teacher learning, student achievement, and scalability*
- *Organizational lesson study supports at district/school levels*
- *In-depth case study of one school district, how lesson study support teacher and student learning*

# *What We Learned at the Earlier Stage of our Project ...*

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- Lesson study spreads
- Many districts/schools/teachers engage for multiple cycles/years
- New forms of ownership develop
  - Creative structures & supports
    - Embedding lesson study time within work hours
    - Recognizing the special role of and paying for facilitators
    - Network of lesson study groups
- Teacher learning experiences vary



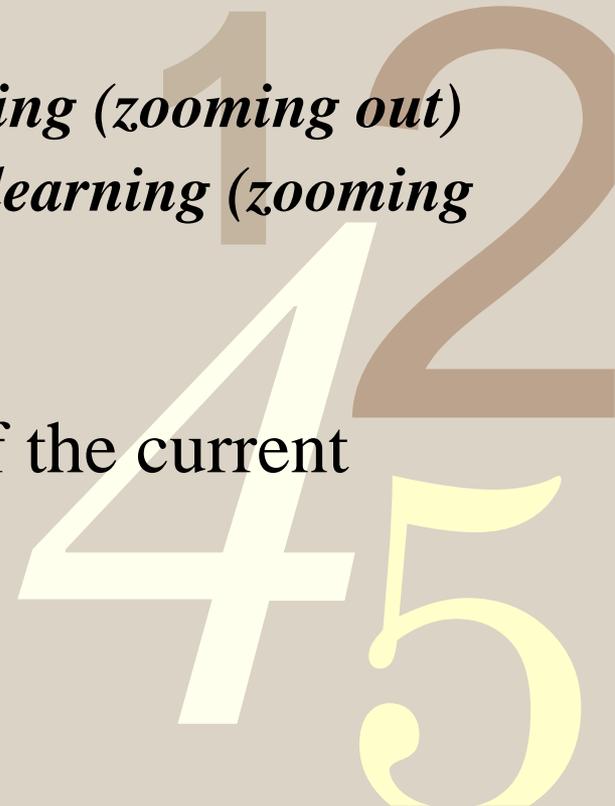
# *Today's talk*

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Sharing findings from two newer studies, from two different perspectives/angles

- *Design features to support teacher learning (zooming out)*
- *Cognitive demands and teacher/student learning (zooming in)*

Together presenting a coherent picture of the current effort



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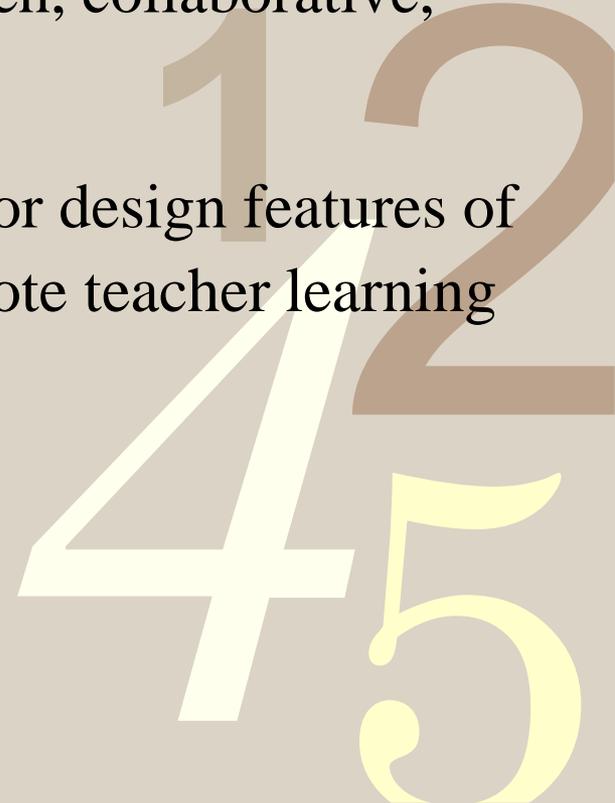
# Identifying Lesson Study Design Features for Supporting Effective Teacher Learning

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# *Background*

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- Empirical evidence on the benefit of teacher collaboration for improving student learning.
  - Global spread of lesson study— a teacher-driven, collaborative, inquiry-based professional learning process.
  - Little is known about what specific elements or design features of collaborative professional development promote teacher learning and professional growth.



