

## Handout 3: Five principles for effective questioning

### 1. Plan to use questions that encourage thinking and reasoning

Really effective questions are planned beforehand. It is helpful to plan *sequences* of questions that build on and extend students' thinking. A good questioner, of course, remains flexible and allows time to follow up responses.

|   |   |
|---|---|
| Beginning an inquiry                                  | <ul style="list-style-type: none"> <li>• What do you already know that might be useful here?</li> <li>• What sort of diagram might be helpful?</li> <li>• Can you invent a simple notation for this?</li> <li>• How can you simplify this problem?</li> <li>• What is known and what is unknown?</li> <li>• What assumptions might we make?</li> </ul>  |
| Progressing with an inquiry                           | <ul style="list-style-type: none"> <li>• Where have you seen something like this before?</li> <li>• What is fixed here, and what can we change?</li> <li>• What is the same and what is different here?</li> <li>• What would happen if I changed this ... to this ... ?</li> <li>• Is this approach going anywhere?</li> <li>• What will you do when you get that answer?</li> <li>• This is just a special case of ... what?</li> <li>• Can you form any hypotheses?</li> <li>• Can you think of any counterexamples?</li> <li>• What mistakes have we made?</li> <li>• Can you suggest a different way of doing this?</li> <li>• What conclusions can you make from this data?</li> <li>• How can we check this calculation without doing it all again?</li> <li>• What is a sensible way to record this?</li> </ul> |
| Interpreting and evaluating the results of an inquiry | <ul style="list-style-type: none"> <li>• How can you best display your data?</li> <li>• Is it better to use this type of chart or that one? Why?</li> <li>• What patterns can you see in this data?</li> <li>• What reasons might there be for these patterns?</li> <li>• Can you give me a convincing argument for that statement?</li> <li>• Do you think that answer is reasonable? Why?</li> <li>• How can you be 100% sure that is true? Convince me!</li> <li>• What do you think of Anne's argument? Why?</li> <li>• Which method might be best to use here? Why?</li> </ul>   |
| Communicating conclusions and reflecting              | <ul style="list-style-type: none"> <li>• What method did you use?</li> <li>• What other methods have you considered?</li> <li>• Which of your methods was the best? Why?</li> <li>• Which method was the quickest?</li> <li>• Where have you seen a problem like this before?</li> <li>• What methods did you use last time? Would they have worked here?</li> <li>• What helpful strategies have you learned for next time?</li> </ul>   |

## 2. Ask questions in ways that include everyone

It is very important that everyone is included in thinking about the questions asked. Here are three ways that teachers have tried to achieve this:

- **Use a 'no hands up' rule.** After a few hands have gone up some students stop thinking because they know that the teacher will not ask them. When students have their hands up they too stop thinking as they already have the answer they want. 'No hands up' encourages everyone to keep thinking as anyone may be called upon to respond.
- **Ask questions that encourage a range of responses.** Rather than asking for specific right answers, ask for ideas and suggestions: "How can we get started on this?", "What do you notice about this?" Everyone will then be able to offer a response.
- **Avoid teacher - student - teacher - student 'ping pong'.** Encourage students to listen to and to reply to each other's responses. Aim for a pattern more like: teacher - student A - student B - student C - teacher.
- **Arrange the room to encourage participation.** Think about where students are sitting – are there some who cannot hear? Can students see and hear one another so that they can respond to the points another student makes? It is often better to sit students in a U-shape, if possible.

## 3. Give students time to think

The time interval between a teacher asking a question and supplying the answer herself, or following up with an additional question or comment, is commonly called 'wait time'. For many teachers, the mean wait time is less than one second (Rowe (1974)<sup>1</sup>). When teachers increase this wait time to between three and five seconds the research shows that students begin to:

- respond at greater length and with greater confidence;
- offer more unsolicited, but appropriate, responses;
- offer more diverse, alternative explanations;
- relate responses to those from other students.

Increasing wait time is difficult. Silence in a classroom can be hard to bear!

- **Talk to students about 'wait time'.** Make sure that students *know* that they must take time to think before responding. (Some teachers even make themselves wait by counting slowly to themselves: "One, two, three, four, got to wait a little more"!)
- **Use "Think - Pair – Share".** Ask the question, give 10 seconds thinking time and then allow 30 seconds for talking to a partner. After this, everyone should be ready with an answer and they should know that anyone may be asked for what they think.
- **Use mini whiteboards.** Ask the students to spend 30 seconds thinking about the problem and jotting ideas for the solution onto their mini whiteboards. Then ask the students to share the ideas they had for starting the problem

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<sup>1</sup> Rowe, M. B. 1974. 'Wait time and rewards as instructional variables, their influence on language, logic and fate control'.

