What Are Students Really Thinking?

Stimulated recall shows that students in the same classroom use a variety of mental strategies, some of which help and some of which hinder learning.

JOHN EDWARDS AND PERC MARLAND

Focusing on the ways students think during instruction reveals a view of the learning process in which students actively interpret classroom events and engage in mental processes that either facilitate or impede their learning.

To find out what those mental processes are, researchers are using a technique called *stimulated recall*. In recent years it has been used successfully to study the mental functioning of teachers (Marland, 1979); physicians (Elstein and others, 1978); and counselors (Kagan and others, 1967), who were videotaped in their respective work environments. In subsequent interviews, the videotapes were used to prompt the subjects' recall of their thinking processes during the course of their work.

The pilot study reported here describes the classroom thinking—as revealed by stimulated recall—of four 11th grade biology students in a moderately large, rural, secondary school in North Queensland, Australia. The lessons were typically teacher-centered; the only difference was the presence of cameras. The four students were interviewed separately within half a day following three separate lessons. Recall of the students' thinking was stimulated by viewing a split screen videotape of the teacher and themselves at study during the respective lessons.

What Students Think About

Information processed by the four students during classroom instruction showed a remarkable diversity but typically was related to three sources:

1. Classroom events involving the teacher and students.
2. Events and topics discussed with neighboring students.
3. The private, inner world of each student, where such factors as moods, feelings, interests, personal experiences, and fantasies directed his or her thinking.

Variations in how these sources interacted and overlapped, and their relative importance to the student, demonstrate the idiosyncratic nature of student learning. For instance, lesson-relevant thinking occupied anywhere from 25 to 60 percent of the lesson time. Also, since students' attentiveness rarely coincided at any stage, each student experienced a quite different lesson at the personal level.

Some educators might see this as a depressing situation. However, our interviews suggest that off-task periods

John Edwards and Perc Marland are Senior Lecturers, School of Education, James Cook University of North Queensland, Townsville, Australia.

are important, perhaps essential, because they serve:

- As a relief from intensive information processing.
- As a means of improving the concentration and clarity of on-task periods.
- As a possible means for better linking new knowledge to existing cognitive structures or for elaborating and enriching the material being learned.

A fundamental premise in understanding the teaching-learning process is that the learner determines the "received lesson" just as much as the teacher. Doyle (1977) incorporated this concept of learning into his mediating process paradigm for teaching effectiveness research, which presumes that students' covert mental processes intervene between teaching processes and student learning outcomes.

"Since student attentiveness rarely coincided at any stage, each student experienced a quite different lesson at the personal level."

From this perspective, teacher behaviors and instructional materials, rather than 'causing' student learning, influence outcomes only to the extent that they activate information-processing responses . . . which determine what a student learns (p. 171).

Tuning In, Tuning Out, and Monitoring

In our research, we found that there were times when students were receptive to the teacher, and times when their attention was elsewhere. Such shifts were often frequent during a lesson. For example, one student within a 15-minute segment reported 32 such attention shifts.

Identifying the stimuli that result in attention shifts has obvious value for classroom practice, but some students seemed relatively unaware of, or unable to articulate, what caused them to tune in or tune out. Also, some students seemed to be in more direct control of their attention span than others.

A range of personal factors seems to be primary determinants of student attention or involvement:

- Mood or mental set.
- Climatic conditions.
- Private or personal experiences.
- General attitude to the subject.
- Self-image as a biology (in this study) student.

In addition, the following general factors can help or hinder student involvement:

- Use of audiovisual materials.
- Student responses (especially from students who provide outlandish or provocative answers).
- Interaction with neighbors.

Teacher-initiated actions that generally attract student attention include:

- Using humor in the lesson.
- Staying in close proximity to the student.
- Involving students or their neighbors in the lesson.
- Talking loudly.
- Presenting interesting, challenging, or relevant work.
- Showing enthusiasm or being motivating.

Teacher-initiated actions can also cause students to tune out. These include:

- Laboring a point.
- Saying the "same old stuff."
- Dealing with material seen by students as irrelevant or trivial.