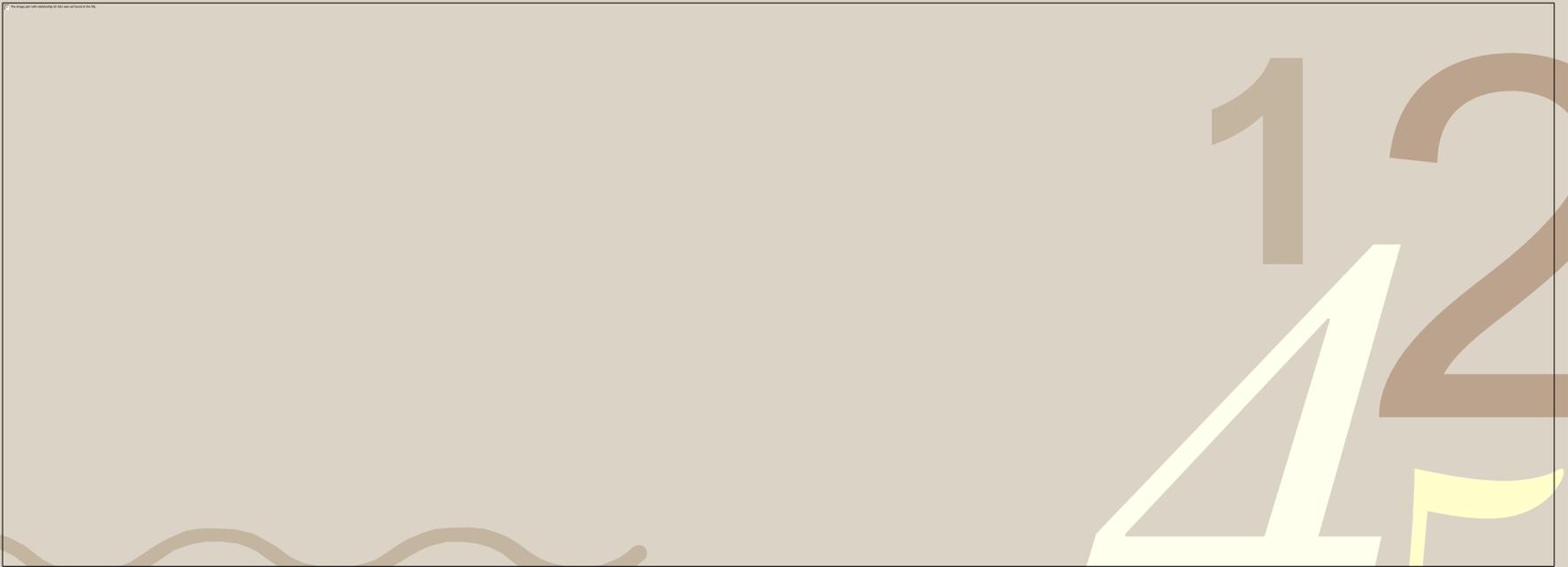
# Research Questions

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1. *What are the variations in design features (duration, facilitator orientation, and material quality) and teacher participation in an effective inquiry process in mathematics lesson study?*
2. *How are design features associated with teacher learning outcomes measured by perceived changes in knowledge, self-efficacy, and expectation, mediated by teacher participation in an effective inquiry process in mathematics lesson study?*

# *Conceptual Model*

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2  
4  
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# Survey Methods

**Survey Site:** Florida, USA

## Data Collection Methods

Step 1: Gather a list of lesson study group members and meeting schedule from 24 lesson study groups from 6 districts that agreed to participate in the survey

Step 2: Send an online Qualtrics survey, *Lesson Study Teacher Survey*, to 110 teachers in 24 groups

**Response Rate:** 79% (87 teachers participated)

## Survey Respondents:

- 16 elementary school groups and 8 secondary school groups
- School poverty level (%FRL): Mean 60%, Range 34-100%
- Ethnic minority students (%): Mean 36%, Range 10-80%
- Teaching experience: Mean 13.3 years, Range 0-42 years

**Analysis:** Descriptive statistics and path analysis

# Results

RQ1: Variation in Design Features/Inquiry Process

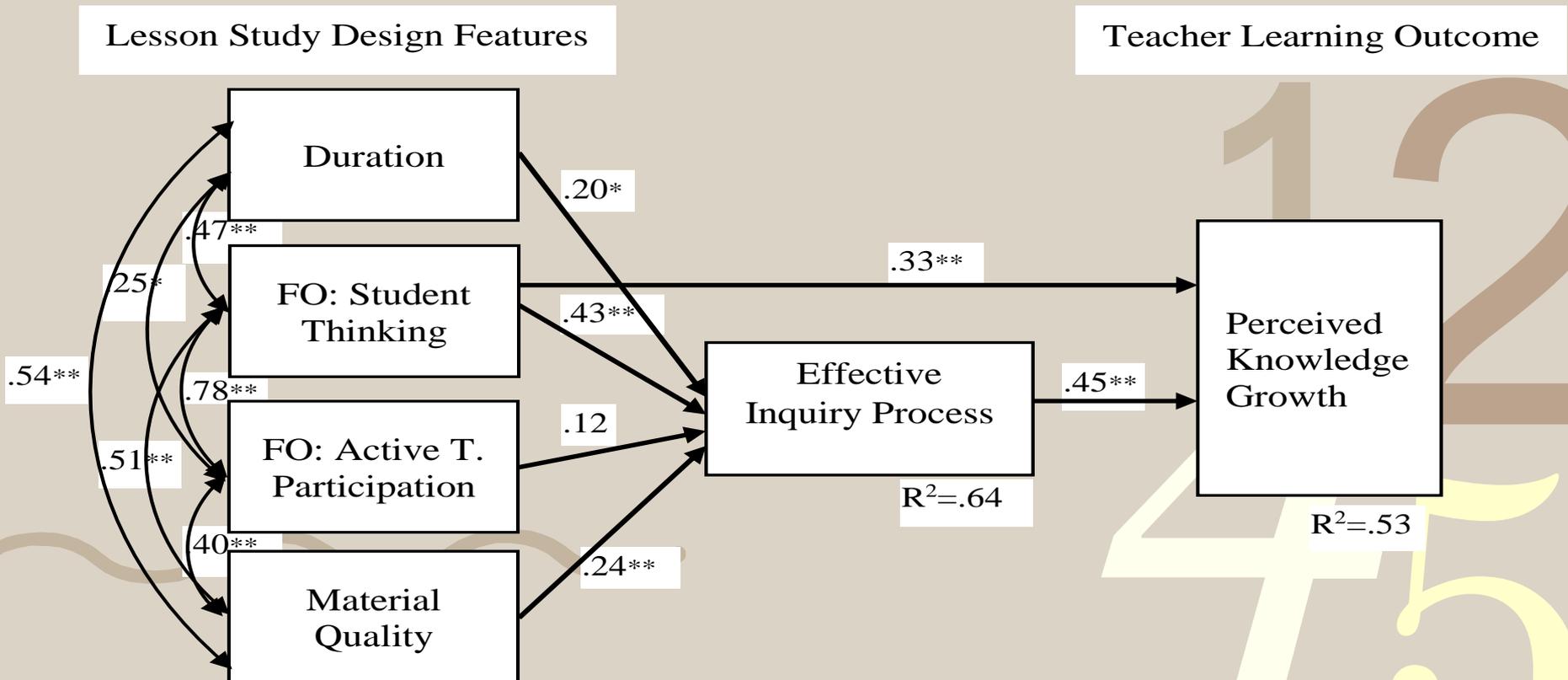
*Major variations in the design features of lesson study as well as teacher participation in an effective inquiry process.*

		Mean	SD	Min	Max
Duration	Time Span (N of days)	44.8	44.8	1	118
	Amount (N of hours)	12.2	7.7	2	23
Facilitator Orientation	Student Thinking	4.9	1.2	1	6
	Active Teacher Participation	5.3	0.9	1	6
Material Quality		3.3	0.7	1.25	4
Effective Inquiry Process		3.5	0.5	1.43	4
Learning Outcomes	Teacher Knowledge	4.8	1.2	1	6
	Self-Efficacy	5.3	0.8	2.75	6
	Expectation	5.4	0.6	3	6

