Presentation, Correlation and Demonstration in Laboratory Work

Carl E. Schilz

Lincoln College, Lincoln, Illinois

Observation in several schools over a period of seven or eight years shows that after many decades of advance in chemical science there are two kinds of teachers in the laboratory classes of our schools and colleges, the good and the bad. The purpose of this paper is to help those who have the progress of their students at heart but have only a hazy idea of the various roles that an instructor must play in conducting a laboratory section successfully. Let us take an example that will illustrate two methods of attack, namely, the glass bending skill.

The opening session of the laboratory class usually consists of a group demonstration by the instructor of the seemingly simple operations of cutting and bending glass tubing, followed by a short practice of these arts by the students. Then five or more weeks later the teacher notices several students assembling a gas generator with tubing bends that are neither neat nor serviceable. These students may be left to struggle alone, referred to the opening exercise and told to review it, cheated of a chance to learn by the instructor who quickly bends the tubing for them, or they may each be given an individual demonstration with all the details carefully and slowly explained, each student repeating the process several times under the personal supervision of the teacher who coaches the points at which trouble is occurring until the skill is mastered.

This painstaking and time consuming process of scrutinizing the skills of each student and then patiently correcting all faulty maneuvers is the real purpose of placing an instructor in the laboratory of a beginning course in science. The method of individual demonstration should be applied to such procedures as filtration, washing, decantation, and lighting burners with only one match. (R. E. Horton in Sixth Yearbook of Department of Superintendence of New York City, page 351, lists 108 such skills that a student should acquire.) All of this means that the teacher himself must be a good technician; perhaps he will need to spend several long evenings perfecting himself, and perfection it must be for the students are quick to sense a lack of skill or confidence.

Only thus can neatness and accuracy be instilled into a class, and not until all these manipulative skills have become automatic habits can the student fix his attention on the chemical principles and relations that we wish him to become familiar with or do any thinking of an

analytical or constructive nature. It is absolutely necessary that he have both the skills and the understanding familiarity with the principles if he is to progress in the elementary or succeeding courses. The procedures may be shown to him by group demonstrations but in many cases individual instruction must follow.

Another type of group demonstration with an entirely different objective is the performance of a series of tests on a large number of materials of the same type. In such a case the students should have made the same test on several common materials until they are familiar with all the details of the manipulation. Then they can concentrate on observing, recording, and interpreting the results when the teacher runs rapidly through a large number of the tests. This procedure applies the test quickly and cheaply to a larger field than could be afforded from the standpoints of either time or cost if done individually. By covering a wide field we impress more clearly that the law is really general in its application, also we have a greater chance of hitting upon some application that is of interest to a given student. Certainly we show the tremendous extent of the field of chemistry in the world around us.

A third type of demonstration that is very useful may be called the cooperative demonstration. As an example, after having the class make the standard test for free alkali on three soaps, chosen to show the extreme cases, each student is asked to bring a small sample of his favorite soap to the laboratory. A check list is made on the blackboard to eliminate duplicates and enlarge the list of samples. It is also explained that for a satisfactory comparison test, water, which might produce a basic reaction through hydrolysis, is a better solvent to use than alcohol. They are told to dissolve about one gram in twenty ml. of water and add four drops of phenolphthalien, label the sample and place it in a test tube rack provided on the side shelf. The samples are then divided into three classes, good, bad, and medium, as determined by the depth of color. It is interesting to include some of the washing powders and chip soaps.

Here in a few minutes of cooperative work is built a demonstration of ten to twenty or more samples that would involve that many times as much work for each student if performed individually, a saving of as much as 400 times the work for a class of twenty students. Each instructor will find other cases where this method will bring an excellent survey of problems to a satisfactory conclusion.

Summarizing briefly, I have attempted to show that there is a need for four types of demonstration in the laboratory, the two types of group demonstrations by the instructor, the individual demonstration by the instructor, and the cooperative demonstration by the class, which combines the thrill and pride of intimate knowledge gained through individual work with the time and expense saving factors of group work. In addition we also teach the student the advantages obtained by pooling knowledge, a fact vital to our great industrial research departments.