Developing ELLs' Understanding of Both Mathematics and Language

Through Professional Development for Elementary Mainstream and ESOL Teachers

April 16, 2016

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NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Welcome!

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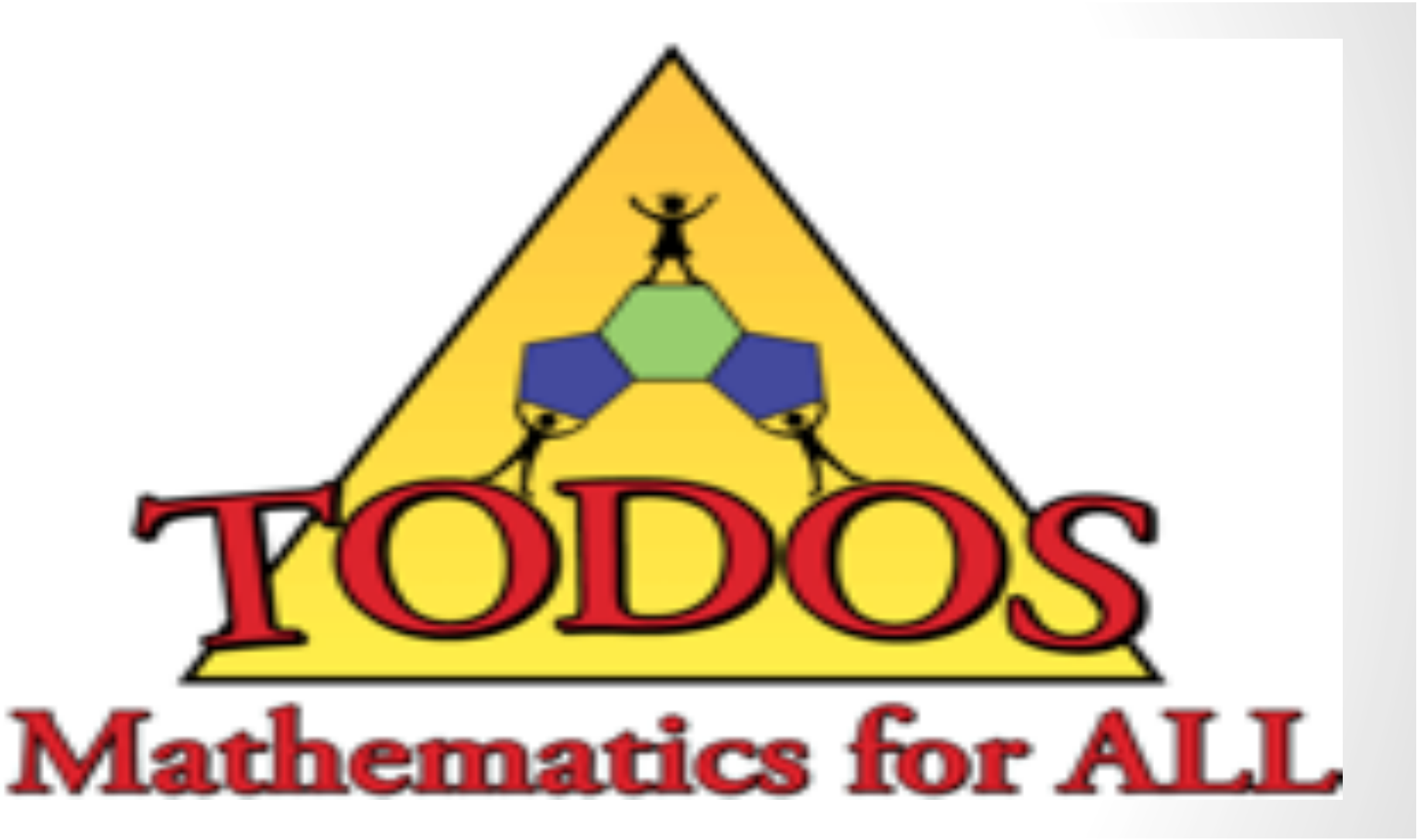
ESOL Enrollment Data

as of August 18, 2015

TOTAL ESOL POPULATION:
19,203

ELEMENTARY K-5	MIDDLE 6-8	HIGH 9-12
15,236	2,891	3,890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Mathematics for ALL

Five Good Reasons to Become a TODOS Member!

- Targeted and ongoing support in your efforts with students.
- Complimentary and sustained professional development.
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- Engagement with a community of learners at all levels of education.
- Ideas to work with underserved students in mathematics.

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Visit the TODOS Booth in the Exhibit Hall, Booth #544

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Renew or Join online at http://www.todos-math.org
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TODOS 2016

TODOS Mathematics for ALL

Mark your calendars for the TODOS 2016 Conference! Supporting educators to teach for Excellence and Equity in Mathematics!

todos-math.org

JUNE 23-25, 2016

SCOTTSDALE, AZ

SCOTTSDALE PLAZA RESORT

TODOS 2016 Conference is co-sponsored by NSF-funded Arizona Master Teachers of Mathematics (AZ-MTM), award #1035330

Warm-up: Share successes and challenges with PD opportunities on Mathematics for ELLs in your district?

- Information/Content
- PD Structure
- Instructional Strategies
- Language Supports
- Follow-up on Implementation

Session Agenda

- Introductions
- ESOL – UMD Focus Group: A Unique Partnership
- Exploration with Instructional Tools
- ESOL – UMD Focus Group: Results
- Closure and Questions

Session Outcome:

Participants will leave with actionable take-aways for developing ELLs' language and mathematics

