Improving Lectures by Understanding Students’ Information Processing

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The lecture is probably the oldest teaching method and still the method most widely used in American colleges and universities. Through the ages a great deal of practical wisdom about techniques of lecturing has accumulated. It is probable that the most effective lecturers utilize this accumulated wisdom plus their own talents in ways that are close to maximally effective. Effective lecturers combine the talents of scholar, writer, producer, comedian, showman, and teacher in ways that contribute to student learning. Nevertheless, it is also true that few college professors combine these talents in optimal ways and that even the best lecturers are not always in top form.

Why have lecturers survived since the invention of print? Why have they persisted in the face of the intrusions of radio, television, computers, and other media? Is the lecture an effective method of teaching? If it is, under what conditions is it most effective? What can be done to improve the lectures? These questions will be answered not only in the light of research on the lecture as a teaching method, but also in terms of analyses of the information-processing techniques used by students in learning from lectures.

For What Are Lectures Effective?

We do not need to lecture when concepts are available in printed form at an appropriate level for our students. In general, print presents information in a form which can be covered more rapidly and in a way more accessible for retrieval than lectures. Students using printed materials can choose their own rate of learning: They can review, they can skip; they can vary the order. The lecturer thus starts with some serious handicaps; however, not all information is available in printed form. For example, most printed sources available to college and university teachers for assignment to students are at least several years out of date by the time they are available for assignment. Lectures are particularly appropriate for helping students get up-to-date information on current research and theories relevant to topics they are studying. Moreover, lecturers may sometimes usefully summarize material scattered over a variety of printed sources, thus providing a more efficient method of conveying information than if students were to be assigned to cover these sources by their own reading. Finally, a lecturer can adapt material to the background and interest of a particular audience—material which in printed form is at a level or in a style not well suited to a particular class.

Lectures also can provide structures to help students read more effectively. In fact the lecture may help students learn to read. As Olson’s chapter in this volume indicates, the readability of material depends on the expectations brought to material by the reader. Thus, appropriate lectures can build structures and expectations that help students read material in the given subject-matter area more effectively.

Lectures also have indirect values apart from their cognitive content. Many lectures have important motivational functions. By helping students become aware of a problem, of conflicting points of view, or of challenges to ideas they have previously taken for granted, the lecturer can stimulate interest in further learning in an area. Moreover, the lecturer’s own attitudes and enthusiasm have an important effect upon student motivation. Research on student ratings of teaching as well as on student learning indicates that the

Research on the Effectiveness of Lectures

A large number of studies have compared the effectiveness of lectures with other teaching methods. As Snow and Peterson pointed out in the preceding chapter in this volume, the reviews of this research indicate that when measures of knowledge are used, the lecture proves to be as efficient as other methods. Alternatively, in those experiments involving measures of retention of information after the end of a course, measures of transfer of knowledge to new situations, or measures of problem-solving, thinking, or attitude change, or motivation for further learning, the results tend to show differences favoring discussion methods over lecture (McKeachie, 1978).
enthusiasm of the lecturer is an important factor in effecting student learning and motivation. Not only is the lecturer a model in terms of motivation and curiosity, the lecturer also models ways of approaching problems, portraying a scholar in action in ways that are difficult for other media or methods of instruction to achieve. In fact there is some evidence suggesting that one of the advantages of live professors is the tendency of people to model themselves after other individuals whom they perceive as living, breathing human beings with characteristics that can be admired and emulated.

Finally, there are values in lecturing for professors themselves. While there is little direct evidence on the point, there is certainly anecdotal evidence, as well as supporting psychological theory, suggesting that preparing and delivering a lecture is an important factor in the professor’s ability to integrate and retrieve his subject matter.

How Can Lectures Be Improved?

The message of this chapter is that one way of improving lectures is to think about how students process lectures. What are students trying to do during a lecture?

As one looks at students at a lecture and observes their behavior, the most impressive thing one notices is the passive role students have in most classrooms. Some students are having difficulty in staying awake; others are attempting to pass the time as easily as possible by reading other materials, counting lecturer mannerisms, or simply doodling and listening in a relatively effortless manner. Many students are taking notes. In most cases, when queried about their listening or note-taking habits, they report that they are primarily concerned about getting the gist of the lecture in order to be prepared for an examination. To do this they try to extract significant features from the lecture, to distill some of its meaning.