# Results

## RQ2a: LS Design Features, Inquiry Process, and Knowledge

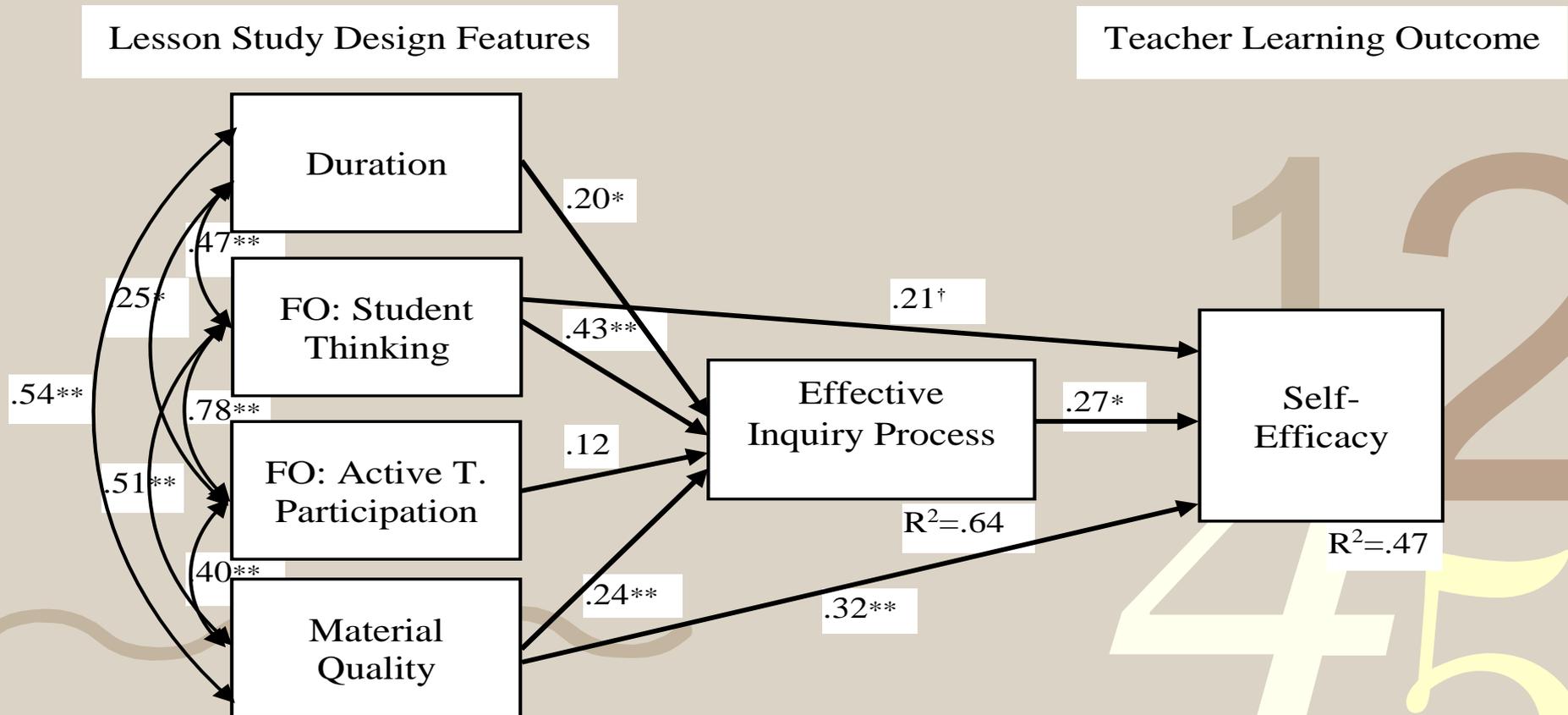
001 *Among the LS design features examined, facilitator focus on student thinking was most strongly associated with perceived changes in knowledge*



# Results

## RQ2b: LS Design Features, Inquiry Process, and Self-Efficacy

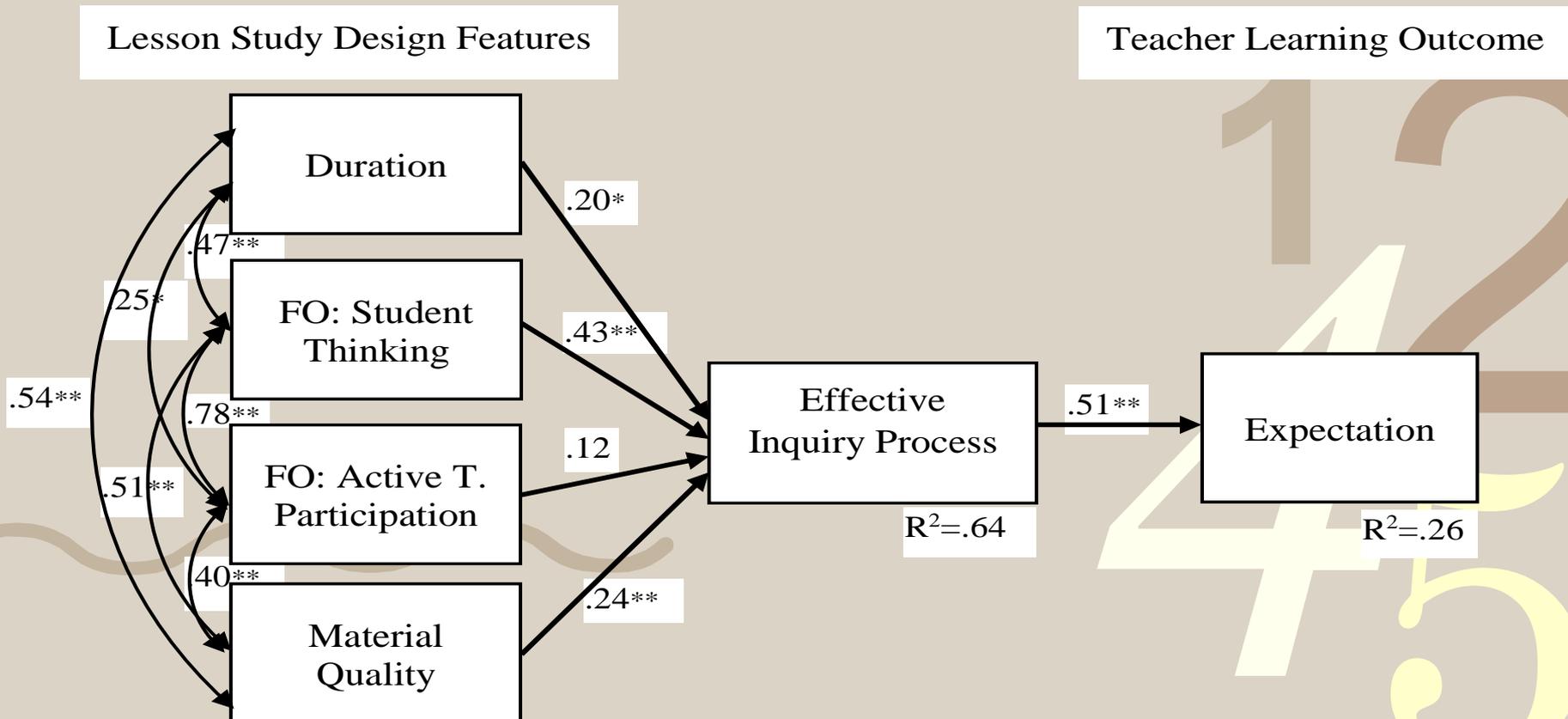
*facilitator focus on student thinking and its effect on changes in self efficacy*