Previous Isolated PD Efforts

- **Prince George's County Public Schools**

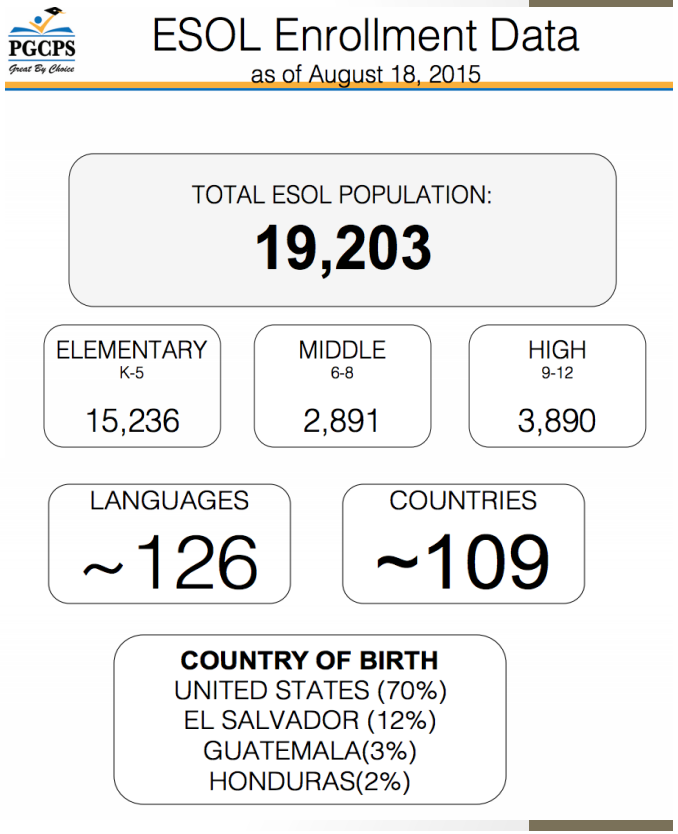
Book Study – Based PD: 4-6 paid evening sessions (prior to 2013-14)
Focus Group 2013-14: 4 half-day sessions on *Discourse for ELLs*
Need: More research-based mathematical pedagogy

- **Center for Mathematics Education, UMD**

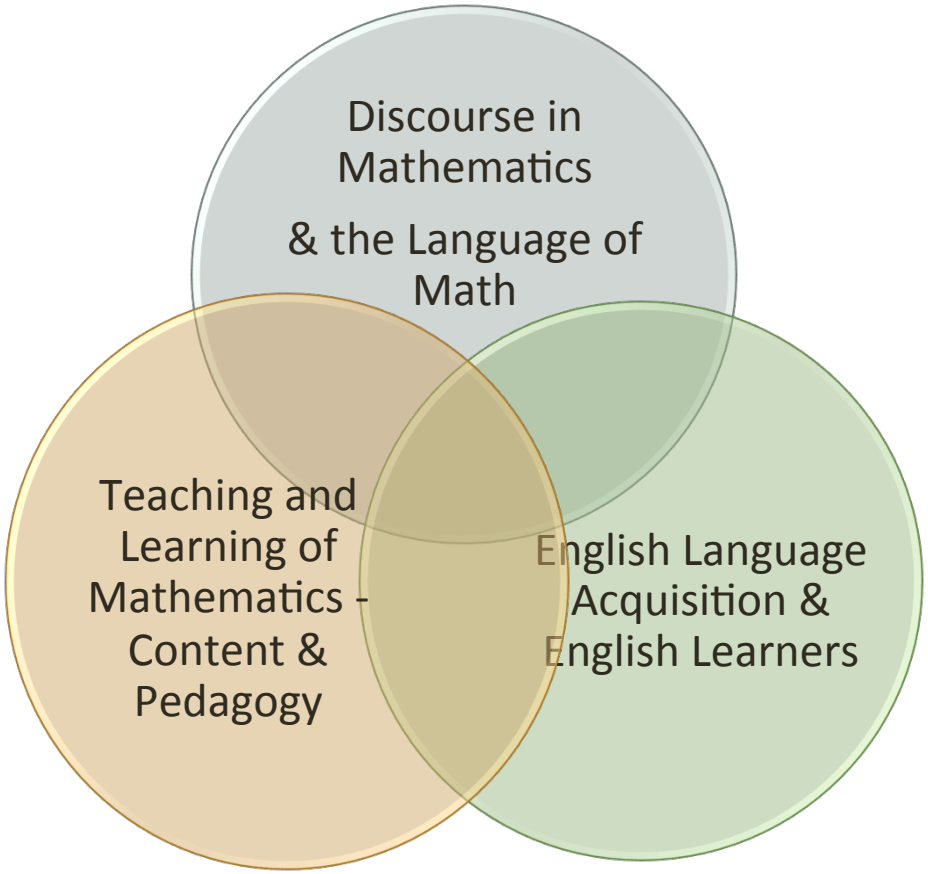
Outreach Courses: Graduate evening courses for practicing teachers with a focus on both content and pedagogy
Need: More authentic connections to the classroom and local contexts for working with English Language Learners

PGCPS ESOL– UMD Partnership: Context and Rationale

- Growing numbers of ELLs
- CCSS/MCCRS: Mathematical Content AND Practices
- WIDA Language Development Standards
- ESOL teachers support language development (L, S, R, W) in ALL content areas, including mathematics
- Teachers of Mathematics = Teachers of Language



