The Mathematical Discourse webinar will begin momentarily.
Mathematical Discourse
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Mathematical Discourse

What is it and why is it important?
Poll Question

Which of the following are examples of mathematical discourse?

A. A student asks whether she should show her work on an assignment.

B. A student writes in his journal to explain his mathematical reasoning.

C. A student says, “I notice a pattern that I think will always work...each number is 3 more than the one before.”

D. The teacher provides a counter example to a method posed by a student.

E. A group of students discuss the mathematical conditions in which an idea won’t always work.
The National Council of Teachers of Mathematics (NCTM) describes discourse as ways of representing, thinking, talking, agreeing, and disagreeing; the way ideas are exchanged and what the ideas entail; and as being shaped by the tasks in which students engage as well as by the nature of the learning environment.
What is Mathematical Discourse?

<table>
<thead>
<tr>
<th>Structure</th>
<th>Multidirectional and responsive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Dynamic, connected, and responsive</td>
</tr>
<tr>
<td>Purpose</td>
<td>Participate and engage in deep inquiry</td>
</tr>
<tr>
<td>Product</td>
<td>Shared understanding and new insights</td>
</tr>
</tbody>
</table>

Discourse requires *participation*, *commitment*, and *reciprocity*.

“From Classroom Discussions to Group Discourse” Web.
## Types of Mathematical Discourse

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Answering</strong></td>
<td>Short answer to a direct question</td>
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<tr>
<td><strong>Sharing</strong></td>
<td>Simple statement or share that does not involve an explanation of how or why</td>
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<tr>
<td><strong>Explaining</strong></td>
<td>Provides process without justification</td>
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<tr>
<td><strong>Questioning</strong></td>
<td>Asks to clarify understanding of an idea or procedure</td>
</tr>
<tr>
<td><strong>Challenging</strong></td>
<td>Pushes someone to reevaluate thinking using a question, statement or counter example</td>
</tr>
<tr>
<td><strong>Relating</strong></td>
<td>Makes a connection or sees a relationship to prior knowledge or experience</td>
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<tr>
<td><strong>Predicting</strong></td>
<td>Making a conjecture based on understanding of mathematics</td>
</tr>
<tr>
<td><strong>Justifying</strong></td>
<td>Provides justification of validity through explanation of thinking that lead to idea</td>
</tr>
<tr>
<td><strong>Generalizing</strong></td>
<td>Shift from a specific example to a general case</td>
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</tbody>
</table>

"Assessing the Quality and Quantity of Student Discourse in Mathematics Classrooms" Web.  
<http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1019&context=ci_fac>
A Classroom Example

“Talking Math: How to Engage Students in Mathematical Discourse” Web.
Why is mathematical discourse important?

• Builds mathematical fluency

• Establishes the student as an expert, building confidence

• Enables students to demonstrate mastery of concepts

• Allows students to share ideas which increases interest and participation

• Provides teachers an opportunity to push thinking and address gaps understanding
Mathematical Discourse

How do I encourage discourse?
Strategies to encourage mathematical discourse

• Choose tasks and/or questions that allow for multiple paths and/or multiple answers; that engage and challenge all students’ thinking in your classroom

• Encourage students to listen carefully to one another’s ideas, to disagree, and to question; shift from teacher-to-student conversations to student-to-student conversations

• Ask questions that extend student thinking; support students to clarify and justify their ideas
Choose tasks and/or questions that allow for multiple paths and/or multiple answers; that engage and challenge all students’ thinking in your classroom.
Let’s try this.

Task 1:
Find the **mean, median, and mode** of the following set of numbers: 6, 5, 5, 5, 7, 9, 11

Let’s try this.

**Task 2:**
Create a data set with at least 7 values so that the **mean** is 20, the **median** is 12, and the **mode** is 23.

“Digging Into Mathematical Discourse; Selecting and Sequencing Student Solution Samples” Web.
What did you notice?

Task 1:
Find the **mean**, **median**, and **mode** of the following set of numbers: 6, 5, 5, 5, 7, 9, 11

Task 2:
Create a data set with at least 7 values so that the **mean** is 20, the **median** is 12, and the **mode** is 23.

What is the difference in the types of discourse supported by each task?

Encourage students to listen carefully to one another’s ideas, to disagree, and to question; shift from teacher-to-student conversations to student-to-student conversations.
Mathematical Sentence Starters

Reporting a Solution
• I believe this is the correct answer because...
• I can verify my answer by...

Reporting a Partner’s Solution
• ____ shared with me that...
• ____ concluded that...

Reporting a Group Solution
• We decided/agreed that...
• We group used a different approach.

Offering a Suggestion
• Maybe we could...
• What if we...

Holding the Floor
• As I was saying...
• If I could finish my thought...
• What I was trying to say was...

Asking for Clarification
• Will you explain that again?
• How did you find your answer?

Soliciting a Response
• What do you think?
• Do you agree?

Acknowledging Others
• My plan is similar to ____’s plan.
• I agree with ____ that...

