

LISTEN—REALLY REALLY LISTEN: TROUBLESHOOTING STUDENT CONFUSION

Henry Gurr

When I began my career as a physics educator, I wondered, "How can I communicate the power and beauty of physics to students who have such negative ideas about math and science?" With that question in mind, I attended a science education workshop led by Robert Fuller of the University of Nebraska, Lincoln. Fuller's advice still echoes in my memory: "Listen to your students. Pay attention and really really listen." In other words, stop talking. I decided to incorporate his advice into my own teaching. After five years, many false starts and much study, I have developed a method for helping students resolve their problems, and I have used this method successfully in a wide variety of tutoring situations. This column summarizes my observations.

The root cause of a student's conceptual lock-up is usually a single misconception, which although quite obscure and debilitating to the student, will be quite easy to resolve—*once it is identified*. Typically, misconceptions arise when a student blends two similar but nevertheless distinct ideas; scrambles two ideas because of similar word spelling; reverses two concepts; learns a definition incorrectly; or makes an interpretation that is reasonable but is considerably different from the intended one.

The ways in which a student's thinking can go astray are legion and astonishingly unpredictable. When a student is confused, the instructor may feel a great urge to take over and show the student how to do the problem. But this urge must be suppressed. Any interruption in the student's chosen direction will reduce the student's ability to perform.

For the confused student, the solution to the problem is verbally inaccessible. The student cannot simultaneously listen to an explanation, no

matter how clearly presented, while trying to find the glitch in his or her own thought processes.

When a student—or anyone with whom I am communicating—asks me a question, or when I find a weak conceptualization in the student's work, I put the pencil into the student's hand and say, "Show me what you have been trying to do." I conduct the session so that the student does all the writing, calculating and drawing and nearly all the talking. In this way, the information necessary to figure out what the student knows and doesn't know flows from the student to me. I can never get ahead of the student and cause additional confusion.

During this process, I check that the student is physically active, making use of all possible senses, and is allowed to proceed at his or her own pace. I let the student's existing plan of action, erroneous as it may be, run fully to its conclusion before a new one is formulated. When the student is doing all the work of drawing, calculating and explaining the problem, he or she controls the work speed so that a firm understanding is achieved at each step. The student will stop or falter when a point of confusion is reached, thus pinpointing the problem.

A properly supported student will show many areas of competence, which I can follow and confirm. In many cases I realize that if I had the same erroneous conceptions, I would be just as confused.

As soon as I have identified the cause of confusion, I direct the student's attention to it by gestures and simple, short sentences. Sometimes I try to spark a shift in the student's thinking by using a simple example to prepare the student for a more complex one, by using the familiar to elucidate the unfamiliar or by providing an apt analog. I may use an extreme or limited case to force the student to see that he or she is wrong, thereby prompting reexamination. If the student remains perplexed, rath-

er than assuming I know the nature of the problem, I ask open-ended, oblique or tangential questions: "What does this remind you of?" "What seems to be the problem?"

As the student works on a problem, body movements and facial expressions give me important clues. Often what the student does is more revealing than what is said. What was he about to do when he pulled his hands back? Where did her eyes go during that step? Why was there a sudden shift in his body posture or rate of breathing? When did she suddenly become motionless and show a blank facial expression?

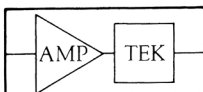
Students will often nod their heads "yes" so that the instructor will continue talking and not discover that they do not understand what the instructor is talking about. Their motivation in this is not conscious dishonesty—rather, they are afraid of embarrassment.

Because it is stressful for a student to work while an observer looks on, I watch closely for precursors of intense emotions such as anger or tears. Intense emotions also emerge when the student has built up feelings of frustration or has been unable to cope with the course, or with school in general.

When a student seems to be feeling helplessness, sadness, angry frustration or other deep emotions, I interrupt the tutoring session, indicate in vague terms that I recognize the student's feelings and then encourage the student to talk about his or her troubles. It is important to follow up on what the student has been feeling and why, because when emotional distress remains unresolved, it blocks learning. Helping the student deal with these larger problems is essential, even though they may not have an apparent relation to the course material.

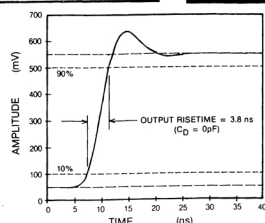
Occasionally it is necessary to divert the student's attention away from the erroneous concept so that a correct one can take hold. I often suggest taking a break, or I tell a joke, and then when

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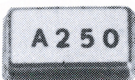
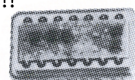
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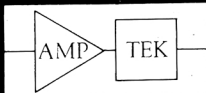
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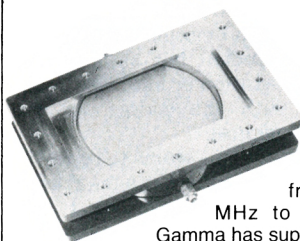
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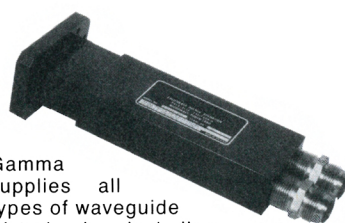
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there is relaxation and lower anxiety, we return to the problem.

Building the student's confidence by giving clear and even enthusiastic credit for progress is always helpful. Successful encouragement—in the sense of "giving courage"—comes from comments and actions that focus on the work itself rather than on the student's intelligence. Negative criticism has no place in tutoring sessions. It tends to make the student defensive, thus shifting his or her thoughts away from the problem, and it may prevent the student from returning for assistance.

In successful tutoring sessions, the student may achieve a flash of insight. These "aha!" experiences, which I find occur in about one in ten sessions, are deeply rewarding to both the student and the instructor. Once a precise area of confusion has been identified, the student may spontaneously resolve the problem at the very moment that the proper understanding clicks into place. Studies of neural functions have in fact shown that such episodes are a natural part of learning. When the flash of insight occurs, the student's previously expressionless face and rigid body posture may be replaced by blinking, smiling, sparkling eyes, an uplifted head, and laughter. She may say something like, "Ohh, now I see!" At this point the student can explain clearly what was causing the difficulty and often will give additional appropriate explanations of the same concept that was so confusing only moments before. This experience is parallel to the sudden understanding of a joke's punchline or the recognition of two images in one in a visual perception exercise. The pleasure the student gets from a flash of insight derives from the removal of his or her distress and the renewed sense of power, control and competence.

The technique I've developed not only pinpoints and resolves serious confusion in learning but also has significant long-term benefits. Because the student sees what has caused the confusion and learns through direct experience how to resolve it, he or she knows how to approach similar problems. The student realizes that what initially seems like a hopeless problem can be cleared up with a pleasant and empowering flash of insight. He or she is more prepared to assist fellow students and more willing to come to the teacher for future assistance. By really really listening, I have learned how to help students move through their confusion, and they in turn gain a sense of ownership toward the science. ■