OVERLAPPING KNOWLEDGE FOR TEACHING MATHEMATICS TO ENGLISH LANGUAGE LEARNERS



WIDA CONSORTIUM

English Language Development Standards

Standard 1: Social and Instructional Language

Standard 2: The Language of Language Arts

Standard 3: The Language of Mathematics

Standard 4: The Language of Science

Standard 5: The Language of Social Studies

WIDA: World Class Instructional Design and Assessment

www.wida.us

Teaching and Analyzing the Language of Mathematics

Vocabulary
- *math terms*
- *everyday words*
- *academic words*

Word & Phrase Level

Grammar Features & Language Structures

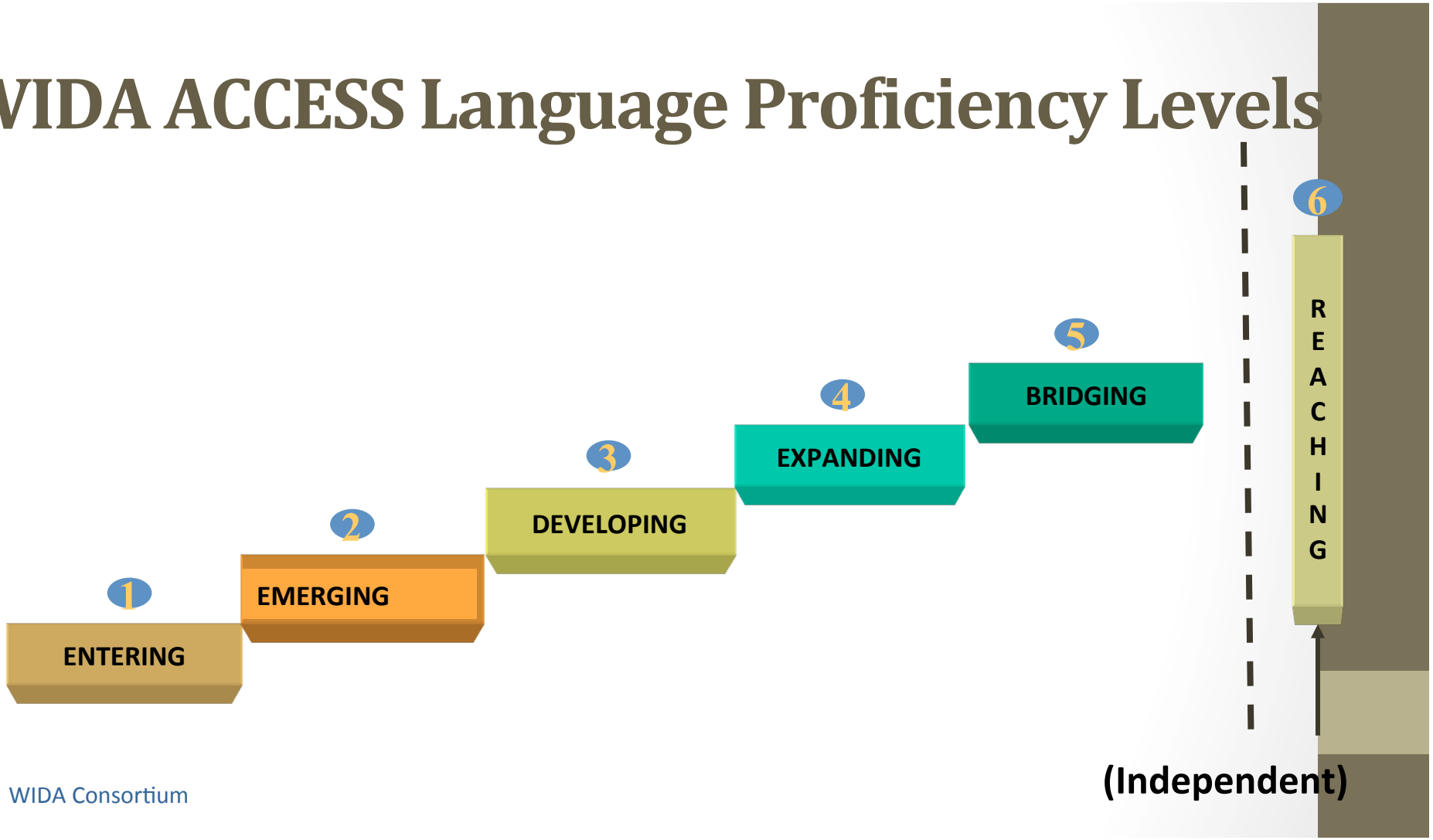
Sentence Level

Discourse Complexity:
extended oral & written logically connected responses

Discourse Level

Modified from *The Defining Features of the Academic Language in WIDA's Standards*, WIDA Consortium, Draft, September 2011

WIDA ACCESS Language Proficiency Levels



WIDA CAN DO Descriptors

Figure 5M: CAN DO Descriptors for the Levels of English Language Proficiency, PreK-12

For the given level of English language proficiency, **with support**, English language learners can:

	Level 1 Entering	Level 2 Beginning	Level 3 Developing	Level 4 Expanding	Level 5 Bridging	Level 6 Reaching
LISTENING	• Point to stated pictures, words, phrases • Follow one-step oral directions • Match oral statements to objects, figures or illustrations	• Sort pictures, objects according to oral instructions • Follow two-step oral directions • Match information from oral descriptions to objects, illustrations	• Locate, select, order information from oral descriptions • Follow multi-step oral directions • Categorize or sequence oral information using pictures, objects	• Compare/contrast functions, relationships from oral information • Analyze and apply oral information • Identify cause and effect from oral discourse	• Draw conclusions from oral information • Construct models based on oral discourse • Make connections from oral discourse	
SPEAKING	• Name objects, people, pictures • Answer WH- (who, what, when, where, which) questions	• Ask WH- questions • Describe pictures, events, objects, people • Restate facts	• Formulate hypotheses, make predictions • Describe processes, procedures • Retell stories or events	• Discuss stories, issues, concepts • Give speeches, oral reports • Offer creative solutions to issues, problems	• Engage in debates • Explain phenomena, give examples and justify responses • Express and defend points of view	
READING	• Match icons and symbols to words, phrases or environmental print • Identify concepts about print and text features	• Locate and classify information • Identify facts and explicit messages • Select language patterns associated with facts	• Sequence pictures, events, processes • Identify main ideas • Use context clues to determine meaning of words	• Interpret information or data • Find details that support main ideas • Identify word families, figures of speech	• Conduct research to glean information from multiple sources • Draw conclusions from explicit and implicit text	
WRITING	• Label objects, pictures, diagrams • Draw in response to a prompt • Produce icons, symbols, words, phrases to convey messages	• Make lists • Produce drawings, phrases, short sentences, notes • Give information requested from oral or written directions	• Produce bare-bones expository or narrative texts • Compare/contrast information • Describe events, people, processes, procedures	• Summarize information from graphics or notes • Edit and revise writing • Create original ideas or detailed responses	• Apply information to new contexts • React to multiple genres and discourses • Author multiple forms/ genres of writing	

Variability of students' cognitive development due to age, grade level spans, their diversity of educational experiences and diagnosed learning disabilities (if applicable) are to be considered in using this information.

