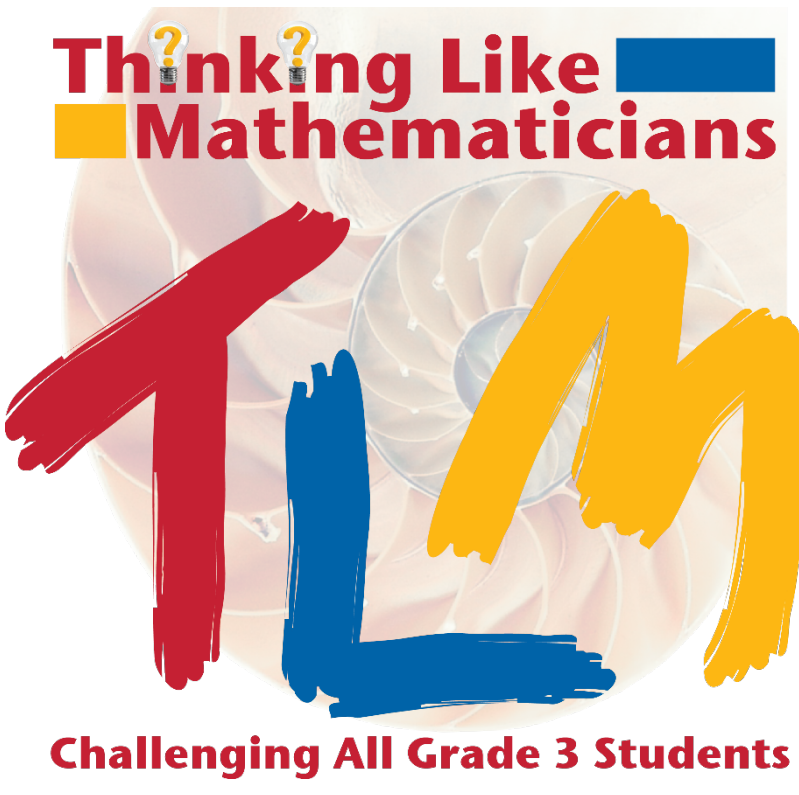


# Promoting Student Engagement Through Mathematical Discourse



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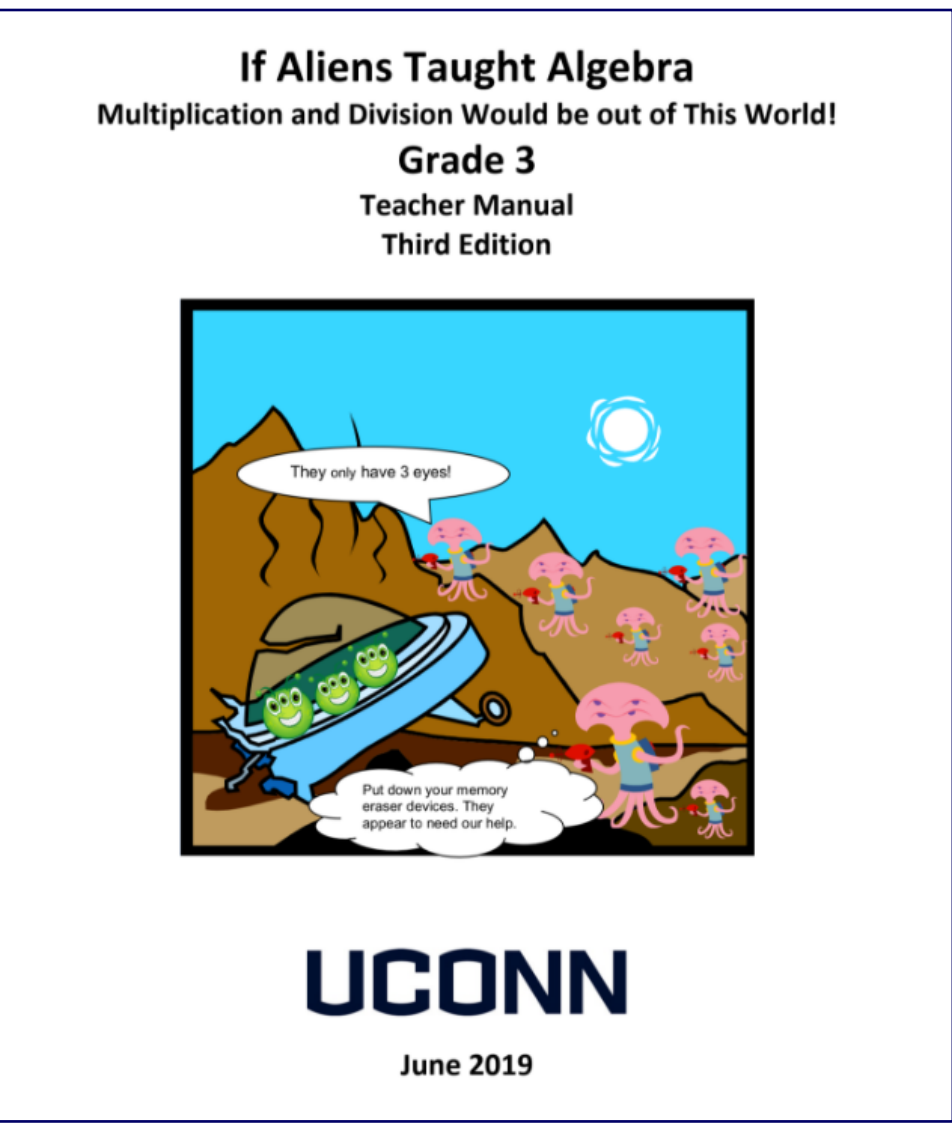
## Description of Thinking Like Mathematicians (TLM)