Hartley and Davies (1978) reviewed the research on note-taking and student information-processing during lectures. They report that students believe that there are two purposes for taking notes: One is that the process of taking notes will in itself help later recall; the other is that the notes provide external storage of concepts which may be reviewed when needed. The research results indicate some support for both beliefs, but note-taking has costs as well as benefits. Student strategies of note-taking differ. Some students take copious notes; others take none. We know that student information processing capacity is limited; that is, people can take in, understand, and store only so much information in any brief period of time. Information will be processed more effectively if the student is actively engaged in processing the information rather than passively soaking it up. Students’ ability to process information depends upon the degree to which the information can be integrated or “chunked”. No one has great ability at handling large numbers of unrelated items in active memory. Thus when students are in an area in which there are new concepts or when the instructor is using language that is not entirely familiar to the students, students may be processing the lecture word by word or phrase by phrase and lose the sense of a sentence or of a paragraph before the end of the thought is reached. This means that lecturers need to be aware of instances in which new words or concepts are being introduced and to build in greater redundancy as well as pauses during which students can catch up and get appropriate notes.

As is pointed out in the chapter by Snow and Peterson, brighter students benefit more from taking notes than less able students, and we believe that this is because the less able students are not able, while they write their notes, to keep what they hear in their memories, so that their note-taking essentially blocks them from processing parts of the lecture. But this is not simply a matter of intelligence; rather a student’s ability to maintain materials in memory while taking notes and even to process and think about relationships between one idea and other ideas depends upon the knowledge or cognitive structures the student has available for organizing and relating the material. Thus the background of the student in the area is probably more important than the student’s level of intelligence.

Attention

One of the factors in determining students’ information-processing is their ability to attend to the lecture. We know that individuals have a limited capacity for attending to the varied features of their environment. The individual’s total capacity for attention may vary with the degree of activation or motivation. At any one time part of the capacity is devoted to the task at hand (in this case listening to the lecturer), part is monitoring other aspects of the classroom, and part of the attention capacity may be available for other uses—in other words, it is simply spare capacity.

In determining how to allocate attention, students use various strategies. Any lecturer knows that one way of getting attention is to precede the statement by the phrase, “This will be on the test.” In addition, students listen for particular words or phrases that indicate to them that something is worth noting and remembering. Statements that enumerate or list are likely to be on tests and thus are likely to be attended to.

Changes in the environment recruit attention. The ability of changes to capture attention can work to the advantage of the lecturer. Variation in pitch, intensity, and pace of the lecture, and visual cues such as gestures, facial expression, movement to the blackboard, the use of demonstrations or audio-visual aids — all of these recruit and maintain attention to the lecture.
Architecture exemplifies a particular kind of inquiry, designing, which I conceive as a kind of making, a making of representations of things to be built. (We might also see other professions in this way; law, for example, as the making of legal decisions, or medicine as the making of diagnoses, but law and medicine tend to describe themselves in terms of analysis and technique.) Moreover, architecture is a making activity that deals with the unique case. In order to understand what architecture designers do, then, we need a special view of inquiry; one derived from reflection on the spontaneous knowing-in-action implicit in architectural making. I shall try to suggest the outlines of such a view by reference to an apparently simple example.

I ask you to imagine an architectural studio. It has been underway for a couple of months, and the students have been given a program for the design of a school. There is a design review in progress. The studio master, Quist, examines the drawings of a student, Petra. He places a piece of tracing paper over her drawing and begins to draw over it, and at the same time, to talk. His talking is neither an explanation of the drawing, nor a parallel activity. Rather, talking and drawing make up a single language. The drawing is understandable only through the talking, and the talking has no meaning without the drawing. I call this drawing and talking the language of designing.

In this dialogue, Quist sits down next to Petra and asks, "What are your big problems?"

P: I am having trouble getting past the diagrammatic phase. I've written down the problems on this list.

I've tried to but the shape of the building into the contours of the land there, but the shape doesn't fit into the slope.