www.wida.us

Identifying What Carlos Can Do

Overall LP Level: 3.6 (L) 3.5; (S) 2.8; (R) 5.0; (W) 3.4

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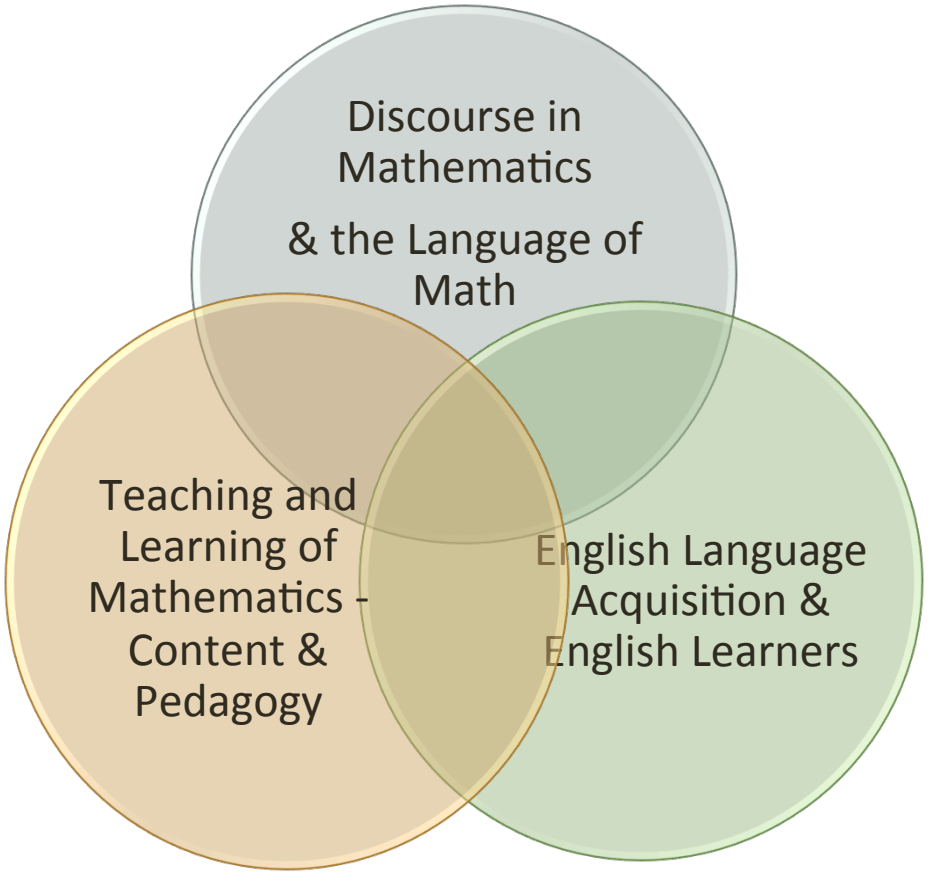


Engaging ELLs in Mathematical Discourse
Focus Group

Structure, Components, Process:

- Participants: 25 mainstream and ESOL teachers (Gr. 2-6)
- 7 full-day PD sessions (September 2014 - May 2015)
- *Mathematical Pedagogy* component
- *Language Development* component
- *Show-and-Tell* small group AND whole group sharing:
  - Implementation of new learning/strategy in the classroom
  - Evidence through classroom artifacts, student work, videos
  - Feedback from colleagues
- LOTS of research-based resources
- Planning time
- Personalized on-site support (planning, coaching, debriefing)

Focus Group in Action

- **What did it look like?**
  - Environment with norms and expectations
  - Task-based and problem-solving approaches
  - Different formats for interaction
  - Student work analysis
- **What did it sound like?**
  - What did you notice about the mathematics?
  - What did you notice about the language development?
  - What can we anticipate students would____ ?
  - How does ____ connect to ____?
  - What can we do so that students can ___?
- **What did it feel like?**
  - Growing as problem-solvers and problem-posers
  - Taking risks to experiment, share, collaborate

Mathematical Pedagogy Component
Emphasizing Teaching Practices

- **Problem Solving-based Mathematics**
  - Teaching Mathematics for Understanding
- **Cognitively Guided Instruction (CGI)**
- The Language of Area and Perimeter
- Number Sense Games
- **Math Talk and Discourse Moves**
  - Questioning Patterns
  - Writing
- Using Children's Literature for Teaching Mathematics

CCSS Mathematical Practice (What Students Do)	NCTM Mathematics Teaching Practices (What Teachers Do)
1) Make sense of problems and persevere in solving them*	• Establish mathematics goals to focus learning
2) Reason abstractly and quantitatively	• Implement tasks that promote reasoning and problem solving
3) Construct viable arguments and critique the reasoning of others*	• Use and connect mathematical representations*
4) Model with mathematics*	• Facilitate meaningful mathematical discourse*
5) Use appropriate tools strategically	• Pose purposeful questions*
6) Attend to precision*	• Build procedural fluency from conceptual understanding
7) Look for and make use of structure	• Support productive struggle in learning mathematics
8) Look for and express regularity in repeated reasoning	• Elicit and use evidence of student thinking

Cognitively Guided Instruction

- Problem Types and Student Strategies
  - Addition/Subtraction; Multiplication/Division
- Videos of clinical interviews with children
- Videos of classroom instruction, student sharing, and group discussions

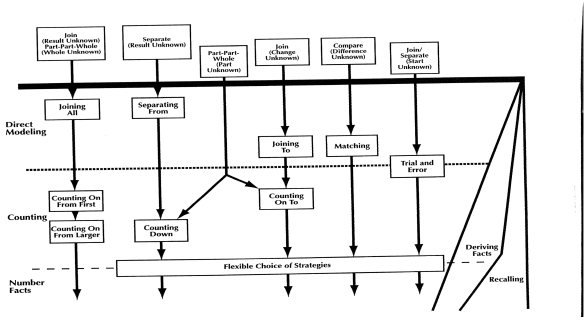
Difficulty of Addition and Subtraction Problems

Location of Unknown

Action or NO Action

Join	Result Unknown	Change Unknown	Start [Initial] Unknown
Separate	Result Unknown	Change Unknown	Start [Initial] Unknown
Part-Part-Whole	Whole Unknown	Part Unknown	
Compare	Difference Unknown	Compare Quantity Unknown	Referent Unknown

Last page of CGI Chapter #3

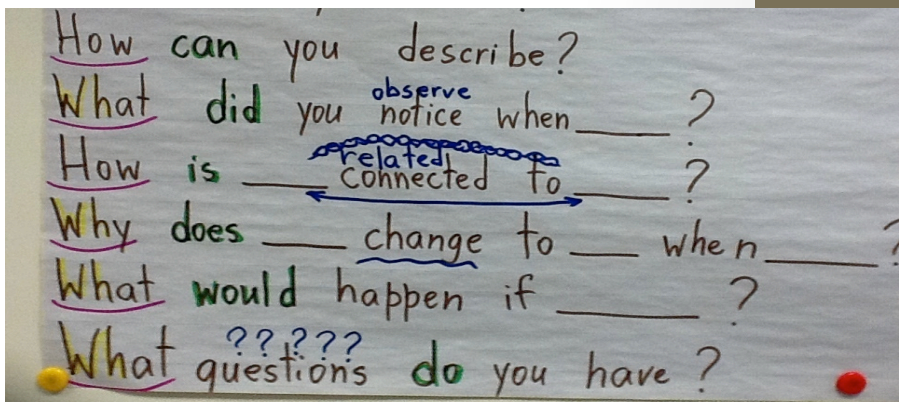


CGI Role Plays

Semantic vs. Computational Interpretations

Mathematical Discourse:
Productive Classroom Discussions

- Anticipating Student Responses
  - Plan teacher reactions and questions
- Patterns of Questioning
  - IRE, Funneling, and Focusing
- Talk Moves (Chapin, O'Connor, and Anderson, 2009)
  1. Revoicing
  2. Repeating
  3. Reasoning
  4. Adding on
  5. Waiting



