



Listening Skills and Students' Learning in Large-Enrollment, Introductory Courses

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Introduction

Every semester I teach either one or two introductory geology courses for non-science majors. Sections of these service courses typically have between 50 and 130 students and my department usually offers two to three sections of three different courses each semester. Approximately 1000 undergraduates enroll in these courses each semester, most of them to satisfy a graduation requirement in science. These students have the option of taking a laboratory and/or a discussion section along with the lecture but the bulk of them enroll in the three-credit, lecture-only section, which means their only exposure to the course consists of a "talking head" lecture in a large room. Courses of this type are typical in science departments (at least at those in which I was a student and the ones at which I and colleagues have taught).

Large classes can be a dreadful experience for both the students and the instructors. The courses tend to be impersonal due to their size; with one hundred or more students in the room it is difficult to establish a relationship with any more than a few of them. You can "speak" to only a few students, the ones who make eye contact with you. Taking attendance is time-consuming unless you use an assigned seating plan, a practice which regiment the students and adds to the impersonal atmosphere.

An experienced lecturer can deal with some of the problems arising from attempts to teach large numbers of people. Someone who is not intimidated by the size of the group, who is enthusiastic about the subject being taught, who tries to reach out to the group by asking questions and ensuring that the students know it is allright for them to ask questions, who engages them in the material with short assignments and gives rapid feedback and encouragement, this sort of instructor becomes known in a university for the ability to teach large lectures and often has oversubscribed classes. Dubrow and Wilkinson (1984) mention the joy of listening to such people but also note that their skills are not innate; developing the energy to teach large classes in that way is a full time job, and takes years

to learn. They give a number of suggestions regarding the presentation of material and the logistics of dealing with large groups, but their discussion seems to assume that the real problem faced by instructors of large classes involves presentation. This assumption is equivalent to the belief that speaking is teaching; that if the instructor presents material carefully and enthusiastically, students will understand it and will internalize it. My experience suggests that for a variety of reasons, the communications channel we call a large lecture is “noisy” and that many students learn little in these classes regardless of how much they like the instructor.

One could argue that with the technologies available today there is no need to lecture to one hundred or more students at a time. For example, we can videotape lectures and let students view them in the university library or watch them on cable television. If we were to convey information at times convenient to the students, using modern technology, we could meet with students in small sections and concentrate on the kinds of interactions that foster critical thinking. That is, we could do these things if we could ignore the real reason we teach large sections. The basis of the argument justifying the use of large sections is economies of scale, which translates into small teaching loads, high faculty productivity, and large departmental budgets. The argument is more appropriate for an assembly line than a university because it neglects the differences in the backgrounds and abilities of the students. The assumption that teaching is just speaking and that all of the students respond to a lecture in the same manner ignores reality. Nevertheless, for economic reasons, the large lecture is not going to be abandoned. In fact, distance education technology lets us “teach” several large sections simultaneously, which lowers the unit cost of teaching the sections - an administrator’s dream. Because this format is a fact of life in some disciplines, it is important that those who use it understand its limitations.

For many years I felt that the secret of teaching science to non-science majors in introductory courses involved explaining the material without relying on prerequisite subject matter. For example, rather than merely tell students that the properties of the water molecule make possible the efficient transfer of heat from the tropics to higher latitudes, I would explain at some length what those properties were and why they have the values they do, before discussing how they facilitate the movement of heat on the planet. I felt that if the concepts from geology, chemistry and physics were presented in a seamless manner, students would not realize that this was material they once thought difficult and would be able to concentrate on principles rather than facts. Eventually, I realized that I was assuming that I could bring all students to the same level — again, the assembly line analogy. In addition, I realized that it makes no difference how clearly I explain something if the students do not know

how to put the pieces of a lecture together. Part of the problem students have in doing that is caused by the fact that they do not realize that listening well is a difficult task, nor do they realize that listening is not enough: they must think about what they hear as they hear it.