Q: What other big problems?

P: I had six of these classroom units, but they were too small in scale to do much with, so I changed them to this much more significant layout (the L-shapes). It relates 1st to 2nd, 3rd to 4th, and 5th to 6th grades, which is more what I wanted to do, educationally anyway. [What I have here is a space which is more of a home base, I'll have an outside/inside which can be used and an outside/inside which can be used. Then that opens into your resource library/language thing.]

Q: This is to scale?

P: Yes.

Q: Okay. Say we have introduced scale, but in the new setup what about north-south?

(He draws his orientation diagram showing preferred orientation.)

P: This is the road coming in here, and I figure the turning circle would be somewhere here.

Q: Now this would allow you one private orientation from here, and it would generate geometry in this direction. It would be parallel.

P: Yes, I thought of 20 feet.

Q: You should begin with a discipline, even if it is arbitrary, because the site is so screwy. You can always break it open later. Now in this direction, that being the guilty and that the hill, that could then be the bridge, which might generate an upper level which could drop down two ways. (One way from the classrooms.) We get a total differentiation potential here from one end of the classroom to the far end of the other. There is the 15 feet max, right? So we could have as much as 5-foot intervals, which for a kid is maximum height, right? The section through here could be one of nooks, in here, and the differentiation between this unit and this would be at two levels. Now you would have given preference to that as a precinct which opens out into here and into here, and then of course, we'd have a wall. On the side there could be a wall or steps to relate "in" downward. Well, that either happens here or here, and you'll have to investigate which way it should or can go. If it happens this way, the gallery is northwards. But I think the gallery might be a kind of a garden, a sort of soft back area to these.

The kindergarten might go over here, which might indicate that the administration (goes) over here—just sort of like what you have here. Then this works slightly with the contours; then you might carry the gallery level through and look down into here, which is nice.

Let the land generate some sub-ideas which could be very nice. Maybe the cafeteria needn't be such a formal function, maybe it could come into here to get summer sun here and winter here.

P: Now this gallery is more a general pass-through that anyone can use.

Q: It's a general pass-through that anyone has the liberty to use, but is not a corridor; it marks a level difference from here to here; it might have steps or a ramp up to it.

P: My concern is the circulation through this way. The gallery is generating something awfully cute, but how to pass through here (the library space)?

(More examples of Quist answering questions before they are asked.)

Q: So don't think of the auditorium as a hard edge block there.

P: Where I was hung up was with the original shape. This here makes much more sense.

Q: Much more sense. So that what you have in gross terms is this (he points to his gallery). It is an artifact, the sort of thing Aalto would invent just to give it some order—he's done that on occasion. So in a very minor way that is the major thing....

A great deal might be said about these few minutes of dialogue. Here, let me mention only a few of the main features of Quist's reflection-in-action.
texts. Prequestions in the introduction of a lecture may help students to discriminate between more and less important features of lectures. For example, before a lecture on cognitive changes in aging, I ask, “Do you get more or less intelligent as you get older?” “What is a fair test of intelligence for older people?” Such questions may also help to create expectations which will enable the students to allocate their information processing capacity more effectively. If students know what they are expected to learn from a lecture, they learn more (Royer, 1977).

Body of the Lecture

In organizing the body of the lecture, the most common error is probably that of trying to include too much. As we have stressed throughout this chapter, student’s information-processing capacities are limited, and a lecturer who is expert in the field is likely to overestimate the students’ ability to grasp large blocks of material and to see relationships. Relationships which seem obvious to an expert in the field are not obvious to students, and thus lecturers very often overload the students’ capacity so that they become less able to understand than if fewer points had been presented. David Katz (1950), a pioneer Gestalt psychologist, called this phenomenon “mental dazzle.” He suggested that just as too much light causes our eyes to be dazzled so that we cannot see anything, so too, too many new ideas can overload processing capacity so that we cannot understand anything.

It seems likely that students will differ in their ability to benefit from particular kinds of sequences. As Greeno and his colleagues have shown in the studies referred to in the chapter by Heller, Larkin, and Greeno, some students do better when they are given a sequence of generalizations first and specific drill and practice sequences second, while other students do better when the specifics lead to generalizations.