Language Development Component

Challenges in Teaching ELLs:

- Vocabulary
- Word Problems
- Discourse
- Cultural Differences

Language Learning Principles:

- Communicative
- Relevant
- Meaningful
- Purposeful

Language Development Supports for ELLs to Increase Comprehension and Communication

Environment	

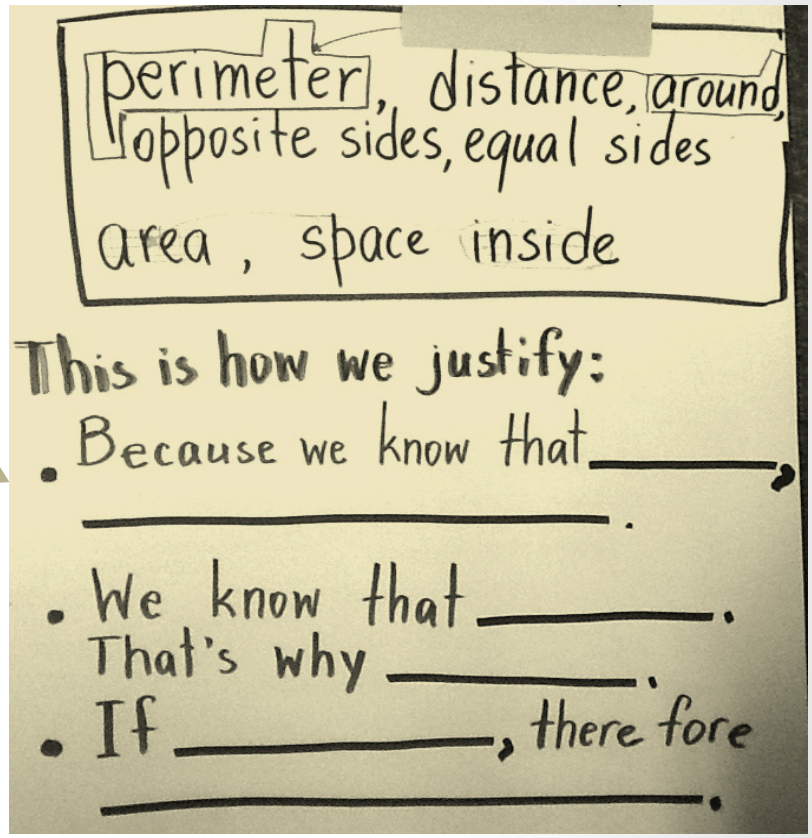
• Welcoming & stress-free
• Respectful of diversity
• High expectations
• Structures & routines
• Thinking-focused (vs. answer-seeking) discourse
• Checks for understanding through multiple modalities
• Explicit instruction of specific language targets
• Participation and engagement techniques
• Meaningful integration of games and learning centers
	• Opportunities to apply knowledge and create problems or representation to further thinking
	• Task/Activity:
	  ○ Accessible by all students
	  ○ Multiple entry points
	  ○ Relevant to students' life experiences and culture
	  ○ Built on prior mathematical learning
	  ○ High cognitive demand
	  ○ Multiple strategies for solutions

Sensory Supports*	Graphic Supports*	Interactive Supports*	Verbal and Textual Supports
• Real-life objects (realia) or concrete objects • Physical models • Manipulatives • Pictures & photographs • Visual representations or models such as diagrams or drawings • Videos & films • Newspapers or magazines • Gestures • Total Physical Response (TPR) • Physical movements • Music & songs	• Graphs • Charts • Timelines • Number lines • Graphic organizers • Graphing paper	• In a whole group • In a small group • In pairs as a group (first, two pairs work independently, then they form a group of four) • With a partner such as *Turn-and-Talk* • In triads, for ex. *Problem-Solution Triads* • Cooperative learning structures such as *Think-Pair-Share Timed Pair Share, Rally Coach, Numbered Heads Together* • Interactive websites or software • With a mentor or coach	• Labeling • Use of students' native language • Modeling • Repetitions • Paraphrasing • Summarizing • Guiding questions • Clarifying questions • Probing questions • Leveled questions such as What? When? How? Why? • Questioning prompts & cues • Word Banks • Sentence starters • Sentence frames • Discussion frames • Accountable Talk moves, including *Wait Time*

*from English Language Proficiency Standards Pre-Kindergarten -Grade 12, 2007 Resource Guide; WIDA Consortium
Modified by Galina (Halla) Jmourko, ESOL Coach, PGCPS; 2015, Rvsd. 2016

Examples of Language Supports

- **Concept-Related Word Bank**
- **Sentence Frames**



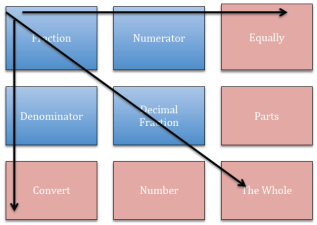
Purpose:

Support ELLs' communication when explaining, justifying, or reasoning

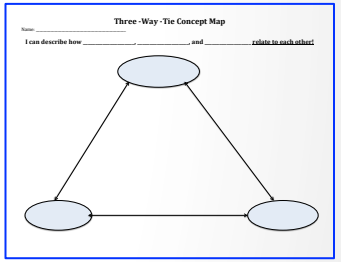
Exploration of Instructional Tools

- *Cubing Game*

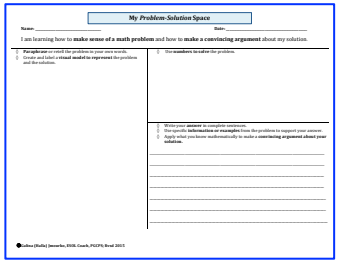
- *2x2 Sentence Builders*



- *Three-Way Tie* Graphic Support



- *Problem-Solution Space*



Discussion Prompts

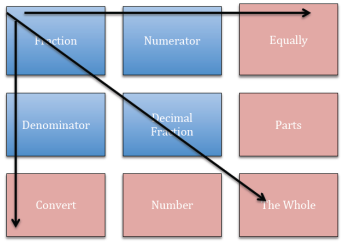
- Make Sense of the Tool
- Benefits for Mathematical Knowledge and Skills
- Benefits for Developing Language
- Other Benefits/Considerations
- Applications

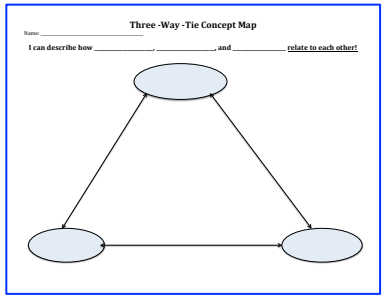
Make sure to consider CCSS for Mathematical Practices!