Thinking Like Mathematicians (TLM): Challenging All Grade 3 Students is a 5-year project (2017–2022). The project addresses important educational issues related to instructional and curricular differentiation for all students, developmental identification strategies for all students, and the necessity of meeting the academic needs of students from all cultural groups, all language groups, all economic strata, and all students with gifts and learning challenges. This project provides grade 3 students in general education classrooms access to high quality mathematics curriculum that incorporates these principles of differentiation. The curriculum is challenging and engaging, but responsive to students’ learning needs, and it uncovers and promotes students’ talents. It also offers teachers the necessary guidance to implement high quality curriculum organized in lesson plan format. The project was a multisite randomized control trial that occurred in five states.

## The Unit

Created an educative math unit entitled *If Aliens Taught Algebra: Multiplication and Division Would be out of This World!* Main components of the unit included:

- Algebraic thinking, multiplication, and division
- 11 of 16 lessons included tiered, differentiated activities
- Common Core Mathematical practices
- 21st Century Skills (4Cs: critical thinking, creative thinking, communication, and collaboration)
- Differentiation strategies
- Talk moves
- On-going assessment and feedback



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## Strategies

### 1. Focusing and Funneling Questions (Zrike & Connolly, 2015)

- Focusing Questions:
- Open-ended questions
  - Enables students to justify responses based on their own thinking
  - Responsibility lies with the students
  - Example: Can you explain why you think this answer is incorrect?
- Funneling Questions:
- Close-ended questions
  - The student is guided through a series of questions built around how the teacher would solve the problem
  - Responsibility lies with the teacher
  - Examples: What unit label should you include after your answer? Can you round that number up to the nearest 10?

**Share and Discuss**  
The following dialogue presents how mathematical thinking involves regularly checking in about the viability of a solution. The teacher facilitates the interactions among students to help them think in this way.

**Teacher:** Quinn, would someone from your group like to share what your conclusion was for how the seats should be arranged?  
**Quinn:** Sure, (see Response A) we decided that just having one row of 12 seats would probably be the best for anyone going to the concert.  
**Teacher:** Alright and why is that?  
**Quinn:** Because it is the easiest way to set it up, and they would be seated in a single line, so they wouldn't have anyone sitting in front of them.  
**Teacher:** Ok, thank you for sharing your thinking. Class, what do you think the mayor will say if he comes and sees this arrangement? Why might the mayor agree or disagree? (Reasoning talk move)  
**Payton:** I don't know, it might take up a lot of space and our group was thinking that the stage could be built into 3 rows of four, or 4 rows of three.  
**Teacher:** Ok, that is a different solution, and what do you think a mayor will say about that plan?  
**Payton:** Maybe that it will take too much time?  
**Teacher:** Can anyone add to Payton's idea? What are some pros and cons of each idea? (Adding On talk move)

Sample dialogues were used throughout the unit to support teachers with questioning techniques. (Cole et al., 2019, p. 138)

### 2. Talk Moves (Chapin et al., 2009)

Move	Definition	Example
Revoicing	Teachers restate a student's answer to clarify the teacher's understanding of the student's response. This is especially helpful if the student's response is not clear.	You said that the numbers in this pattern are increasing by threes. Is this right?
Repeat/Rephrase	Teachers ask other students to repeat or rephrase what a classmate just stated. This allows other students to hear what the first student stated, and it gives them a chance to process the information.	Could someone repeat what Keon just said in your own words?
Reasoning	Teachers ask students to agree/disagree with a peer and more importantly, justify why. This talk move is a way to promote mathematical reasoning among students based on each other's responses.	Do you agree with Quinn's explanation or disagree? Why?
Adding On	Teachers can encourage participation among more students in the class by asking students to add on to a peer's response.	Would someone else like to add more to Aliyah's explanation?
Wait Time	Teachers wait and give students an opportunity to think about a question that has been asked or think about a classmate's answer. This provides students with a chance to process and formulate a response.	Take your time, Andre, and we will wait for you to think.