# Results

## RQ2c: LS Design Features, Inquiry Process, and Expectation

*The material quality and duration of lesson study were also significantly and positively associated with teacher participation in an effective inquiry process of lesson study and positive teacher learning outcomes.*



# Summary

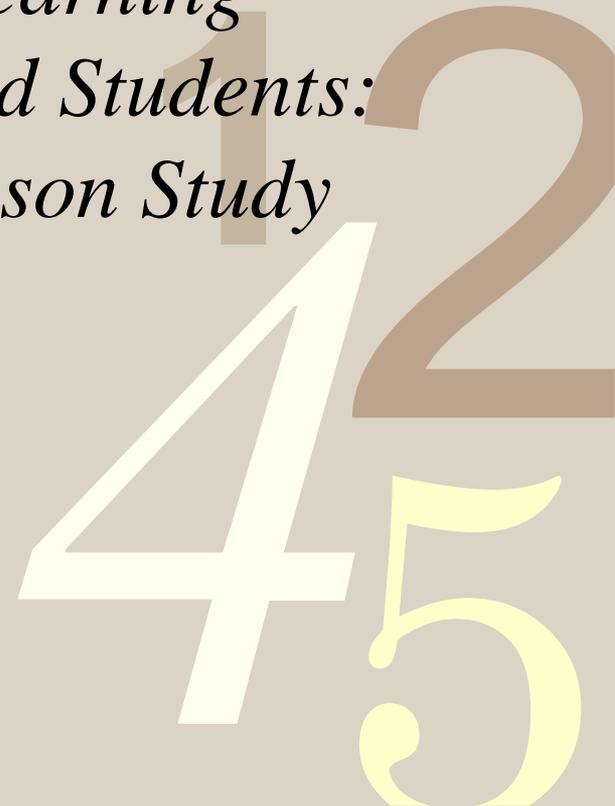
- Major variations in the design features of lesson study as well as teacher participation in an effective inquiry process.
- Among the LS design features examined, facilitator focus on student thinking was most strongly associated with perceived changes in knowledge, self-efficacy, and expectation.
- The material quality and duration of lesson study were also significantly and positively associated with teacher participation in an effective inquiry process of lesson study and positive teacher learning outcomes.

## *Discussion*

- Supporting the improvement of these design features (facilitator focus on student thinking, longer duration, and high quality materials) will likely result in an improved inquiry process and positive teacher learning outcomes.
- Improving these design features requires resources.
- Districts may consider prioritizing LS over other PD programs and embedding LS into regular school PD schedules (e.g., early release days, professional development days, PLC time).
- Partnerships with researchers and other experts may be beneficial for supporting LS facilitators and developing high quality materials.

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*Cognitive Demands and Learning  
Opportunities for Teachers and Students:  
Elementary Mathematics Lesson Study*



# Perspectives

- *High cognitive engagement → increased student learning*  
(e.g., Doyle, 1988; Hiebert & Weane, 1993; Zohar & Dori, 2003)
- *Cognitively demanding tasks* (Smith & Stein, 1996)
  - *Procedures with connections: Using procedures for the purpose of developing deeper levels of understanding*
  - *Doing mathematics: Complex and non-algorithmic thinking*
- *Teachers can set up the task, but the level declines*  
(Henningsen & Stein, 1997; Stein, et al., 1996)
  - *Cognitive effort involves productive struggle and anxiety*
  - *Teachers intervene to reduce the anxiety and confusion*
- *Teachers' roles* (Jackson, et al., 2013; Stein, et al., 2008)
  - *Orchestrate discussions to make student ideas visible and leverage them for class learning*

# Perspectives

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(eg, Doyle, 1988; Hiebert & Weane, 1993; Zohar & Dori, 2003)
- *Cognitively demanding tasks* (Smith & Stein, 1996)
  - *High demand tasks vs low demand tasks*
  - *High demand tasks create space for student learning*
- *Teachers can set up the task, but the level declines*  
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# Research Questions

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*How do teachers plan, set up, and maintain high cognitive demand level in a mathematics lesson through lesson study?*

*How does teachers' collaborative learning contribute to maintaining high cognitive demand level?*