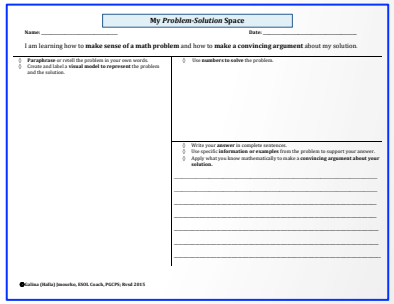
Be prepared to share with the whole group!

(10 min.)

(10 min.)

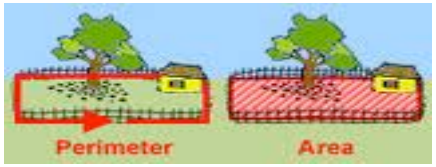

Numerator
Equally
Denominator
Parts
Convert
Number
The Whole


Three -Way -Tie Concept Map
I can describe how _____, _____, and _____ relate to each other!

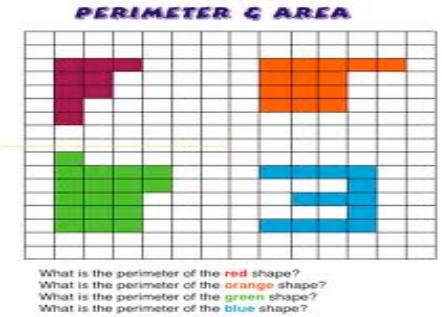

My Problem-Solution Space

Cubing Game: Looking at a Concept from Different Perspectives

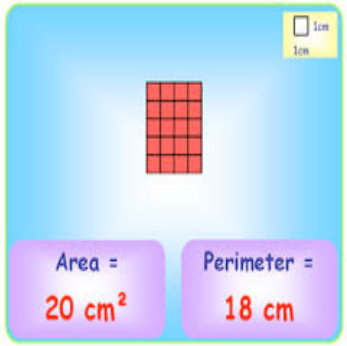
Define



Compare
Contrast



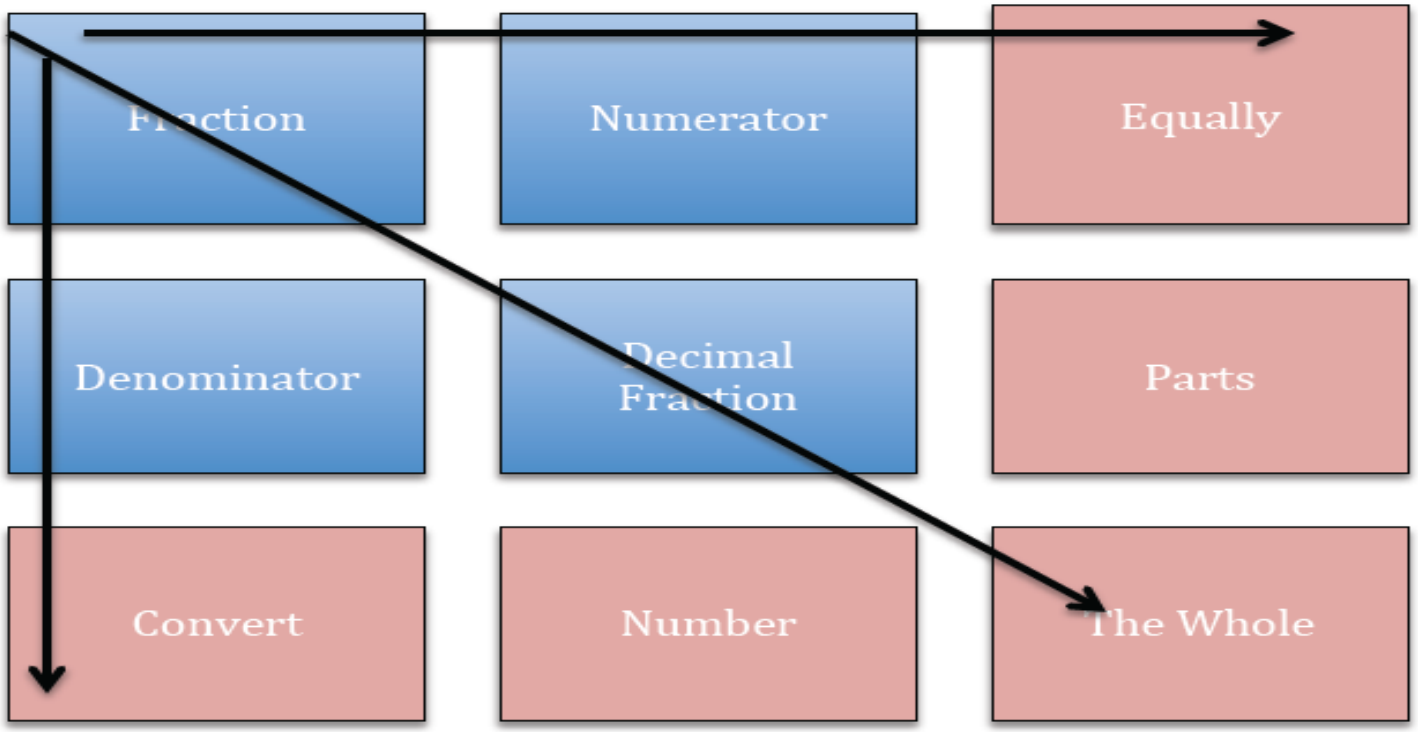
Describe



Connect/Associate

Apply

2x2/3x3 Sentence Builders



Three Way Tie Graphic Support

Problem-Solution Placemats

Manuel saw some birds this week. He saw 2 blue jays on Monday, 5 cardinals on Tuesday, then again 4 blue jays on Wednesday, and again 7 cardinals on Thursday. On Friday, Manuel saw 6 blue jays.