Whatever the structure one uses, it is clear from research that highlighting the structure and giving students cues to the nature of organization that one is using is helpful to many students, particularly those who are lower in intelligence or more anxious (as indicated in the chapter by Snow and Peterson). Davis’ studies of outstanding lectures (1976) indicated that professors known as outstanding lecturers did two things: they used a simple plan and many examples.

Periodic Summaries Within the Lecture

From our knowledge of students’ note-taking behavior and from our theory of information processing, it seems likely that students would be able to learn from lectures if there were periodic summaries of preceding material. These give students a chance to catch up on material covered when they were not tuned in and also give them a check upon possible misperceptions based upon inadequate or misleading expectations. Moreover, such summaries can help make clear to students transitions from one theme to another so that they are aided in organizing the material not only in their notes but in their minds.

Probably one of the greatest barriers to effective lecturing is the feeling that one must cover the material at all costs. While it may seem irrational to cover material when students are not learning from it, one should not underestimate the compulsion one feels to go through one’s lecture notes. A remedy for this compulsion is to put into the lecture notes reminders to oneself to check the students’ understanding—both by looking for nonverbal cues of bewilderment or of lack of attention and by raising specific questions that will test the students’ understanding.

The Conclusion

In the conclusion of the lecture, one has the opportunity to make up for lapses in the body of the lecture. Encouraging students to formulate questions or asking questions oneself can facilitate understanding and memory. By making the oral headings visible once again, by recapitulating major points, by proposing unanswered questions to be treated in the reading assignments or the future lectures, and by creating an anticipation of the future, the lecturer can help students learn. Having suggested all this, I must admit that my own greatest problem as a lecturer is that I never seem to be ready for the conclusion until it is time to dismiss the class.

How Do Students Process the Content of a Lecture?

Let us assume that students are allocating attention appropriately to the lecture. This alone, however, does not ensure that the content of the lecture will be understood, remembered, and applied appropriately. Even though students are trying to meet the demands of the situation, they may differ in the ways they go about processing the words that they have heard. Marton, Saljo, and other researchers at the University of Goteborg have used Craik and Lockart’s (1977) differentiation of surface versus deep processing to describe differences in the way students go about trying to learn educational materials. Some students process the material as little as possible, simply trying to remember the words the instructor says and doing little beyond this. This would be described by Marton as “surface processing.” Other students try to see implications of what the lecturer is saying, try to relate what is currently being said to other information either in the lecture or in their own experience and reading. They elaborate, they translate the instructor’s words into their own. They may question. This more thoughtful and more active kind of listening is what Marton and Saljo refer to as “deep processing.” Experienced students can probably vary their strategies from verbatim memory to memory of concepts, depending upon the demands of the situation. Obviously there are times when exact recall of what the lecturer said is important, but, in general, “deep processing”
The architectural studio should be of interest to other professional schools because it represents a tradition of education for artistry, which other professions are learning increasingly to value. The paradox and predicament of learning to design have their parallels in the process by which other kinds of practitioners learn to become competent, though often outside the boundaries of the school. In other professions, too, neophytes sometimes learn to become competent through learning by doing (through practice, in the second ordinary sense of the term) coupled with criticism and coaching. There, too, the communicative processes of testing and listening, demonstrating and initiating, are centrally important.

Insofar as other professions seek to reform professional education by combining their normative curriculum with education for artistry, they have much to learn from the traditions of studio education in architecture. And to the extent that architects, practitioners and studio masters choose to reflect on their own competent doing, they are potential leaders in that much-needed process of educational reform.

NOTES

1. The material of this article is taken from my The Reflective Practitioner (Basic Books, 1983) and from a book on the education of the reflective practitioner, now in preparation which will be published by Jossey-Bass.
5. The case of Quist and Petra was recorded by Roger Simmonds as part of a study of architectural education in which he participated while he was a graduate student at MIT. His case study, of a studio, is included in Architectural Education: A Study, Vol. 2 (The Andrew Mellon Foundation and the Consortium of East Coast Schools of Architecture, 1981). This volume is distributed by the MIT Laboratory of Architecture and Planning.

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