# Methods

- *Participants*

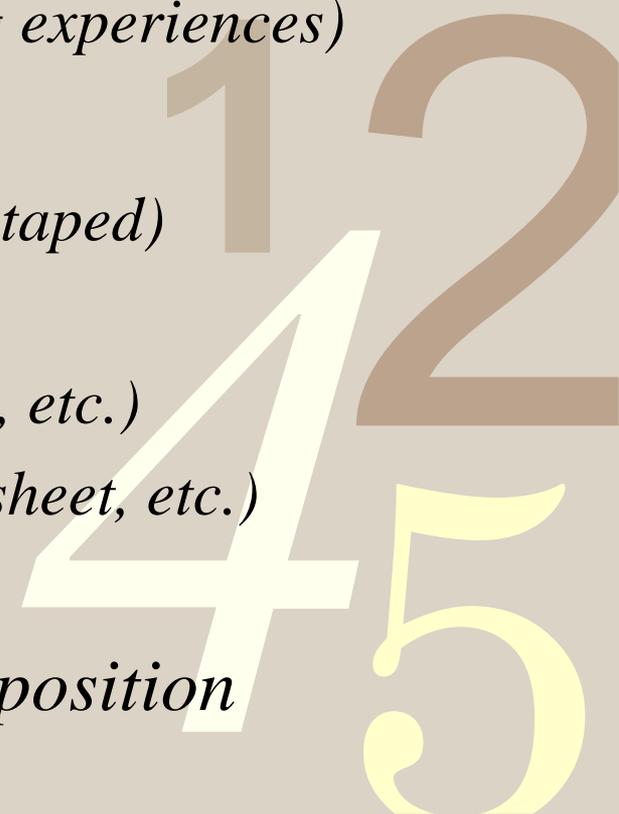
- *Lesson study group: 7 elementary school teachers*
- *District used lesson study for 10+ years, teachers were familiar with lesson study*
- *Experienced teachers (10-28 yrs teaching experiences)*

- *Data*

- *Planning meeting data (5 meetings, videotaped)*
- *Research lesson data (videotaped)*
- *Lesson materials (lesson plans, textbooks, etc.)*
- *Student learning materials (student worksheet, etc.)*
- *Debriefing data (videotaped)*

- *Lesson: Grade 1, addition with decomposition*

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# Analysis

- *Cognitive demand*

- *Lesson plan and research lesson videos coded for cognitive demand levels, using four-category dimensions (Smith & Stein, 1996)*

- *Facilitation practice*

- *Facilitation practices were identified using Five Practices framework (Stein, et al., 2008)*
- *Make visible how teachers thought about the lesson while planning and how they actually executed the plan*

- *Teacher learning*

- *Identified how teachers talked about student learning and teaching practices through lesson study*

# Cognitive Demand Framework

## Low-level: Memorization

- Involves either reproducing previously learned facts, rules, formulas, or definitions or committing facts, rules, formulas or definitions to memory.
- Have no connection to the concepts or meaning that underlie the facts, rules, formulas, or definitions being learned or reproduced

## High-level: Procedures with connection

- Focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas.
- Represented in multiple ways, such as visual diagrams, manipulatives, symbols, and problem situations. Making connections among representations helps develop meaning.

## Low-level: Procedures without connection

- Are algorithmic. Use of the procedure either is specifically called for or is evident from prior instruction, experience, or placement of the task
- Focused on producing correct answers instead of on developing mathematical understanding

## High-level: Doing mathematics

- Require complex and non-algorithmic thinking – a predictable, well-rehearsed approach or pathway is not explicitly suggested by the task, task instructions, or a worked-out example.
- Require considerable cognitive effort and may involve some level of anxiety for the students because of the unpredictable nature of the solution processes required.

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# Understanding the maintenance process

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*Five practices (coded as either high use, partial use, or no use)*

- *Anticipating*
- *Monitoring*
- *Selecting*
- *Sequencing*
- *Connecting*



# Five practices coding

			Examples	Task 1: FG 9+7	are in the carton	gy & solve 56+8	Task 1: FG 9+7	are in the carton	gy & solve 56+8		
Sequencing	Anticipating	(N) No use	There is no evidence of anticipation	No anticipation about how students might respond/think mathematically about the task.							
		(L) Little use	The teachers only anticipate how students will respond generally Only one response is anticipated	"Students may have questions about that"							
		(P) Partial use	The teachers anticipate specific strategies students might use on the task At least two strategies are anticipated by the teachers								
		(H) High use	The teachers anticipate both correct and incorrect strategies		X	X	X				*Anticipates 11 correct strategies, monitoring questions reveal that they also anticipate incorrect counting
	Anticipating	(N) No use	Teacher does not observe students as they work on a task.								
		(L) Little use	The teachers circulates around the classroom to observe the students work on the task, without recording The teacher does not ask any mathematical questions. Interactions with students are focused on behavior or non-mathematical procedures	"Write your name on the top of the sheet"							
		(P) Partial use	The teacher asks students assessing OR advancing questions as they work that tend to 'lead' students in certain ways.	When teacher has in mind ONE WAY TO DO IT: "Can you make another bundle with those extra cubes?" "Do you have two tens?" "you could try...., right?"					X		5/7 interactions with students include either an assessing or advancing question or both. Students with correct answers may be asked to explain their answer but are not further challenged.
	Monitoring	(N) No use	The teachers plan how to respond to anticipated solutions by asking assessing OR advancing questions that tend to "lead" students in certain ways	We will find in the WLP same kind of question as the ones described in the Monitoring Partial Use code.							
		(L) Little use	The teachers discuss what to look for in students' work	"Scan student work and decide which 2 or 3 student groups you would like to share their thinking" "Teacher circulates and monitors progress"		X					
		(P) Partial use	goal(s) of the lesson but not both OR "								
(H) High use		Teachers discuss connection Connections are made both a) between two or more approaches AND b) between one or more approaches and the learning goal(s) of the lesson	Why do you think X did that? Did any of you use a similar approach? So, what are some things we learned today about X using the approaches presented?	X							
Connecting	Anticipating Connecting (Partial)	Teachers plan specific questions to mathematically connect students' responses to each other and the goal	Lesson plan shows questions like: "What is the same about all of these strategies presented?" "What did we learn								
	(H) High use	Teachers plan specific questions to mathematically connect students' responses to each other and the goal	Lesson plan shows questions like: "What is the same about all of these strategies presented?" "What did we learn								



**Main Task:** Working with a partner, students must devise a strategy to solve  $56+8$  (how many eggs are in the cartons).

