IV. GUIDELINES FOR CLASSROOM PRESENTATION

The following sections of Rishel's book should also be read at this point:

- Cooperative Learning
- Technology
- Writing Assignments
- Using Cognitive Models (***this is very strongly recommended reading!***)
- The Active Classroom
- "What Was That Question Again?"
- Motivating Students
- Teaching Methods for Various Types of Classrooms
- Case Studies: IV, VII

We have already made many suggestions on what to do in class and mistakes to avoid. The purpose of this unit is to review some points and to discuss some more specific techniques that others have found useful.

Orderly procedures for answering questions

One natural way of fielding questions about homework is to begin by answering one question, asking for another show of hands, answering a second question, and so on. This is simple, but it carries the risk of consuming far more time than is available. As noted earlier, it is better to take all the questions first and select some of each general type in the assignment if there might not be enough time to do everything.

Most student questions are fairly standard, but in any class you can expect some that require some thought or diplomacy. The section in Rishel's book titled "What Was That Question Again?" describes questions that can be at least mildly distracting to an instructor, and it also gives some hints for dealing with such questions when they arise.

Finding the right level for instruction

A syllabus prepared by experienced instructors usually gives some valuable information (at least implicitly) about the level at which the course should be taught, but this only provides an abstract frame of reference for your actual in-class experience. As noted earlier, asking the students questions is the best way to get feedback on how well they are absorbing the material. Ideally such questions should be focused rather than general (see the discussion about speaking to the class below). When asking questions, an instructor should pause briefly before proceeding; for example, counting to ten before saying anything further is an option.

Speaking and blackboard techniques

It is natural for students to focus on learning the material and not on observing the ways

in which the instructor delivers his comments or writes them on the blackboard. Probably the most notable exceptions occur when an instructor's techniques are deficient to the point where they interfere with learning the material. Therefore it is important to be conscious of how one is using his/her voice and the blackboard and what sorts of habits can interfere with the message to be delivered. These topics are also covered in section of the UCR TA handbook (*The Next Step*) on use of space and resources (pp. 68–70).

Use of the blackboard

Experience has indicated that the quality of a TA's performance is often reflected very quickly by the use of the blackboard. Why is the blackboard so important? Many students learn better when they can see as well as hear the material. The blackboard can help organize the presentation and allow the most important points to be highlighted. Effective boardwork allows students to see how a problem is solved as well as presenting the solution to an equation or problem. Students tend to assume that the things written on the board are things that are worth writing down in their notes, and comments on the blackboard are often useful in reminding students of the objective of a lesson or helping them to catch up if they have become lost or temporarily distracted. \medskip A list of suggestions for effective blackboard use is given below. Some of these overlap with material in previous units.

1. Before the lecture, think about how your material can be conveyed visually, and be prepared to draw it on the board or to make overhead slides or handouts.
2. Begin by erasing the blackboard completely. Material left from the previous class can be distracting. Also, if some stray chalk marks are left unerased, they can often change or confuse the meaning of things you write on the blackboard; therefore it is important to be thorough when erasing.
3. Begin writing at the top of one blackboard panel, move down, and proceed to the next panel. Skipping around the blackboard, placing expressions haphazardly here and there, is discouraged. Explain what you are doing when writing. Organize your work in the same way that you would like your students to organize their notes. Scattered comments on the board not only make your presentation hard to follow, but they almost guarantee that students' notes will be confused and filled with errors.
4. Right handed persons will probably be unable to use the extreme left hand panel effectively. In any case, try not to stand in front of the material you are writing.
5. If there are more than two rows of students, avoid writing to the very bottom of the blackboard because students in the back will not be able to see. Keep the desk at the front clear of large objects that might block the students' views.
6. Don't use an eraser to simplify complicated expression because this can easily interfere with students' opportunities to take notes. Similarly, if a mistake is made in the middle of a problem and it requires major changes, it is better simply to cross out the wrong part and to redo the problem elsewhere on the board. A different color of chalk might be helpful. Remember that it will take students time to make corrections in their notes.
7. When solving a problem at the blackboard, write the page and number on the board, but do not copy the complete statement; read the problem aloud or ask a student to do

so. Write down briefly what is given and what is required. Draw pictures if appropriate, and define in writing any variables used in the solutions. Explain what you are doing and why you are doing it, carry out all computations or indicate in writing what the student is supposed to supply. Students' notes usually consist almost entirely of what you write on the board; they rarely write down what is said but not written down. Use the same notation as the book.

8. Highlight important results that you want the students to memorize by drawing boxes around them.
9. All writing must be clear and legible, with a height of at least two inches recommended. However, do not write so large that you run out of space after a couple of lines.
10. Avoid putting too many irrelevant marks on the board. Students often view everything you write on the board as important, and extraneous material merely confuses them.