From time to time I see notes taken by students in my courses and, on a few occasions, I have seen notes they have taken in other courses. Relatively few of the examples I have seen were what I would call a good set of notes. Most of the time they consisted of lists of short statements, few of which appeared to be related to each other. Even when the notes were fairly complete, in that they contained much of what was said in the class, rarely was there any indication that the material was organized in any way. Thinking about the notes students take in lectures led me to some of the literature on the ways people process language. Because I prefer to learn by reading, I also thought and read about the different ways we respond to spoken language and written text. I found interesting discussions of story grammars in the works of Rumelhart (1975) and Meyer (1975) but their approaches seemed too complex for me to utilize in designing lectures. Halliday's (1987) discussion of the difference between written and spoken text was informative and the work of Perfetti (1987) provided a valuable link between reading skills and listening skills. Finally, to obtain some empirical data, I conducted an experiment on myself to determine how easy or difficult it is to figure out the meaning of a lecture. I wanted to know what students taking my courses and other science courses must do to succeed, so I listened to several lectures and analyzed the notes I took in them. The experiment convinced me of the need to change the way I deliver lectures. Although in the past I used some of the techniques recommended in the literature on ways to improve teaching to large groups of students (McKeachie, 1980), I did not implement them consistently, so their effect was not noticeable. Some of the things I do now to affect the atmosphere in my large sections are discussed at the end, but specific techniques are not as important as the principles behind them. Metacognitive strategies help me design lectures and have the potential to help students learn from them.

Written and Spoken Language

One reason we can make sense of text written in a very formal manner, with its attendant ambiguities and complex clause structures, is that it is presented to us synoptically. We can peruse written material in any order we choose and review it any number of times, until the meaning becomes apparent. Determining the meaning of written text is facilitated by the recognition that patterns exist beyond the level of the sentence; a variety of structures exist in written materials that signal its meaning (Cook

and Mayer, 1988). On the other hand, spoken language is presented to us serially, as a set of linked clauses, which requires careful attention to relationships between propositions if one is to establish the meaning in “real time.” Comparisons between written and spoken language are given by Halliday (1987), who recommends translating one into the other to illustrate the differences between the two. I have constructed an example of the difference between the spoken and written versions of English by using the verbatim transcript of a public meeting I conducted once that dealt with the creation of a sewer district for the private community in which I live. Some of the residents wanted assurances that the decision to install sewers would be put to a vote and not be made by a sewer district’s elected trustees. I said that if I were on that board there would be a vote. In response to the question “And if you are not on the board?” I said

“Then the other people - I don’t know. You should ask that. If we have a district and we have an election, you should find out what the attitudes of the people who are running are. And don’t vote for anyone not willing to put it up for a vote.”

That is probably typical of what should be expected after two hours of responding to questions from a hostile audience. If I had had the luxury of writing a response to a question submitted ahead of time, my response would have been something like the following.

“The people on the board will have the final responsibility. But if we create a sewer district and have an election for its trustees, before voting for any of the candidates, you should question them carefully to determine how they feel about letting the community have the final decision.”

The spoken version consists of four “phrases,” some of which are complete sentences and some of which are not. That version would not make sense to anyone who was not aware of the context. On the other hand, the written version contains two sentences, one of which contains enough background material that knowledge of the context is not too important in interpreting what is being said. A writer cannot assume that a reader is aware of context, so writers normally do not rely on context to avoid ambiguities as much as speakers do. But the context of speech often provides hints about the way its propositions are linked. Few students think that the task of taking notes may be just as difficult a task as understanding the content of the lecture because the meaning of a lecture usually seems to be clear. The reason for that is that the instructor may have been lecturing on the subject for many years and is quite good at explaining difficult concepts. The temptation is to neglect writing anything about what is obvious, a practice that causes problems weeks later when studying for a test.

Learning from Spoken and Written Media

In principle, students listening to a lecture should take notes differently than when reading a book. Notes taken during a lecture will be influenced strongly by the manner in which the words are spoken. A narrative relating a series of events should be perceived differently from an explanation, which uses internal relationships to inform. But the difference will not be apparent to many students because either they do not normally listen for such distinctions, or they have no time to think about them during a lecture.