**Cognitive Demand:** Level 3: Procedures w/Connections; Some Level 4: Doing Mathematics

⊕ **Lesson Scoring**

	Anticipating 3	Monitoring 3	Selecting 2	Sequencing 3	Connecting 3
Lesson Plan Score 11	Anticipates 11 correct strategies, monitoring questions reveal that they also anticipate incorrect counting	Ex: "Teacher will assess student strategies and decide 3 or 4 to share with class" (includes examples w/sequences; probes for correct & incorrect answers	Selecting discussed, but mathematic rationale is not explicit "teacher should call on a child who can decompose to solve."	Ex: Possible examples as follows: 1st - Counting from 56, 2nd - Decompose the 8 into $4+4$ , then adding $56+4=60$ , then $60+4$ , 3rd - decompose 56 into $50+6$ , add $6+8=14$ and $50+14=64$	Ex: "What do you notice about the strategies you used?"

	Monitoring 2	Selecting 2	Sequencing 3	Connecting 3
Lesson Score 11 (8)	<p>Ex: "You're going to have to show how you got to the answer. Make sure you show the work to get to the answer."</p> <p>"You've got to show me how you get to the answer."</p> <p>"How would you show that on your paper? How would you show 6 on this paper?"</p>	(correct only)	<p>(Math rationale Implied)</p> <p>1st-Decompose the 8 into <math>4+4</math>, then adding <math>56+4=60</math>, then <math>60+4</math>.</p> <p>2nd-5 quick tens, then decomposed 8 into 4 and 4 and made another 10? 3rd-Decomposed 8 into 4 and 4, added one of the fours to 56 to make 60, then added four. 4th-decomposed 56 into 54 and 2, then added <math>8+2</math></p>	<p>What did you notice that we used in these strategies?</p> <p>Teacher: Yeah. Were you going to agree with her? ((Pointing to another student.)) Is that what you were going to say? That they were all making tens? Oh. I love it, because I love tens. Tens are my favorite number. Do you think we could take that strategy, making tens, and put it to any problem and solve that problem?</p> <p>.....</p> <p>What math ideas did we learn today from doing all of this work? ...</p> <p>Student (Dylan): Make a ten.</p> <p>Teacher: We learned how to make a ten. Okay. Any other ideas? Did making a ten make it easier to do the problem?</p> <p>...</p> <p>Teacher: Yeah. So that's something we can learn from this. That when you make a ten, that friendly ten. It can make adding those bigger numbers a little easier. You guys made tens different ways. I liked the variety.</p>

# Lesson sketch

*Compiled results of analyses for the lesson study team*

- *Lesson task description*
- *Cognitive demand levels and description*
- *Five practice scores and descriptions for lesson plan and research lesson*

# Lesson Task and Set Up

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*Finding the total number of eggs delivered for Easter, some were in cartons of ten (56) and others were loose (8).*



# Anticipating

*Teachers anticipated 11 student strategies in planning  
(high use)*

- Counting all: (using cubes or tally marks) Count 56 from 1, count 8 from 1, and count 56 and 8 altogether from 1.
- Counting on from 56: (using cubes, fingers, or tally marks), Count 8 more, starting 56.
- Counting on from 8: (using cubes or tally marks), Count 56 more, starting from 8.
- Making a ten: Decomposing the 56 into  $50 + 6$ , decompose 8 into  $4 + 4$ , then making a ten from  $50 + (6 + 4) + 4 = 50 + 10 + 4 = 64$ .
- Decomposing and adding: Decompose 56 into  $50 + 6$ , then add  $50 + 6 + 8 = 50 + 14 = 64$ .
- Decomposing to get to the next ten: Decompose 8,  $56 + (4 + 4) = (56 + 4) + 4 = 60 + 4 = 64$ .
- Decomposing both addends:  $56 + 8 = (50 + 6) + (4 + 4) = 50 + (8 + 2) + 4 = 50 + 10 + 4 = 64$
- Compensation: Add 10 to 56 because it is easier to add 10,  $56 + 10 = 66$ . Then  $66 - 2$  because of extra 2. Answer 64.
- Compensation by using the first addend: Turn 56 to 60,  $60 + 8 = 68$ . Then  $68 - 4$  because of extra 4. Answer 64.
- Recomposing 1:  $56 + 8 = (56 + 4) + (8 - 4) = 60 + 4 = 64$ .
- Recomposing 2:  $56 + 8 = (56 - 2) + (8 + 2) = 54 + 10 = 64$ .

# Monitoring

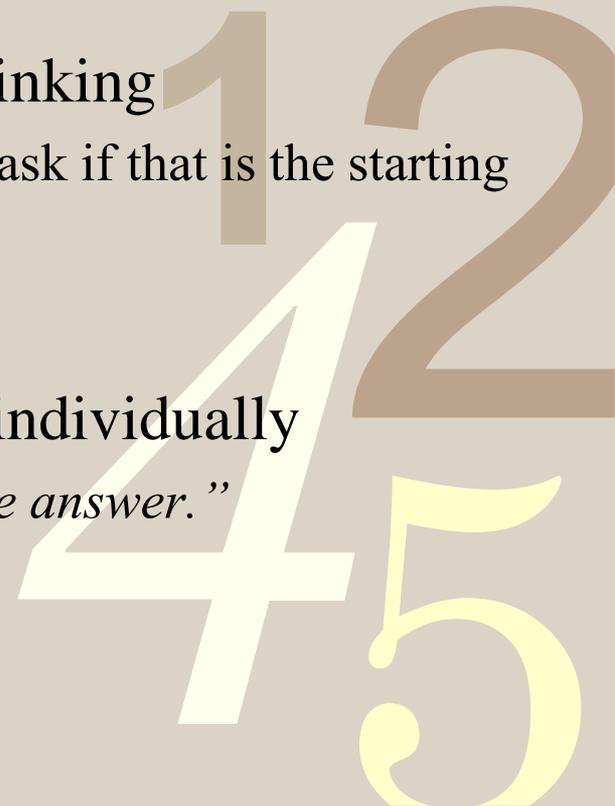
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## Lesson plan (*partial use*)

- “... assess student strategies [and decide 3 or 4 (students) to share with class]”
- Specific teacher probe to guide student thinking
  - “if student starts counting at 56 instead of 57, ask if that is the starting place.”