If the pattern continues, what is the number and type of bird Manuel will see on Saturday?

CCSS Mathematical Practice (What Students Do)	NCTM Mathematics Teaching Practices (What Teachers Do)
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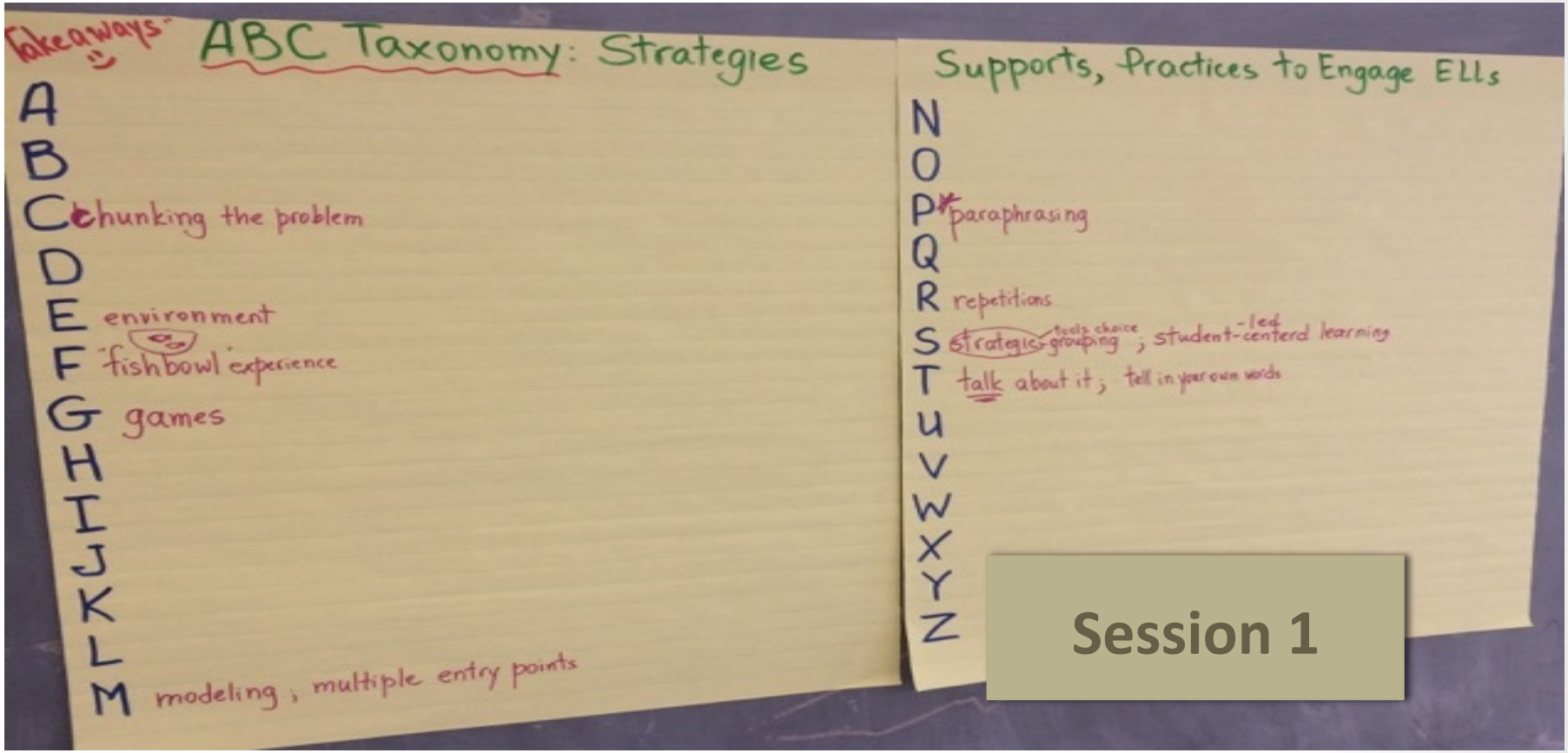
7) Look for and make use of structure	• Support productive struggle in learning mathematics
8) Look for and express regularity in repeated reasoning	• Elicit and use evidence of student thinking

Our Take-Aways

- Instructional Tools have explicit **language** focus (vocabulary, sentences, oral skills) AND support development of **mathematical** ideas
- Classroom implementation of Tools create opportunities for students to ***practice*** L/S/R/W and the CCSS Mathematical Practices.

- Teachers may not instinctively turn to these tools for mathematics instruction
  - Need models and experience before experimenting
- Importance professional decisions to coordinate the Tools with appropriate Tasks.

ABC Taxonomy: Tracking New Learning



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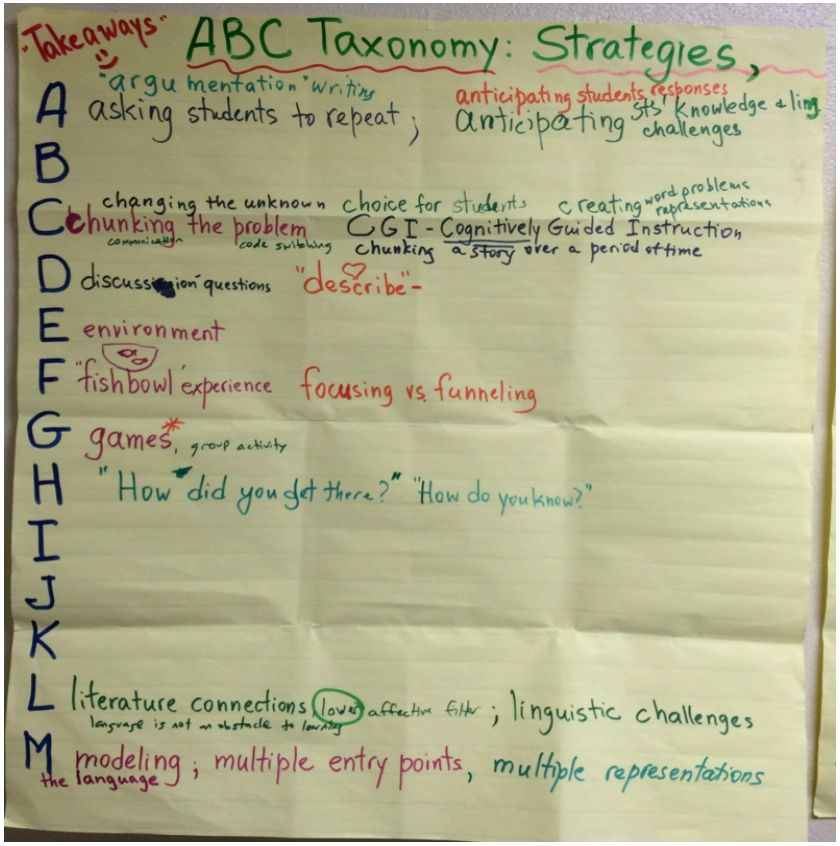