#### 4. Avoid judging students' responses

Interestingly, Rowe (1974) found that if a teacher made judgmental comments, even positive ones such as "Well done!", then this negatively affected students' verbal performance even with the lengthened wait times. Task persistence was greatest where verbal rewards were fewer. When a teacher judges every response with 'yes', 'good', 'nearly' and so on, students are likely to reason to themselves:

"The teacher said that was good. That is not what I was going to say. So what I was going to say cannot be good. So I won't say anything."

Ask open questions that permit a greater variety of responses and reply to students with comments that do not close off alternative ideas.

"Thank you for that, that is really interesting. What other ideas do people have?"

#### 5. Follow up students' responses in ways that encourage deeper thinking

The following approaches encourage further thinking and dialogue:

|   |  |
|---|--|
| <b>Ask students to repeat their explanation</b> | <ul style="list-style-type: none"><li>• Can you just say that again?</li></ul>                             |
| <b>Invite students to elaborate</b>             | <ul style="list-style-type: none"><li>• Can you just say a little more about that ...</li></ul>            |
| <b>Challenge students to offer a reason</b>     | <ul style="list-style-type: none"><li>• Can you explain why that works?</li></ul>                          |
| <b>Cue alternative responses</b>                | <ul style="list-style-type: none"><li>• Can you suggest another way of doing this?</li></ul>               |
| <b>Support with non-verbal interest</b>         | <ul style="list-style-type: none"><li>• Nod head, rotate hand to indicate that you want more ...</li></ul> |
| <b>Encourage students to speculate.</b>         | <ul style="list-style-type: none"><li>• What would happen if ...?</li></ul>                                |
| <b>Make challenging statements</b>              | <ul style="list-style-type: none"><li>• Someone in this group said ... were they right?</li></ul>          |
| <b>Allow rehearsal of responses</b>             | <ul style="list-style-type: none"><li>• Try out the answer on your partner first.</li></ul>                |
| <b>Encourage students to ask questions</b>      | <ul style="list-style-type: none"><li>• Would anyone like to ask Pat a question about that?</li></ul>      |
| <b>Ask students to think aloud</b>              | <ul style="list-style-type: none"><li>• Can you go through that step by step?</li></ul>                    |
| <b>Encourage students to make connections</b>   | <ul style="list-style-type: none"><li>• Can you remember something else we did like this ...?</li></ul>    |
| <b>Thinking aloud with students</b>             | <ul style="list-style-type: none"><li>• Let's think this through together ...</li></ul>                    |

# THE ART OF QUESTIONING IN MATHEMATICS

From The NCTM Professional Teaching Standards

## HELP STUDENTS WORK TOGETHER TO MAKE SENSE OF MATH

- “What do others think about what \_\_\_\_\_ said?”
- “Do you agree? Disagree? Why or why not?”
- “Does anyone have the same answer but a different way to explain it?”
- “Would you ask the rest of the class that question?”
- “Do you understand what they are saying?”
- “Can you convince the rest of us that that makes sense?”

## HELP STUDENTS TO RELY MORE ON THEMSELVES TO DETERMINE WHETHER SOMETHING IS MATHEMATICALLY CORRECT

- “Why do you think that?”
- “Why is that true?”
- “How did you reach that conclusion?”
- “Does that make sense?”
- “Can you make a model and show that?”

## HELP STUDENTS TO LEARN TO REASON MATHEMATICALLY

- “Does that always work? Why or why not?”
- “Is that true for all cases? Explain?”
- “Can you think of a counter example?”
- “How could you prove that?”
- “What assumptions are you making?”

## HELP STUDENTS LEARN TO ANALYZE, INVENT, AND SOLVE PROBLEMS

- “What would happen if \_\_\_\_\_? What if not?”
- “Do you see a pattern? Explain?”
- “What are some possibilities here?”
- “Can you predict the next one? What about the last one?”
- “How did you think about the problem?”
- “What decision do you think he/she should make?”
- “What is alike and what is different about your method of solution and his/hers?”

## HELP STUDENT CONNECT MATHEMATICAL IDEAS AND APPLICATIONS

- “How does this relate to \_\_\_\_\_?”
- “What ideas that we have learned before were useful in solving this problem?”
- “Have we ever solved a problem like this one before?”
- “What uses of mathematics did you find in the newspaper last night?”
- “Can you give me an example of \_\_\_\_\_?”