## Research lesson (*partial use*)

- Winona checking student work, engaged individually
  - “*you’re going to have to show how you got the answer.*”
  - “*How would you show that on this paper?*”



# Selecting and Sequencing

Lesson planning (*high use*)

Teachers practiced how to represent student strategies on the board:

Anticipated Strategy 1 - Counting on	Anticipated Strategy 2 - Making a ten	Anticipated Strategy 3 - Compensation	Anticipated Strategy 4 - Decomposing and Adding
$56$ // // // //	$56 + 8$ $4 \quad 4$ $56 + 4 = 60$ $60 + 4 = 64$	$56 + 8 \quad +2 - 2$ $8 + 2 = 10$ $56 + 10 = 66$ $66 - 2 = 64$	$56 + 8$ $50 \quad 6$ $50 + (6 + 8)$ $50 + 14 = 64$

– Very time-consuming process

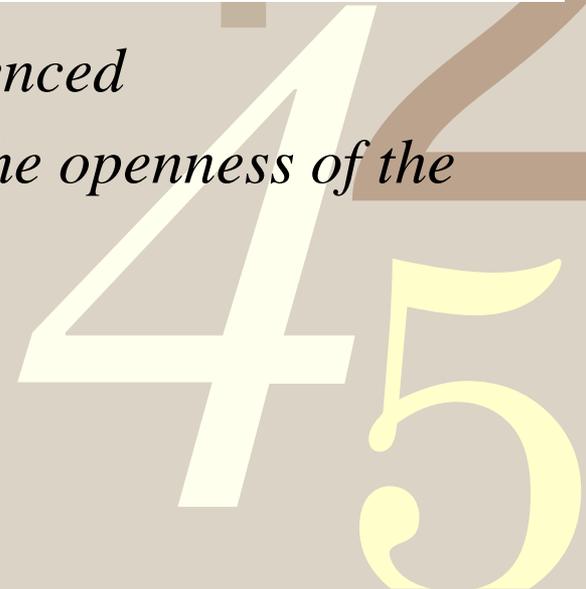
- *Co-constructing of representations, to make strategies in discussion visual, real, and concrete.*

# Selecting and Sequencing

## Research Lesson (*high use*)

Student Strategy 1	Student Strategy 2	Student Strategy 3	Student Strategy 4
<p><math>56 + 8</math> 4    4 4    4</p> <p>60 61, 62, 63, 64</p>	<p><math>60 + 4 = 64</math></p>	<p><math>56 + 8</math> 4    4</p> <p><math>56 + 4 = 60</math> <math>60 + 4 = 64</math></p>	<p><math>56 + 8</math> 54    2 2    8</p> <p><math>54 + (2 + 8)</math> <math>54 + 10 = 64</math></p>

- *Similar strategies were selected and sequenced*
- *Making it easier for Winona to maintain the openness of the lesson, keeping student discussion going*



# Connecting

Lesson planning (*high use*)

- Teachers discussed how to help students make conceptual connections and how to support the process.

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# Connecting

## Lesson planning (*high use*)

- Teachers making conceptual connections in discussing student strategies.

But what do we want to say? What is realistic as to they're going to get out of this? ... Well, 'let's talk about what you notice about these (strategies)', and then maybe just take a minute for them to talk about ... I mean, really just making them aware, because I worry what would the kids say ...

Hama

Well, they all make a ten.

Hudson

# Connecting

## Lesson planning (*high use*)

- Teachers making conceptual connections in discussing student strategies.

No, this is a ten ... this is making a ten ... this one is not making a ten

Amali

$$56 + 8$$
$$50 + (6 + 8)$$
$$50 + 14 = 64$$

Sure it is.

Maia

Well, when they pulled the 10 out of the 14 ...

Hope

It's a ten?

When you decompose 56 to make 50, 6 plus ... 50, I mean ...

Hudson

# Connecting

## Lesson planning (*high use*)

- Teachers making conceptual connections in discussing student strategies.

Yeah, you turned it into a multiple of tens, and you're saying how it's a multiple of ten, because it's not making a ten ...

Hama

$$50 + (6 + 8)$$
$$50 + 14 = 64$$

I'd be surprised, though, if someone did it this way ...

Winona

Actually, in all of these ways this is how we all learned it. It's 14, then it's 50, it's 64. I think it lines up more with the traditional algorithm, or maybe that's the way my brain is wired. Like 6 and 8 is 14, it's just the way you record it

Hudson

I had kids do it that way before ...

# Connecting

## Lesson planning (*high use*)

- Teachers making conceptual connections in discussing student strategies.

... OK, the 50, she'll still got the 50, and then she put ... she made another 10 with 6 and 4 from the 8, so she did  $50 + 10 + 4$ .

Hope

...so that's  $50 + 4 + 6 + 4$ , kind of ...

Beryl

$$56 + 8$$

50      6

$$50 + (6 + 8)$$
$$50 + 14 = 64$$

That's a big one! I have a lot of kids do it that way ...

Hudson

$56 + 8$ , 2 and 4,  
 $50 + 10 + 4$  ...

Amali

# Connecting

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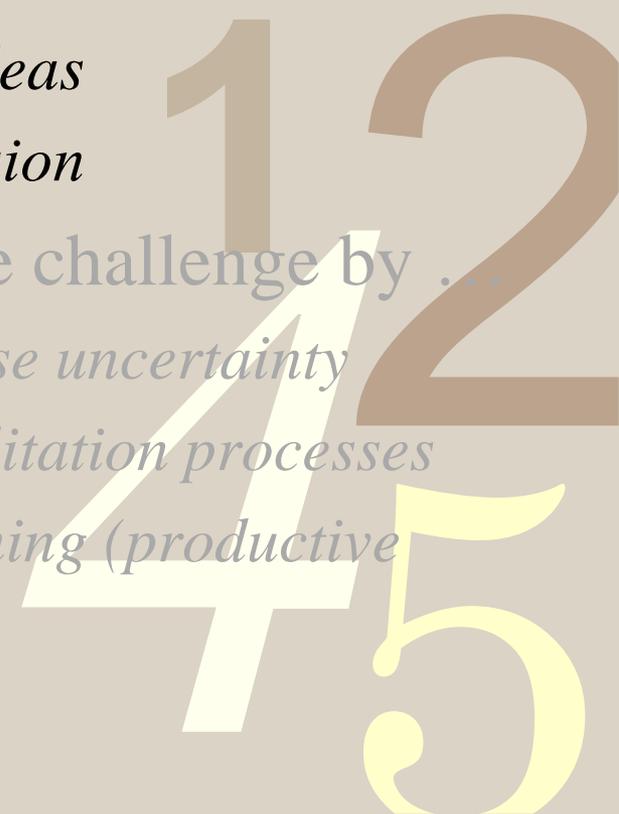
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# Summary