Think about what happens during a lecture. For students to understand a sentence and get its idea into their notes, they either have to be stenographers or they have to encode the idea and put that version into their notes. They cannot possibly write each sentence spoken unless they either repeated or the instructor speaks very slowly. Some students tape lectures but they find themselves spending much more time on the course than they intended because the linear format of an audio tape prevents them from going directly to the parts of the lecture that are missing in their notes. What usually happens is that students taking notes manage to get a few words of a sentence down and then must pay attention to the next sentence, which they are listening to as they write their version of the last one. Short term memory can store about seven plus or minus two items from anywhere from three to twenty seconds. By that time the items are either considered important enough to be transferred to one's permanent memory, or they are forgotten (Abadzi, 1990). Students' notes are a surrogate for long term memory but nothing goes into their notes that has not passed through their short term memories. Unrelated items rarely are stored permanently, so unless you give students some signals to assist them in the coding process, most of them will jot down an abbreviated version of what you say, not a coded version. Abbreviated notes introduce ambiguities that can only be overcome by some indication of the structure of the spoken material - perhaps an outline, or some key words designed to link the statements to each other. Without some indication of structure, lecture notes are little more than grocery lists; they certainly are not learning tools.

Notes made from a textbook will differ from those obtained by listening to a lecture because written materials display fairly clear patterns. We may digress in a lecture without realizing it, and without the students noticing it, but the editors of a textbook discourage that practice in authors. Written text contains various structures, such as lists, definitions, comparisons, etc., that are signaled near the beginning of a paragraph (cf. Cook and Mayer, 1988). For example, a paragraph might begin with the statement "This phenomenon occurs for three reasons..." Or, the opening

sentence might have the form “This process differs markedly from the one previously discussed because...” In addition, the last sentence of a paragraph often provides a lead-in to the next paragraph. And sometimes there are cross-references to relevant material in other parts of the book (which the students can turn to immediately or put off until later). These “signals” provide information about the overall semantic structure of written materials, and when used carefully, they compensate for the sparseness of the nominal structure. In a commonly quoted comment, Goethe supposedly apologized to someone for writing a long letter, saying he did not have time to write a short one.

A carefully prepared lecture will contain some of the structures found in written text; after all, the instructor has a message to convey, and the kinds of structures we find in written text are representative of the ways academics organize their thinking. But these structures are not characteristic of the language people normally speak and hear, so students may not notice them when they are contained in a lecture. Students may not even recognize hints given during the lecture that pertain to the meaning beyond the level of the sentence because relationships between ideas tend to be subtle and are easily missed due to the pressure involved in taking notes. So, students’ notes often seem to consist of unrelated statements. Students tend to let the context they share with the instructor during the lecture lull them into a false sense of security, one which causes them to think that what they hear makes perfect sense. The explanation they hear seems clear and the ideas are all related, so a cursory set of notes seems sufficient. When students read their notes later, once the details of the lecture, the body language of the instructor, and the dialogue between the instructor and other students in the class (when that occurs) have all been forgotten, the organization of the presentation is not recoverable from what is in their notes.

Major Source of the Problem

The ability of students to learn from written materials such as a textbook or a laboratory manual, or from supplemental readings, depends strongly on the way they think about written materials. Perfetti (1987) noted that people who are not good at reading, tend to think of reading in terms of speech. That is, they approach reading as they approach listening to people speak. They view written communication serially, in terms of individual, loosely coupled statements. There is no attempt to look for subtle distinctions. Such people miss a lot because they overlook the fact that although written text tends to be sparse, there is a considerable amount of meaning packed into the sentences; the information density of written text tends to be quite high and there often exist multiple levels of meaning.

In the same manner, students who consider the formal speech in a lecture as a series of loosely coupled statements underestimate that medium. They hear statements but not relationships between the statements. In effect, they misunderstand both media.