The idiosyncratic nature of the stimuli to which students responded and the overwhelming variety and unpredictability of their mediating responses ruled out any possibility of identifying consistent stimulus-mediating response patterns. Our analysis of student mediating responses to teacher questions in the three lessons revealed 68 different types of responses (Edwards and Marland, 1982). Such diversity in outcomes offers one possible reason why classroom research in such areas as questioning so often yields equivocal results.

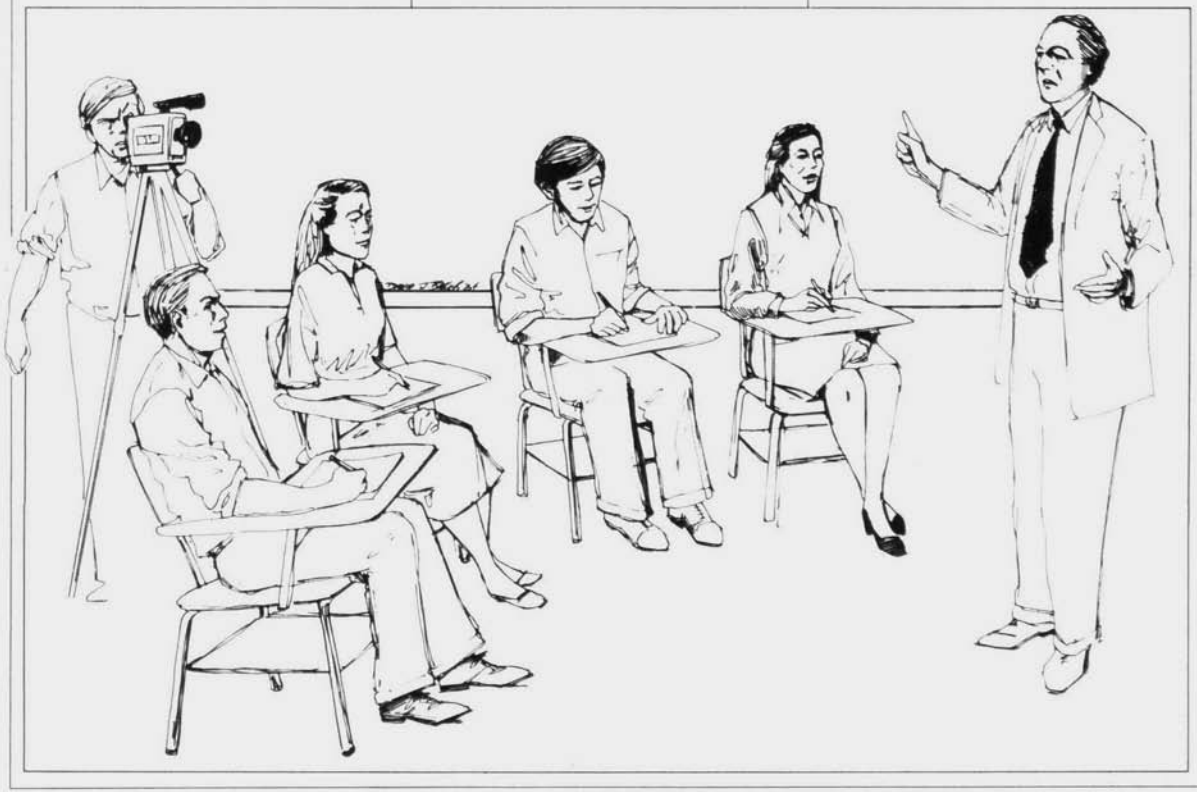
Whether tuned in or tuned out, students generally monitored other things occurring in the classroom. Monitoring teacher behavior while tuned out is a regular feature of student functioning. On some occasions students became so engrossed in their own thinking that they were oblivious to other stimuli around them, as if they had closed out all other events or detached themselves from the classroom. This seemed to occur mainly when students were engaged in deep-level processing of information. Kagan and others (1967) have observed this in teachers and refer to it as the "field detachment phenomenon."