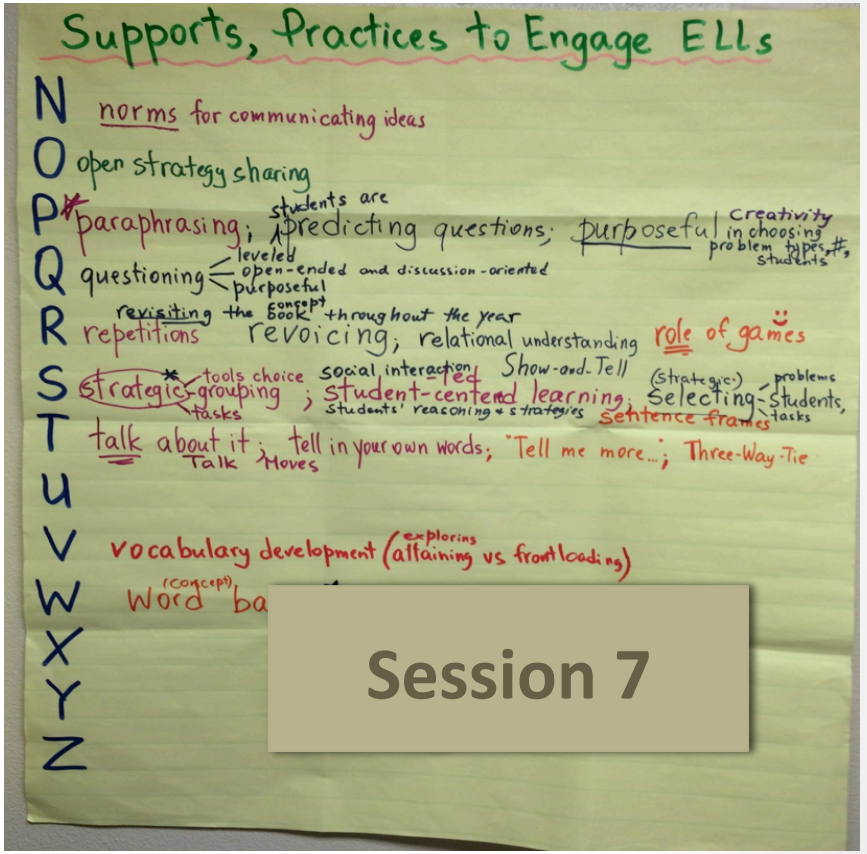

Teacher Journaling

Reflecting on Teaching Practices
Rationale

Teacher: _____

Math Strengths/Challenges:	**Language Strength/Challenges:**	**Participation/Attitudes/Motivation:**

Teaching Practices	**Observations and Impacts**		
		Students	**…gs/Motivation**
When I _____,	***Mathematics:*** *Knowledge, Skills, Thinking, Communication*	***I noticed that my s…***	
	English Language Skills: *Vocabulary Usage, Language Control, Linguistic Complexity*	***I noticed that … (s)_____***	***I noticed that I _____***

Ms. PB: *"I didn't know my kids can talk like that!"*

(Created by Galina (Halla) Jmourko, ESOL Teacher Coach, PGCPS)

Results

- Growth in Teacher Collaboration and Leadership
- Shifts in Classroom Norms and Instructional Strategies
- New Noticings About Practices and Students' Abilities
- Multiple Lenses: Language, Mathematics, Environment
- Shifts in Teacher Beliefs of and Knowledge for Teaching Math to ELLs

Results in the Classroom: Student Discourse

Unit: Planning a Party on a Budget of $100

Closure: Teaching Shifts

What was your instruction like **BEFORE** the focus group?	What **insights** have you gained through your participation in the focus group in terms of math pedagogy and the language of mathematics?
What **remains the same** in your instruction now? Why?	What is **different** in your instruction now? Why? Please provide specific examples from the classroom.
What do you feel would be your **next steps** (professionally or instructionally) in the nearest future?	

Teaching Shift:

One Teacher's Journey

*What was your instruction like **BEFORE** the focus group?*

- **Instruction was narrow and disjointed**
- **Teaching the way I was taught**
- **Strategies all over the place**
- **Without research-based purposes**

*What **INSIGHTS** have you gained through your participation in the focus group in terms of math pedagogy and the language of mathematics?*

- **Research-based teaching strategies to encourage student discourse**
- **Anticipating students' knowledge**
- **Accepting <u>all</u> ways of completing a problem**
- **(Children's) Literature connections**

*What **remains the same** in your instruction now? Why?*

- **Inability to promote small groups needs to improve**
- **Lack of time**
- **Interruptions in the classroom**
- **Too narrow a focus**

What is **DIFFERENT** in your instruction now? Why? Please provide specific examples from the classroom.

- **Research-based mathematical discourse strategies**
- **New knowledge and strategies to experiment with in the classroom**
- **Developing math vocabulary**
- **Questioning techniques: Withhold the Question; Paraphrasing; Focusing vs Funneling**
- **(Writing Strategies) Admit/Exit cards, journal writing, Quick writes, creative stories, pen pals, cubing**

*What do you feel would be your **NEXT STEPS** (professionally or instructionally) in the nearest future?*

- Continue learning about mathematical discourse and exchange of knowledge in the classroom
- Continue professional development…so I will not teach the same way and become stagnant and revert to old methods
- Focusing on questioning
- Expanding knowledge of the 4th grade curriculum
- Joining NCTM

Successes and Considerations

Successes:

- Design and implementation of the PD
- Working with teachers in their classrooms
- OUR collaboration is being recognized!
- Opportunities to share our knowledge and experience with educators

Considerations:

- Role of Principals
- Transiency of teachers: grades, subjects, schools
- Personalized on-site support to a large number of FG participants

THANK YOU!

Feel free to contact us for more information, resources, etc.

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