It seems that the traditionally taught lecture course suffers from several problems: students who do not read well do not get much from the written components of the course; these students also tend to have relatively poor vocabularies, so they may not understand some of the points made in a lecture; and their lack of reading experience and proficiency makes it unlikely that these students will recognize the underlying structure of a lecture. Poor reading proficiency is not the only reason the traditional lecture is inefficient, but it should be a major contributor.

For reasons mentioned earlier, most instructors in science departments use lectures as the major component of communication with students in introductory courses, so we wonder how often students “see” beyond the immediate points made in class. How can we get students to recognize the existence of levels of understanding in what we are saying in class, and to recognize their importance? Telling them about such things does no good. We tell them things every day, things which get lost in their notebooks. Perhaps we need to think about how we would learn the material instead of concentrating on how we think the students should learn it.

Note-taking in a Lecture

More than 30 years have passed since I was an undergraduate, and what little I recall about the introductory courses I took is that they were of the “talking head” type. The instructor usually stood behind a podium and read

prepared notes to us. The notes I took in those courses were discarded long ago, so I cannot say much about how I learned at that time but I passed all of the courses, so I must have developed some strategies that were successful. Because my past experiences were not available for me to learn how I learned in large-enrollment courses, I decided that the only way to learn what students face in the kinds of courses I often teach was to attend some lectures myself. That is, I decided to learn how to take notes in the lectures of a large-enrollment, introductory course in which I was as much a neophyte as the students. I chose Psychology because I never did any course work in that area and have not made a conscious effort to learn about it since I graduated. In this experiment, I did not actually attend the classes because the lectures were available at the university library on videotape. So, on four consecutive days I viewed the tapes for four seventy-five minute lectures. One lecture was on Theo-

ries of Personality, one was on Stress, another was on Social Psychology, and the fourth was on Abnormal Psychology. They were not chosen randomly; the first three were delivered by the same instructor and the fourth by a different one. I wanted to hear the same person lecture on different topics, and I used the lecture by a different instructor for additional control.

The experience was quite interesting. All four lectures were delivered smoothly. The instructors clearly had rehearsed the presentations, and were delivering material with which they were comfortable. They did not use a teleprompter (from time to time they glanced at some index cards), but they managed to make eye contact with the audience (the camera) as completely as do the anchors on the evening television news programs, who do use one. Although no outline was shown on the screen, and very few visual aids were used, the material delivered seemed to be so reasonable as I heard it that I should have had no trouble taking coherent notes, from which I could easily prepare for a test. Yet I was satisfied with my results in only two of the four attempts. Because I often present lectures in outline form, I tried to take notes that way. That was easy to do in the first two lectures but I found it very difficult to take notes in outline form in the third and fourth lectures. My notes in those two lectures were little more than lists, each item recorded and embellished, but with no obvious relationship to previous items.

Does a Lecture Have a Semantic Structure?

The outline form that I assumed would be appropriate for lecture notes is designed for the retrieval of material organized hierarchically. This form displays clearly the relationships and relative priorities that exist between levels of the material. It provides information about the semantic structure of the material delivered. In a lecture, details are embedded within statements about principles, so in outline form, lectures combine the spontaneity of spoken language with the clause structures of written text. When the material is suitable, and when the instructor thinks about the material in this manner, taking notes in outline form should be fairly easy to do. This appears to have occurred in the first two lectures I viewed.

What about the other two lectures? If I could not take notes in outline form, perhaps the material was not hierarchical in nature. It is hard for me to imagine lecturing for seventy-five minutes without some sort of structure in mind, so I am sure that the instructors had mental maps of the material they presented, maps which organized the content in a coherent manner. But it was not obvious to me that they existed, so I probably did not organize the material in the way the instructors would have hoped.

This experiment was instructive because it showed me that even a professional student can experience difficulty in understanding the structure underlying a lecture in an introductory course. If I cannot recognize a pattern in a lecture when I am looking for one, how can I expect beginning students to do so?

I should note here that students in the Psychology course mentioned do more than watch videotapes. No more than 20% of the course involves the videotapes I watched. Students also attend discussion sessions and are expected to read sections of a textbook before viewing the tapes, so they have more opportunities and more ways to learn than I did in my experiment, and some of those opportunities and ways undoubtedly provided contexts for the material which I lacked. I am not criticizing the manner in which that course is taught; I am saying that my experience convinced me that extended oral delivery of course content (the way I have taught for many years) does not always work as well as many instructors assume.