Affirming
• That’s a different way. I hadn’t thought about that
• I agree with ____ because

Disagreeing
• I don’t agree with you because...
• I got a different answer than you.
• I see it another way.

Ask questions that extend student thinking; support students to clarify and justify their ideas.
Questions to Encourage Discourse

- Encourage students to **work together** to make sense of mathematics
- Empower students to **rely on themselves** to determine whether something is mathematically correct
- Support students in learning to **reason mathematically**
- Teach students to **evaluate their own processes** and engage in productive peer interaction
- Support students with **problem comprehension**
- Teach students to **conjecture, invent, and solve problems**
- Encourage students to **connect mathematics, its ideas, and its application**
- Show students how to **persevere**
- Enable students to focus on the **mathematics in activities**
Encourage students to **work together** to make sense of mathematics

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>What strategy did you use?</td>
<td>Do you agree?</td>
<td>Do you disagree?</td>
<td>Would you ask the rest of the class that question?</td>
<td>Could you share your method with the class?</td>
<td>What part of what he said <strong>do you understand</strong>?</td>
<td>Would someone like to share _____?</td>
<td>Can you convince the rest of us that your answer makes sense?</td>
<td></td>
</tr>
<tr>
<td>What do others think about what [student] said?</td>
<td>Can someone retell or restate [student]'s explanation?</td>
<td>Did you work together? In what way?</td>
<td>Have you discussed this with your group? With others?</td>
<td>Did anyone get a different answer?</td>
<td>Where would you go for help?</td>
<td>Did everybody get a fair chance to talk, use the manipulatives, or be the recorder?</td>
<td>How could you help someone without telling them the answer?</td>
<td></td>
</tr>
<tr>
<td>How would you explain _____ to someone who missed class today?</td>
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Empower students to **rely on themselves** to determine whether something is mathematically correct.

**Questions to Encourage Discourse**

19. Is this a reasonable answer?

20. Does that make sense?

21. **Why** do you think that? Why is that true?

22. Can you **draw a picture or make a model** to show that?

23. **How** did you reach that conclusion?

24. Does anyone want to **revise** his or her answer?

25. **How were you sure** your answer was right?

Questions to Encourage Discourse

Support students in learning to **reason mathematically**

- **26** How did you begin to **think** about this problem?
- **27** What is another way you could solve this problem?
- **28** How could you **prove** _____?
- **29** Can you explain how your answer is different from or the same as [student]’s answer?
- **30** Let’s **break the problem into parts**. What would the parts be?
- **31** Can you explain this part more **specifically**?
- **32** Does that **always work**?
- **33** Can you think of a case where that **wouldn’t work**?
- **34** How did you **organize** your information? Your **thinking**?

Teach students to **evaluate their own processes** and engage in productive peer interaction

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Help students with **problem comprehension**.

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</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>What is this problem about? What can you <strong>tell me about it</strong>?</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Do you need to <strong>define</strong> or <strong>set limits for</strong> the problem?</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td><strong>How would you interpret</strong> that?</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td><strong>Could you reword that in simpler terms?</strong></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td><strong>Is there something that can be eliminated or that is missing?</strong></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td><strong>Could you explain</strong> what the problem is asking?</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td><strong>What assumptions</strong> do you have to make?</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td><strong>What do you know</strong> about this part?</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td><strong>Which words were most important? Why?</strong></td>
<td></td>
</tr>
</tbody>
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Help students learn to conjecture, invent, and solve problems.

Help students to connect mathematics, its ideas, and its application.

Help students **persevere**.

Question to Encourage Discourse:

1. Have you tried making a **guess**?
2. Would another **method** work as well or better?
3. Is there another way to draw, explain, or say that?
4. What else have you tried?
5. Give me another **related problem**. Is there an easier problem?
6. How would you **explain** what you know right now?

Help students focus on the **mathematics from activities**.

1. What was one thing you learned (or two, or more)?
2. Did you notice any patterns? If so, describe them.
3. What **mathematics topics** were used in this investigation?
4. What were the **mathematical ideas** in this problem?
5. What is mathematically **different about these two situations**?
6. What are the **variables** in this problem? What stays **constant**?

For questions after the webinar, please email monisha.Karnani@dc.gov
Invite a colleague into your classroom to scribe student conversations while you teach.

- In looking at the student dialogue, **what do you notice?**

- What **types of discourse** are your students engaging in?

- How can you **elevate the quality and quantity of mathematical discourse** in your classroom?
The OSSE Teaching and Learning Team offers a wide variety of professional development opportunities.

Ways to stay informed:

1. LEA Look Forward Weekly Newsletter
   osse.dc.gov/newsroom/newsletters

2. Teaching and Learning PD Calendar
   osse.dc.gov/publication/2016-17-school-year-k-12-program-calendar

3. OSSE Events Calendar
   osse.dc.gov/events
Thank you!

Please submit any additional questions to OSSE via the OSSE Support Tool or to OSSE.tta@dc.gov

Next Monthly Webinar:

Wednesday, March 29, 2017

Topic: Math Anxiety