Maintaining high cognitive demands is possible

- Level decline happens when ...
  - *Teachers become uncertain about student learning and content*
  - *Leading to unsystematic exploration of ideas*
  - *Teachers' desire to reduce student confusion*
- The teachers in the study overcame the challenge by ...
  - *Anticipating situations that normally cause uncertainty*
  - *Thoroughly discussing and planning facilitation processes*
  - *Developing shared vision of student learning (productive struggles)*

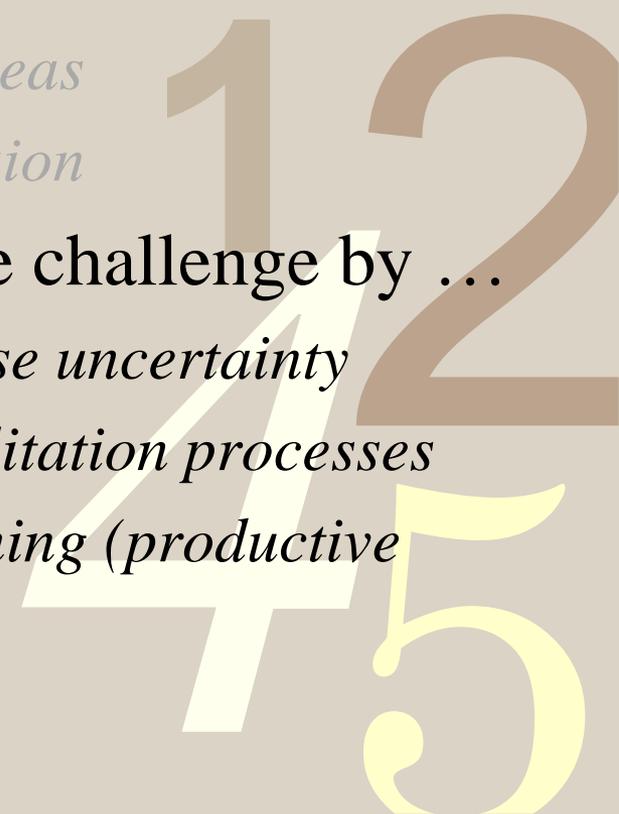


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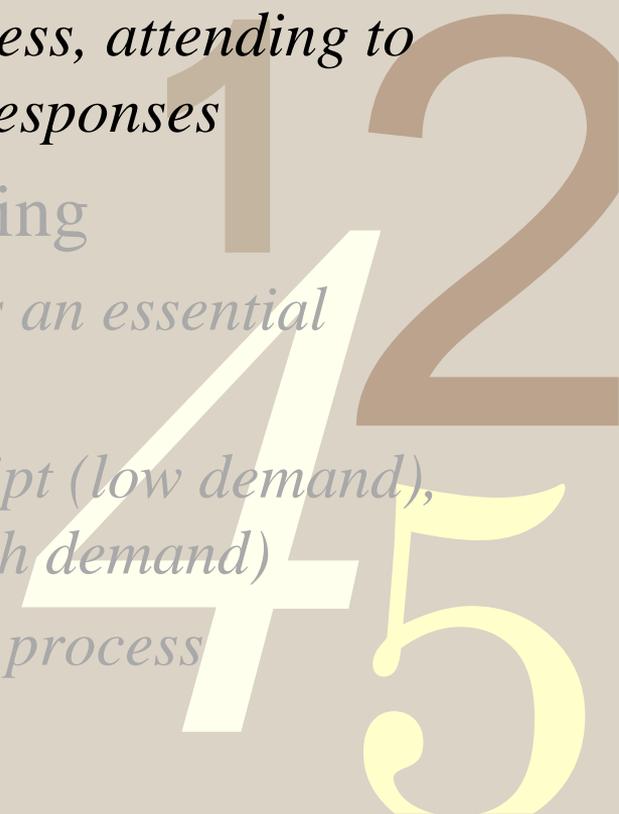
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  - *Developing shared vision of student learning (productive struggles)*



# Conclusions

- Importance of thorough lesson planning (and rehearsals)
  - *Length of lesson study – one of the critical design feature, along with focus on student learning*
  - *Thinking it through, verbalizing the process, attending to details of student thinking and possible responses*
- Cognitive Demand for Teacher Thinking
  - *Collaborative teacher learning context is an essential foundation*
  - *Instead of following teacher-proofed script (low demand), teachers actively engage cognitively (high demand)*
  - *Five Practices can be a way to guide the process*

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# Conclusions

- Importance of thorough lesson planning (and rehearsals)

- *Length of lesson study – one of the critical design feature, along with focus on student learning*
- *Thinking it through, verbalizing the process, attending to details of student thinking and possible responses*

- **Cognitive Demand for Teacher Thinking**

- *Collaborative teacher learning context is an essential foundation*
- *Instead of following teacher-proofed script (low demand), teachers actively engage cognitively (high demand)*
- *Five Practices can be a way to guide the process*

# *Connecting two studies: Focus on student learning*

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- Most strongly associated with teacher learning via survey
- Different lesson study groups focus on different aspects of student learning
  - *Superficial learning vs. deep learning*
  - *Procedural learning vs. conceptual learning*
- Anticipating student responses itself is not enough
  - *Thoroughly planning facilitation process (attending to all practices) helps maintain the cognitive demand level of lesson task in research lessons*

## *Next Step*

- Purposefully guide teachers' (and facilitators') attention to ...
  - Student thinking, but especially ...
    - *How to address deeper levels of knowledge*
    - *How to plan, set up, and maintain high cognitive demands tasks*
    - *How to plan facilitation practices (5 Practices) to help students make connections between ideas*
- Quality materials with thought revealing tasks
- Longer lesson study period

Thank you!

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