Lecturing Introspectively

As I deliver lectures now, sometimes I try to listen to what I am saying. This kind of exercise is more instructive than listening to someone else because it shows me the difference between what is in my notes and what I actually say (and how I say it). I like to think I deliver what is in my notes, but sometimes I realize that what I am saying does not correspond to how the material appears in my notes. In addition, although most of the time the material I hear myself delivering has a structure that is clear to me, sometimes I find myself rambling and realize that I am delivering a sequence of loosely related "paragraphs." These clusters of statements are related to each other, and to the main topic, but I have noticed that I do not always remember to point out how they are related. Using the overhead projector, as I usually do, does not seem to have an effect on my delivery. I find that my delivery is not structured by what I write. Instead, the style of the delivery affects what I write. So if I ramble verbally, the written material on the screen rambles too.

It is easy to change my style when I become conscious that I am rambling, and impose onto my delivery the structure that is in my mind and my notes, but I wonder how often I do not realize when it is necessary to do that. I wonder how often my lectures consist of little more than lists of facts. How can I expect students to recognize the forest if all I present to them is a list of trees? I recall a story about Alfred Wallace, the Nineteenth Century Biologist, who illustrated the diversity of tropical rain forests by saying that if he leaned against any tree anywhere in the forest, there would not be another one of the same type within sight. The spatial scale

over which relationships between components of the forest ecosystem existed was not apparent to the eye. The relationships that define a forest ecosystem will not become apparent by just counting the trees: empiricism alone is not sufficient in science; empiricism guided by some prior knowledge is what provides insights. The tasks involved with studying a forest provide an excellent analogy for the tasks faced by students listening to a lecture. Students must be aware that the delivery is structured and must have some idea of how it is. We must communicate the nature of that structure if students are to “understand” what is said to them, as opposed to just hearing what is said. Many people, especially students, think that hearing is equivalent to understanding.

To communicate, you must establish a context. If you tell students something will be on a test, they will all write it down and note its importance. You will have connected with a schema they all use. They know it is important material. On the other hand, if you merely say the material is interesting, or even if you say it is important, without saying why, students may not connect the material with anything, in which case it will join the rest of what is in their notes, as just another statement. As an example of providing a context, when I give a class on septic systems in an Environmental Geology course, I begin by asking how many people in the room live in a house that is connected to one. Then I ask how many do not know if they use a septic system or a municipal sewer system. There are always a few who respond to the last question; waste disposal is not something people think about too often. By spending a minute or two explaining how to tell what kind of system they use and why it can be important to know, I establish a connection between the material and their lives (albeit one that is not as strong as by assuring them that the material will be on a test), and ensure that students will pay a bit more attention than to a “normal” lecture on waste disposal. Without some kind of context, little will be accomplished during a lecture to a large class.

The Efficacy of Alternative Activities

Lest I be accused of killing paper tigers, I will say here that I am aware that many instructors do not rely solely on the passive pedagogy associated with “talking head” lectures. A variety of techniques to help students maintain attention have been recommended and a number of “active” learning approaches have been promoted for a number of years. Under labels such as situated cognition, cooperative learning, and collaborative learning, cognitive scientists and educational psychologists have stressed the importance of hands-on activities and the social nature of learning. But, for at least two reasons, not all alternatives are necessarily any better at stimulating learning than the traditional lecture. First,

some techniques rely on proficiency in reading, and if poor reading skills affect one's ability to listen, they can also affect the efficiency of some alternative activities. Communication with students requires conscious attention to the problems they face in deciphering what we say. The second reason alternative activities may not be effective is that having students do something other than listen accomplishes nothing unless they are aware of how the task is going to improve their learning. They must understand how they are going to learn as well as what they will learn.