Selective Information Processing and Lesson Control

In our study of the four biology students, student information processing was primarily selective rather than adaptive. There were occasional instances of adaptive behavior such as student-initiated questions and comments, and requests for teacher help with a problem. Students also exercised some degree of covert control through their independent learning strategies. However, they made few attempts to influence the direction of the lesson, choosing instead to sample from what the teacher offered.

This apparent unwillingness or inability of students to play a more dominant role in adapting the lesson to suit their own learning needs is a cause for concern. While some suggested that they did not redirect the lesson because they felt other students did not

"Lesson-relevant thinking occupied anywhere from 25 to 60 percent of the lesson time."



share their needs or interests, many students seemed to feel that the locus of control was totally external to them.

Student Deception Strategies

The students used a variety of deception strategies with considerable success. Generally, their goals were to:

- Create an impression of being task-oriented and attentive.
- Ensure good marks for attitude in class.
- Avoid becoming the target for questions.
- Avoid attracting the teacher's attention so that they could pursue a personal line of thinking.

Only rarely throughout the study could we infer with confidence a student's mental functioning from direct observation. We believe this brings into serious question the validity of research based on observer inference.

Student Learning Strategies

A planned outcome of this study was the identification of learning strategies students used to cope with the intellectual tasks of the classroom. The number of strategies identified in the self-report data of the four students varied markedly. One student isolated and explained over 20 different strategies (see Figure 1), while another could isolate and explain only six.

Students also differed in learning ability; in attitude toward the teacher, subject, and teaching techniques; in self-image as a biology student; in achievement motivation; and in their ability to apply themselves to a task. There were also considerable day-to-day differences in such areas as mood, mental set, and effects of previous lessons. Each factor represents a possible partial explanation for the significant range of student learning strategies. Another plausible explanation relates to differences in students' metacognitive ability; that is, their ability to think about their own thinking.

Figure 1. One Student's Strategies for Learning.

- **Evaluates answers given by other students.**
- **Formulates answers to questions asked of other students.**
- **Solves academic problems through discussing with neighbor; solicits help from teacher during or after class (if no agreement reached with neighbor); and engages teacher in debate.**
- **Tries to identify goal of teacher's or student's line of questioning.**
- **Distinguishes what he knows from what he doesn't know.**
- **Compares other student's oral answers with his own.**
- **Arranges with neighbor for both to raise hands to attract teacher's attention regarding problem (academic); discusses problem with teacher.**
- **When retrieving important information from text, divides task with neighbor (for rapid information retrieval).**
- **Analyzes task to be attempted; defines what is to be found; sets down what is known and what is not known; identifies ways of finding unknown from known.**
- **Monitors teacher's movement around class; predicts time when contact with teacher is likely.**
- **Formulates own problem and questions; discusses these with neighbor.**
- **Negotiates understanding of problems with neighbor.**
- **Chooses location in class (front row) where contacts with teacher can be made frequently.**
- **Asks teacher questions about areas of direct interest in lesson or areas related to lesson.**
- **Uses logical approach in problem solving.**
- **Remains alert for teacher cues about what is important and/or examinable.**
- **Pays close attention when teacher outlines content of future lessons; prepares for these lessons by previewing new material.**
- **Preserves best answer only (uses for revision); discards less satisfactory ones.**
- **Relates new material to old to see how it fits together.**
- **Divides classroom task between self and neighbor for quicker coverage of work.**
- **"(I) set up a debate with myself or someone else to try to find out both sides of an argument; and if I'm not quite satisfied then I have a go at the teacher and try to get an argument going with him, to get him to explain his side of the argument."**

It is not possible at this stage to decide whether it is the absence of strategies, the inability of students to recognize and articulate them, or a combination of the two that represents the real picture. However, our data suggest that students do differ greatly in the skills they have available in particular situations. This raises the possibility of using focused programs to develop thinking skills in students. Recent work using de Bono's CoRT materials (Edwards and Baldauf, 1983) suggests that there is great potential in such an approach.

The Role of the Neighbor in Student Information Processing

One aspect of student information processing that stood out in this study was the major role played by the neighbor, even in contexts in which group work was neither required nor encouraged. Clearly, there was considerable interaction between each student and his or her neighbor. This interaction served a variety of pur-

poses, from assisting learning to "escaping" from the classroom.