**Marcus:** [Students from both groups nod in agreement.] Yeah, but we have different ones.  
**Teacher:** Can someone add onto Marcus' observation? (Adding On talk move)  
**Avis:** Me and Marcus and Janell all shared our ideas, but I think we forgot some. But the other group, Melinda's group, forgot some too.  
**Teacher:** Ok, let's compare your equations. Do you think we should start with the list that Marcus' group has or with Belinda's? Why?  
**Belinda:** I think ours. We put it in order.  
**Teacher:** Belinda thinks we should start with her group list. Who agrees or disagrees with this idea, and why? (Reasoning talk move)  
**Maddie:** I agree. Because it's in order.  
**Teacher:** Belinda, can you repeat what Maddie just said in your own words? (Repeat/Rephrase talk move)  
**Maddie:** Yeah, we started with zero, then went to one, then to two, then three.  
**Teacher:** Maddie, is that what you said?  
**Maddie:** Yeah, that's what I meant. I noticed that the first numbers start at zero, then go up one each time.  
**Teacher:** Ok, work with your group to compare both lists. Let's try out Belinda's idea to start with the list her group put together, then check to see if Marcus' group has each equation.

Sample dialogues also specified which talk moves were being used. (Cole et al., 2019, p. 52)

### 3. Listening Orientation Framework (Gilson & Little, 2016)

- How teachers listen can promote or hinder student participation
- Teachers tend to listen through
- Many factors affect how we listen such as our expectations of students, our relationships with them, and our teaching style

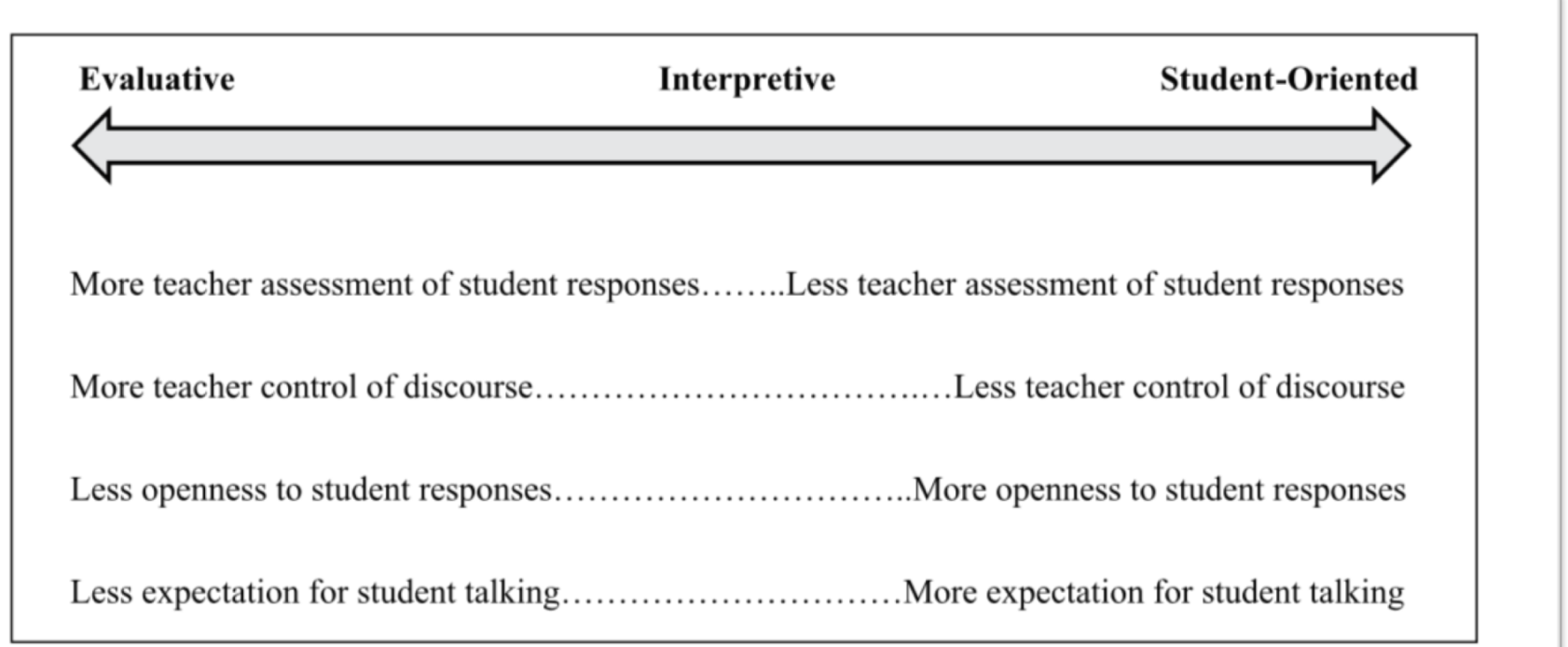


Figure 2. A continuum of teacher listening orientations.

Continuum of listening orientations (Gilson & Little, 2016, p. 230)

## The Professional Learning

- Formal Professional Learning
- Two full-day professional learning sessions
  - One session prior to implementation
  - Second session halfway through implementation of the curriculum
- Educative Curriculum
- The curriculum is designed to serve as a form of professional learning in itself

## Integrating Discourse Strategies

Teachers responded positively to the discourse strategies, especially the talk moves. These can also be incorporated into pre-existing curriculum. Choosing just one strategy or talk move to focus on first can help teachers add it to their instructional toolbox before integrating a new one. Using these strategies can increase discourse and engagement.

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