Activities that Enhance Communication with Students

There are many ways to learn but the traditional lecture format puts a premium on listening well. Perfetti (1987) suggests that this format will likely be successful only with those students who read well, so a mix of activities seems called for if we expect students to learn in large-enrollment introductory courses.

Abadzi (1990) discusses a variety of ways to provide new stimuli to maintain the attention of a class. All of the techniques are familiar to anyone who teaches large classes, but I repeat some of them and give some others in order to provide reasons for doing each one and to emphasize the importance of making students aware of how each affects their learning. Richardson (1990) claimed that merely recommending techniques in an article such as this one is a sterile exercise; the important thing is to show other instructors what principle underlies a technique so they can evaluate its effectiveness. He used the example of "wait time." If you ask a question in class and wait for an answer, the length of time you wait is a measure of the importance you give to learning what the students have to say. Wait time is more than a technique: it represents a value judgment that is communicated to the class. We probably use many techniques without realizing the subliminal messages they send or could send. The principle behind each of the techniques discussed in the next section is the stimulation of metacognitive processes in a traditional lecture course.

A Few Things That Can be Done in the Classroom

Asking questions and using examples are simple things that most instructors do. One which was recommended by Abadzi (1990) is called rearranging the material. She suggests stopping the lecture occasionally and having the students explain the material to their neighbors. Disagreements between students are of interest because they show the class how much variation there is in understanding what was said. This technique

can require a lot of class time, so the frequency at which it is used will depend on the instructor's priorities.

A very valuable technique is to have students work through an in-class exercise. During the first lecture each semester, I have my Environmental Geology class work through an exercise that is a qualitative cost-benefit analysis of a water quality problem (de Caprariis, 1985). Students fill out a form that requires them to make decisions and establish priorities. I display the class response on an overhead projector by asking for a show of hands to see how everyone responded to each part of the exercise and I plot histograms of the numbers who made each choice. The choices made are not technical; they involve the kind of environment in which each student would like to live. For this reason, all answers are "correct." This exercise shows students the wide range of attitudes about a subject (clean water) that few would consider controversial. It helps students understand the controversies over topics covered in the course such as development in wetlands.

Concluding Remarks

The activities discussed in the previous section are just a few of the many designed to cause students to think about course material for periods of time considerably longer than it takes for them to listen to a few sentences and write something about the ideas in their notes. As such, these techniques should help students to overcome some of the language problems caused by poor reading skills. One might go farther and say that such activities are necessary to improve students' learning in large-enrollment courses, whose environment is not conducive to learning. But even if they are necessary, it is not clear that they are sufficient. Bruer (1993) called such methods of stimulating learning "weak" methods, because most of them represent a general, domain-independent approach to teaching skills and are not always useful. The poorest students in a class benefit from weak methods because those students will probably benefit from any alternative approach.

Bruer (1993) noted that metacognitive strategies seem to work with all students, not just with those at the bottom end of the grade spectrum. Students learn best when they are taught in such a way that they are aware of things such as when they understand or do not understand something; when the strategies they use are working or not working; and when the answer they get is reasonable or unreasonable. He stated that the way we teach is as important as what we teach. Students learn best when they are taught to think about the process of learning, rather than about just what is being said in class. The techniques discussed in the last section can all be successful if they are used properly. They must be

considered means not ends. The techniques will not stimulate learning if it is clear to students that they are just one more thing done to break the monotony of a class. Students must be made aware that such methods are valuable and why they are. They must learn to recognize how an approach provides insights and why it does. These things will not happen unless we provide some instruction about the process. It is not enough to tell students that they must do more than memorize lecture material; we must teach them how to do more than memorize if we want them to become active learners. An instructor does not have to become an expert in Cognitive Psychology to recognize that hands-on activities alone do not make active learners; these activities will do little good unless students are aware of the principles behind them. It is necessary to make students aware that they cannot succeed by being passive recipients of information; they must monitor what they receive and interact with it and with the instructor. Only then can they be said to be learning. Only then are students likely to be successful in transferring knowledge and skills learned in one domain to another. And that kind of transfer is the main diagnostic criterion of a learned person.

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