One student used an impressive array of cooperative learning strategies with his neighbor. For example, they divided tasks to allow more rapid progress, shared findings, jointly put up their hands to coerce teacher attention, negotiated understandings, debated problems, and formulated alternative hypotheses.

Another student reported mood-convergence with her neighbor. Most of their cooperative effort in the first two lessons was directed toward "having fun," joking, talking about non-lesson-related issues, distracting each other, and distracting others. However, in the third lesson they regularly challenged and helped each other with lesson-related activities.

Much of this productive, cooperative learning was done *in spite of the teacher*, suggesting that the neighbor may be a greatly undervalued educational resource. This invites consideration of strategies such as introducing throughout the lesson regular periods of perception sharing and negotiating understanding with the neighbor.

The Value of Stimulated Recall Research

The validity of the data generated by stimulated recall research is a complex issue. To begin with, the extent to which human behavior is consciously purposive is arguable. Even accepting this, several factors remind us to proceed with caution: the ability to recall accurately and to articulate clearly, the effect of the time lapse between lesson and interviewer, the relation of post hoc justifications to situational realities, the possible effects of willingness to "please" interviewers, and the possibility of self-fulfilling prophecies. For practitioners trying to decide what credence to give to findings from this type of research, such issues are crucial.

"Only rarely throughout the study could we infer with confidence a student's mental functioning from direct observation."

When questioned about the validity of the data, the four students commented:

"Oh well, I'm not just telling you only the things I'd like you to hear."

"I'd say I told you about 95 percent of the thoughts that I actually recalled, and they were completely accurate as far as I could actually describe them."

"The camera wasn't forgotten all the time, and we weren't exactly natural, but it was sort of more on the way to what a normal classroom would be."

"You don't normally think about thinking; you only think about thinking when you're trying to. So it would be almost impossible to do it any other way. I don't know anyone who can just think naturally and remember it. I think that what I'm giving you is as close as you're going to get."

After careful study of the literature (for example, Shulman and Elstein, 1975), we were convinced that stimulated recall offered us the best access to student thinking, and the results we obtained reinforce that view. The data generated confirm the complexity of the teaching-learning process. Treatment of the data has been mostly descriptive here, and we have resisted the temptation to generalize from limited data. However, the potential for more related comprehensive studies to reveal new insights into the teaching-learning process appears impressive.

The major outcome identified by this pilot study is the need to focus on the idiosyncratic nature of student learning. While most teachers readily accept this finding, few can show how this realization manifests itself in the teaching styles they commonly use.□

References

Doyle, W. "Paradigms for Research on Teacher Effectiveness." In *Review of Research in Education, Volume 5*. Edited by L.S. Shulman. Itasca, Ill.: F.E. Peacock, 1977, p. 198.

Edwards, J., and Baldauf, R.B., Jr. "Teaching Thinking in Secondary Science." In *Thinking: The Frontier Expands*, pp. 129–138. Edited by W. Maxwell. Philadelphia: Franklin Institute Press, 1983.

Edwards, J., and Marland, P. "Student Thinking in a Secondary Biology Classroom." *Research in Science Education* 12 (1982): 32–41.

Elstein, A.S., Shulman, L.S., and Sprafka, S.A. *Medical Problem Solving: An Analysis of Clinical Reasoning*. London: Harvard University Press, 1978.

Kagan, N.; Krathwohl, D.R.; Goldberg, A.D.; and Campbell, R. *Studies in Human Interaction: Interpersonal Process Recall Stimulated by Videotape*. East Lansing: Michigan State University, 1967.

Marland, P.W. "A Study of Teachers' Interactive Information Processing." In *Proceedings of the A.A.R.E. Annual Conferences*. Edited by G. Rowley. Melbourne: A.A.R.E., 1979, pp. 42–61.

Shulman, L.S., and Elstein, A.S. "Studies of Problem Solving, Judgment, and Decision Making: Implications for Educational Research." In *Review of Research in Education, Volume 3*. Edited by F.N. Kerlinger. Itasca, Ill.: F.E. Peacock, 1975.