## Developing Mathematical Thinking with Effective Questions

### What teachers should know about questioning in the math class

Asking questions that motivate student reflective thinking is an art. If our lessons are to be effective, we need to develop this art. It takes practice. As with most arts, there is not a set of hard and fast rules that work in all situations all the time, but here are some general effective ideas to keep in mind for most times.

<table>
<thead>
<tr>
<th>Build in...</th>
<th>Phase out...</th>
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<tr>
<td>• Use effective pauses and wait time.</td>
<td>• Avoid frequent questions that require only a yes/no answer or simple recall.</td>
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<td>• Follow up student responses with questions and phrases such as, “why?” or “tell me how you know” or “think about how you can put Jim’s response into your own words.”</td>
<td>• Avoid answering your own questions</td>
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<td>• Follow up a student’s response by fielding it to the class or to another student for a reaction.</td>
<td>• Avoid directing a question to a student mainly for disciplinary reasons</td>
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<td>• Make it easy for students to ask a question at any time.</td>
<td>• Avoid giveaway facial expressions to student responses</td>
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<td>• Ask the question before calling on a student to respond.</td>
<td>• Avoid calling on a particular student immediately after asking a question.</td>
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<td>• Ask questions that are open-ended.</td>
<td>• Avoid labeling the degree of difficulty of a question.</td>
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<td>• Leave an occasional question unanswered at the end of the period.</td>
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<td>• Replace or enhance “lectures” with a set of appropriate questions.</td>
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### Questions to SEELDOM ask

Even though you do want to know the answers to these questions, the way these questions are phrased probably won’t get you very far in learning what you want to know.

- “How many of you understood that?”
- “You want me to go over that again?”
- “Do you have any questions?”
- “Everybody see that?”
- “This is a right triangle, isn’t it?”

### Questions That Need Enhancing

Use Yes-no, true-false, and one-word-answer questions with special care the math classroom. These questions do not provide much information to check students’ reasoning. If you do use these question types, add these phrases for enhancing questions.

- “Tell me more about what you were thinking.”
- “How did you decide that?”
- “Elaborate for others in the class so they can check their thinking.”
- “Can you justify that?”
- “Give us your insights about arriving at the answer.”
- “What steps did you take?”

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**Phrases That May Fail to Motivate**

These phrases permit students NOT to participate – that is, students are not required to take responsibility to develop a response depending how the question is phrased.

- “Can anyone here give me an example of...”
- “Who knows the difference between...”
- “Someone tell me the definition of...”

**Phrases That Encourage Participation**

It’s useful to have a handful of effective ways to start your questions that will motivate all students to participate.

- “Don’t raise your hand – yet; just think about a possible answer. I will give you a minute...”
- “Everyone: Picture this figure in your mind. Can you sketch a possible counterexample to this statement? I will walk around to look at your work and select 3 students to share with the class.”
- “Find an example for this statement and write it down. In a minute I will tell you possible ways to check your example to see if it indeed makes the statement true.”
- “Put the next step on your paper and write a reason to justify this step. Raise your hand when you are ready and I will be around to see what you’re thinking.”
### Effective Questioning By Purpose In The Math Classroom

#### To promote problem solving
- What do you need to find out?
- What information do you have?
- What strategies are you going to use?
- What do you think the answer or result will be?

#### To check student progress
- Can you explain what you have done so far? What else is there to do?
- Why did you decide to use this method?
- Can you think of another method that might have worked?
- Is there a more efficient strategy?
- What do you notice when...?
- Why did you decide to organize your results like that?
- Do you think this would work with other numbers?
- Have you thought of all the possibilities? How can you be sure?

#### To help when students get stuck
- How would you describe the problem in your own words?
- What do you know that is not stated in the problem?
- What information do you have?
- How did you tackle similar problems?
- Could you try it with simpler numbers? Fewer numbers?
- Would it help to create a diagram? Make a table? Draw a picture?
- Can you guess and check?
- What did other members of your group try?

#### To help students build confidence and rely on their own understanding
- Why is that true?
- Does that make sense?
- How did you reach that conclusion?
- Can you make a model to show that?

#### To make connections among ideas
- How does this relate to...?
- What previously learned ideas were useful in solving this problem?
- Can you give me an example of...?

#### To encourage conjecturing
- What would happen if...? What if not?
- Do you see a pattern? Can you explain the pattern?
- What are some possibilities here?
- Can you predict the next one? What about the last one?

#### To help students learn to reason mathematically
- Is that true for all cases? Explain.
- Can you think of a counterexample?
- How would you prove that?
- What assumptions are you making?
Effective Questioning By Purpose In The Math Classroom

To encourage reflection
- How did you get your answer?
- Does your answer seem reasonable? Why or why not?
- Can you describe your method to us all? Can you explain why it works?
- What if you had started with... rather than...?
- What if you could only use...?
- What have you learned or found out today?
- Did you use or learn any new words today? What do they mean? How do you say them?
- What are the key points or big ideas in this lesson?

To help students collectively make sense of mathematics
- What do you think about what _____ said? Do you agree? Why or why not?
- Does anyone have the same answer but a different way to explain it?
- Can you convince the rest of us that your answer makes sense?