

## 2. THE ART OF QUESTIONING

### The trouble with one-on-one

How can you tell if your students are really paying attention? And how do you find out if they understand the material you're teaching? Obviously, you ask questions. But is it that simple? Here's the way it worked when I was first teaching and using a traditional one-on-one questioning method.

I would call on *one* student to answer a question. If that student gave the right answer, I would go on with my teaching or ask some more questions. If the student gave the wrong answer, I would call on another student, and another, until I heard the right answer. If I didn't get the correct answer soon enough, I would often become impatient and answer the question myself. Or I might ask cleverly, "The answer is  $\frac{1}{2}$ , isn't it, class?" At that point a few students would say yes and nod their heads. After all, what students would want to disagree with me, especially if they didn't understand why or how I came up with that answer?

What meager feedback I was getting! All I really learned was whether one student, the one who usually volunteered, knew the answer. I wasn't learning anything about how much the majority of the students really understood. When I finally realized this, I knew I had to change my method of questioning.

I now try to involve *all* students with my questions, not just one at a time. I also try to ask the type of question that will tell me, and the students themselves, how well they really understand what is being taught. I make an effort to be encouraging in my questions. Nobody likes to feel stupid, and unfortunately that's not an unusual feeling when you're trying to learn something new. I also do everything I can to promote both listening

and discussion. None of this is easy. Learning the art of questioning takes practice. I save myself some trouble by taking the time to prepare questions for each objective I plan to teach, then keep those questions for the next time I'll be teaching that same objective.

### A "try-to" list

To help myself keep on track with my questions, I have devised a "try-to" list of things to keep in mind during the class period.

1. *Try to pause after asking a question.* A recent survey indicated that many teachers ask a question, then pause only one second before calling on a student for the answer. This habit limits the type of student who can respond. A pause of three to five seconds or even more will bring amazing results. Now the slow thinker will be able to participate. The pause clearly indicates that the question is directed to everyone, not just to one or two of the quick-thinkers and hand-raisers. Most students will not even try to answer a question unless they feel safe or sure of the answer. The longer pause gives them time to think carefully and gain confidence before responding.

2. *Try to avoid frequent questions which require only a yes or no answer.* Even when the student gives the correct response, there is nothing to tell me or the other students *how* the answer was obtained. It may have been a guess. After all, the odds aren't bad!

3. *Try to avoid answering my own questions.* I often used to answer my own questions when no one had volunteered or when I was running short of time. This led students to believe that they were not obligated to respond. They realized that if they didn't volunteer, I would give them the answer. My questions and answers turned into part of a lecture.

4. *Try to follow up student responses with the question "why?"* This will help the student who could not answer the initial question to understand how the answer was reached. It also encourages discussion by the students. It eliminates guessing. Hearing a short answer is rarely helpful in itself. "Why?"

ought to be one of the most commonly used questions in the classroom.

5. *Try to limit the use of questions which rely almost completely on memory.* Students may be perfectly able to recite an answer such as “Association Law,” but this does not mean they can recognize the law or apply it to a new situation.

6. *Try to avoid directing a question to a student for disciplinary reasons.* Firing a quick question at an inattentive student usually results in a response such as “What?” It accomplishes little, and will probably just alienate that student.

7. *Try to avoid repeating a student’s answer.* Repeating the answer allows students to listen only to “teacher talk” and not to “student talk.” They can learn a lot by listening to each other. There will be times when I might be able to state the answer more directly, but not necessarily more effectively.

8. *Try to follow up a student’s response by fielding it to the class or to another student for a reaction.* This is another way to encourage students to listen to one another.

9. *Try to insist on attentiveness during question periods.* I want all students to learn to listen — to me, to each other, to everyone.

10. *Try to avoid giveaway facial expressions to student responses.* I try not to show disappointment when a student gives an incorrect answer. Nobody wants to give the wrong answer in front of his or her peers. If a student has volunteered, at least that student has tried. He or she has the courage to share an answer with the rest of the class. My reactions should not in any way discourage the students from contributing to class discussions.