Other visual aids

In a mathematics class the most widely used visual aids besides the blackboard are overhead transparencies, but videotapes and computers with output to large screens are also beginning to have an impact. Besides introducing variety into a class, they also offer another means of presenting well organized, professionally created material for the students. On the other hand, such materials cannot be used as a substitute for adequate planning; if their purpose is not made clear, they can be utterly meaningless or even confusing to the students. Here are some more specific comments on the advantages and disadvantages of various media. Overhead transparencies are simple to prepare, and they can save valuable time that would otherwise be consumed in drawing or writing complicated diagrams or charts. The major disadvantage is that students often have trouble taking notes from transparencies, especially since there is a natural tendency for an instructor to remove a transparency too quickly. Videotapes differ from lectures and readings in the same way that watching the news or a documentary on television differs from listening to the radio or reading a newspaper or magazine. Moving pictures can illustrate mathematical and physical ideas more completely than static photographs or diagrams. One disadvantage for the instructor is the time and effort needed to find or produce suitable materials. Another disadvantage is that videotapes can only be used sparingly, for otherwise students tend to get bored and start thinking that you are too lazy to prepare your own lessons. Conflicts with class notation and outdated information (*e.g.*, a statement that a computer procedure runs very slowly with a 386 microprocessor) present other potential difficulties. The introduction of computers into a mathematics classroom has enormous potential in several respects. First of all, one can use the computer to produce visual displays and interactive instructional programs in just about any subject. More important, the computer can be an invaluable aid to illustrating topics with numerical examples that are too complicated for hand calculation and graphics that require some nontrivial artistic skill (this is particularly relevant to the sorts of 3-dimensional sketches that one encounters in multivariable calculus courses). Of course, the training and preparation needed to produce computer material for the classroom is a major drawback in many cases, but advances in software promise to make this less of a

problem in the future. It is good to remember that high tech aids are supposed to be your servants and not your masters. There is no need to be intimidated by the technology, but you do need to take time to learn a bit about operating the relevant devices. On the other hand, high tech equipment should not be viewed as a replacement for good teaching on your part. The instructor is still the primary agent in the classroom, and even in the computer laboratory. If you plan to use audio-visual materials, check out the classroom well in advance to see if it contains the sorts of equipment that you need; if not, speak with the office staff and ask them to make arrangements. Needless to say, the sooner this is done the better the chance are that you will get what you need.

Demonstrations

Some general comments on this topic appear on page 84 of *The Next Step.* Most if not all of us have been in science classes where the instructor illustrated a point with a physical demonstration using suitable props. There are numerous instances in mathematics classes where a demonstration can make a geometric concept much easier for the students to grasp. Multivariable calculus courses provide a wide assortment of examples. For example, one can use a tabletop and a pointer to illustrate coordinates in 3-dimensional space, and this can often be combined with other physical props or hand motions to provide a better idea of the shape of a region than the students would obtain from a sketch on the blackboard. Likewise, if you are discussing Stokes' Theorem and its failure for the Möbius strip, it is very easy to illustrate things with a long thin strip of paper that you make into a Möbius strip in front of the class.

Contingency planning

Both audio-visual aids and demonstrations carry more risks of malfunctions than the usual means of instruction in mathematics classes. For example, computers and video players can break down at the most inconvenient times, and the bulbs in overhead projectors can burn out as soon as you switch them on. It is always good to be ready with alternative plans if unexpected difficulties arise.

Speaking before the class

Even a well prepared lecture can seem disorganized if the speaker's techniques for delivery are deficient or the speaker ignores the reaction of the audience. So here are some guidelines:

1. Write your notes in such a way that they can be referred to but not so structured that you must read from them extensively.
2. Face the class as much as possible. In particular, try to avoid talking into the blackboard. Make sure you look at all the students and not just at those near the front or middle of the room.
3. Speak clearly and slowly enough to be understood but don't exaggerate your speech unnaturally.
4. Use your voice and body effectively, varying the tone and pitch of your speech and

moving around. This can give important clues to the students about which points are particularly important. Maintain eye contact with the students, both to monitor their understanding and to convey your own feelings.

5. Do not be afraid to repeat or rephrase something, especially if it is an important aspect of the course. Some students' attention may have been distracted for any of a number of reasons, and sometimes an idea does not register until the third or fourth time it is stated.
6. Speak slowly and allow pauses so that students can catch up with note taking or pose questions. Avoid using terms that the students have not yet seen; introduce new words as such.
7. Be alert to the nonverbal reactions of the students, such as rustling, frowns, puzzled expressions or whispering. These indicate that students might not be absorbing the material.
8. Pose specific questions to the students. Asking something of the sort, "Is anyone confused about …" is more likely to get responses than "Any questions?" A more detailed discussion of various types of questions, including types to avoid, appears on pages 86–89 of *The Next Step*.
9. Mistakes are inevitable. Just make sure you explain your errors to the students, make your corrections, and then proceed.
10. Remember that interjections such as "um" or "ah" or "okay" or "like" or "you know" can become annoying and distracting. Brief silent pauses are usually better.
11. Similarly, be careful not to overuse words such as "clear" or "easy" or "obvious" or "trivial," especially in lower level courses, even if they seem extremely well justified. Think about the extent to which these will help the students master the material; they can be useful to the best students in the class, but for the weaker students they are generally useless at best and demoralizing or aggravating at worst.
12. At the end of class, try to point out where the class is now and what comes next. This can provide a useful link to the next class period(s).
13. Relax, be friendly, and try to give an air of self-confidence.

Few of us can follow all these suggestions all the time. One way to improve your lecturing style is to ask someone to view you in a regular or synthesized class session and provide feedback. Another method is to consider the questions on page 90 of *The Next Step* in the section titled, "How did your section go?" Still another method is to make a tape of such a real or simulated class session and view it later yourself.