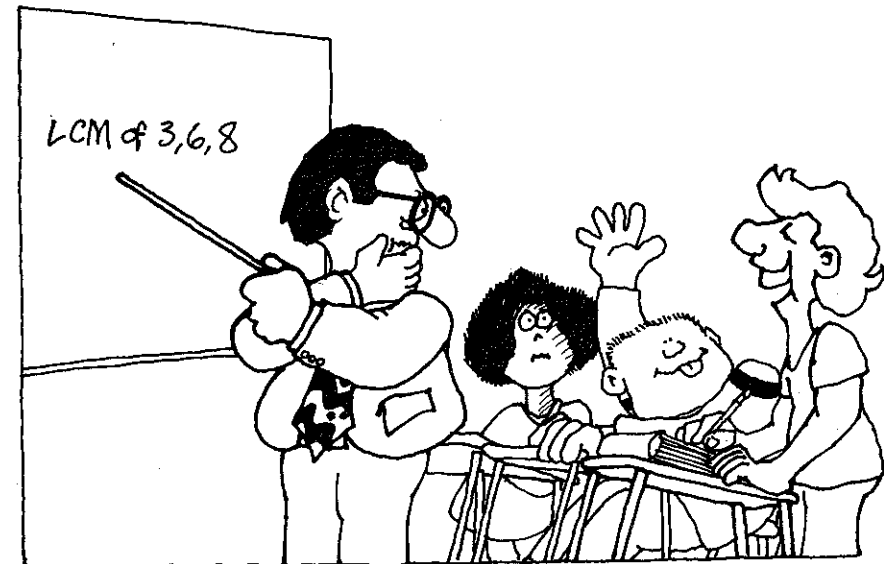
11. *Try to make it easy for students to ask a question at any time.* When I’m trying to make a point in class, the last thing I need is interruptions — and that’s what student questions often are. I try to be patient when this happens. Even though these questions may not come when I want them, they may show that the students are puzzled and need more explanation of something I have assumed they understood.

12. *Try to avoid asking questions that contain the answer.* Here are some examples of questions that really aren’t questions at all. Perhaps you recognize them.

- “This is a right triangle, isn’t it, class?” (Few students are going to challenge my judgment of a right triangle.)
- “Now, you will have to find the lowest common multiple first, won’t you?”
- “A two-termed polynomial has the prefix *bi*. What’s its name?”

13. *Try never to call on a particular student before asking the question.* Suppose I say, for example, “Chris, what is the height of this triangle?” All students other than Chris will immediately turn off my question and wait until I ask another one. I want *all* students to listen to my question and be ready to answer it.

14. *Also try not to call on a particular student immediately after asking a question.* It’s no good to ask, “What’s the height



Try to avoid giveaway facial expressions when a student gives an incorrect answer.

of the triangle, Chris?" This gives the same result as calling on the student *before* asking the question. The other students will tune out the question immediately upon hearing Chris's name. As mentioned earlier, I try to pause after asking each question.

15. *Try to ask questions that are open-ended.* I might ask, for example, "Which is greater,  $(b)$  or  $(-b)$ ?" Students trying to answer this will soon discover that there is no single right answer. A question like this can provoke a lively discussion, leading students to a greater understanding of variables and negative numbers.

16. *Try not to label the degree of difficulty of a question.* How many times have I said, for example, "Here's an easy one!" Think for a minute about that phrase and what it does to the student. A student who answers the question correctly can't feel much satisfaction, thinking, "So what? It was easy." A student who *can't* answer the question is going to feel even worse: "Why try? I can't even answer an easy question!"

17. *Try to leave an occasional question unanswered at the end of the period.* When I do this, I challenge the students to look for a possible solution. It is important that the question be appropriate to the type of student and type of class. It is also imperative, of course, that the answer be discussed and explained the next day.

18. *Try to replace lectures with a set of appropriate questions.* With guidance, students can *discover* the same ideas that I had planned to give them in a lecture. Formulating the right questions for this approach is a real challenge. It requires experimentation and practice. You'll know it's worth it when you see the pride students take in answering these guided discovery questions.

19. *Try to avoid asking for verbal group responses.* The accuracy of the feedback I get from this is questionable. I might ask, for example, "The sum of  $7x$  and  $5x$  is what, class?" And I hear the entire class respond in a routine tone, " $12x$ ." But do they really all understand? When I listen carefully to this group response, I discover that some students respond quickly. Others join in later, and those who are very unsure of the

answer join in at the end. It is difficult for me to tell how many students really know the answer is  $12x$  by listening to a group response.

20. *Try to keep the students actively involved in the learning process.* If students really mastered mathematics just by listening, I would have been replaced by a tape recorder long ago.

One of the best questioning guidelines of all came from Peter, a former student of mine. Peter met with me after our first class. We had a brief discussion about the course goals, then he closed the conversation with a comment that I have tried to remember in each class I have taught since then. His comment offered a real challenge to me. I pass the challenge on to you:

"In your mathematics class, Mr. Johnson, I hope you will never tell me anything that, with your direction and questioning, I could have told you."

### Questions I seldom ask

How many of you understood that?

Few students, especially those with a lack of confidence or those not doing well, are going to confess in front of an entire class that they don't understand. I must employ more effective teaching techniques to find out if my students understand a particular concept, rather than just asking them.

Everybody see that?

This kind of question doesn't elicit much of an answer. Asking such rhetorical questions can actually work against me, as students begin to ignore all my questions or treat them as statements.

You want me to go over that again?

A frightening thought has occurred to me that some students didn't want me to go over the material in the first place.

Did I go too fast for you?

Naturally students always shout, "No, go faster, please!"

This is a right triangle, isn't it?

Another rhetorical question. It would be better to say simply, "This is a right triangle."

Right?

Again, do I really expect an answer here? Most students will not have enough courage to respond to the question in any meaningful manner.

Do you have any questions?

Only a few students will have enough confidence to ask questions when they are confused. With the use of pencil-and-paper responses (further described below), I can find out from *written* responses who doesn't understand. This way no student is embarrassed by having to admit publicly, "I just don't get it."

### Getting better student responses

Part of the art of questioning is knowing how to interpret student responses. This includes being sensitive to the number of responses I'm getting. If no one raises a hand, it is possible that no one knows the answer. If two people raise their hands, it is possible that only two people really know the answer. It is *not* safe to suppose that just because a few students can answer a question, the rest of the class could answer it, too. It is tempting to assume that the rest of the class is just too lazy to volunteer, but that's probably a false assumption. Students generally vol-

unteer if they are confident or feel safe in answering a question. They rarely pass up the opportunity to show that they really know something. To excuse low participation on the grounds that students are "just naturally shy" is oversimplifying the problem. A lack of volunteering could well mean a lack of understanding.

There is one good way to get around low participation: use a paper-and-pencil method of response. Here's how it works. Students have pencil and scratch paper in front of them at all times. *All* times means as soon as they sit down. This takes a bit of practice at first, but before long you'll find students ready to work when the bell rings. Then as I begin questioning I might say, for example, "On your paper, write the factors of 24." *Pause!* "Show me what you have written." I then circle around the room to spot-check answers. The change to a U-shaped seating arrangement makes this kind of check possible in just a few seconds. After checking their responses, I know whether or not each and every student can find the factors of 24. This gives me much more information than I would get by asking one student to respond to my question. If my check shows that most students have answered the question correctly, I proceed with the lesson. If only a few students have answered the question right, I know I must review the objective.

There are several advantages to this method of response. It increases student responsibility because all students are obligated to participate, each student writing a response on paper. As a result, attentiveness also increases; everyone is busy thinking because the question has been directed to all students. The slower students have a chance to participate because they have time to think. Also, it becomes safe for a student to make a mistake. No one is embarrassed because of a wrong answer.

With my spot-check of written answers, I discover which students need help, and in a very short time I have a good sense of the skill level of each student in the class.

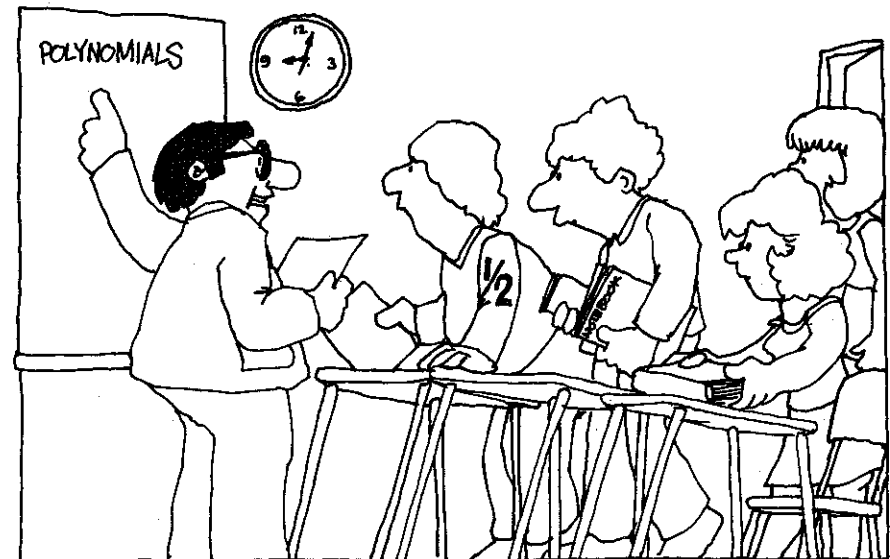
I find it's a good idea to vary the use of written and oral responses. I never rely on a single method throughout the

entire class period. But I've discovered one especially noteworthy bonus for both the teacher and the students when I use the paper-and-pencil method of response. As students begin to answer questions correctly on paper, their confidence and willingness to volunteer a verbal response increases. Those students who have never before raised their hands for fear of being wrong become a little more adventurous and are willing to take the risk of speaking up in class. Confidence is being built slowly but surely. Some of my goals are being reached.

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The first five minutes.