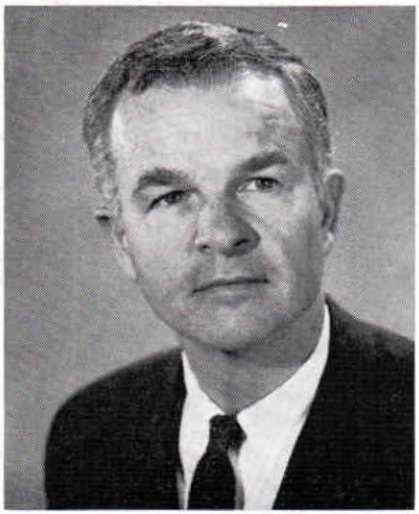
Efficiency in Technical Teaching



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An educational program is only as good as its teachers, and the quality of teachers is largely determined by their mastery of subject matter and their ability to apply any of the many and varied teaching techniques that may be used for organizing and teaching the subject matter. One who knows his subject matter may "get by" without taking the time to learn some teaching techniques, but the teacher who wants to impart the greatest amount of permanent learning to his students in the least amount of time soon finds that a little help from an expert in techniques of teaching makes it possible for him to do a much more efficient job.

One of the most perplexing problems in medical and paramedical education today is how to teach the increasing amounts of scientific and clinical skills and knowledge without increasing the amount of time the student must go to school. Perhaps the answer is to increase the efficiency of the teaching, so the students will learn more in the time now allotted to their education.

When the Prosthetics Education Program was started nine years ago, it was agreed that it would be extremely difficult to lure practicing physicians to attend a class of greater duration than five consecutive days. In fact, many predicted that attempts to get physicians to attend prosthetics classes of any length were foredoomed to failure. Thus it became accepted that no matter

what the subject—upper extremities prosthetics, above knee prosthetics, or below knee prosthetics, it had to be covered in five days—on the average about forty hours of classroom and laboratory time. It was quickly seen that the traditional leisurely lecture and note-taking methods would have to be supplanted with more efficient teaching techniques if the course objectives were to be achieved.

For example, in the session on upper extremities prosthetics components, the objective was to develop in the students knowledge and understanding of the nomenclature, appearance, function, and application of each of several dozen units such as terminal devices, elbows, hinges, wrist units, and the like. Hours were spent passing the parts around the class, lecturing about them, and trying to get the students to sketch and take notes about each one. The members of the class tended to sit passively, listening to the lecturer, after a few desultory attempts to make drawings and take notes. An objective test was given at the end of the session, and the results indicated that the students were only learning about half of the material presented.

The immediate reaction to the problem was, "We need more time!" However, examination of the schedule showed that no more time was available for this subject without seriously handicapping the sessions devoted to other equally important subjects. The only recourse left was to explore the possibilities of improving the quality of the teaching, so that the students could learn more in less time. It was observed that in the lecture-note taking situation the students were seldom very adept at making sketches quickly and accurately, and much time was wasted in trying to do this. After a few attempts most of them gave up. Sitting passively, they soon grew bored and paid less and less attention to the lecturer. Perhaps here was an opportunity to apply one of the principles of the psychology of learning—"There is no learning without activity, either physical, or mental, or both." What was needed was some "learning by doing," but how was it to be done?

The solution to this problem hinged on providing the student with some kind of "do-it-yourself kit" learning material. It was decided that "lesson sheets" would be prepared consisting of drawings of the various upper extremities components in a column down the left side of the page, with parallel columns on the rest of the page. These columns were headed "Name," "Function," and "Application." (See Fig. 1) The teacher drew similar columns on the blackboard. He would show a component, write its name, function, and application in the columns on the board, and the students wrote this material in the corresponding columns on their lesson sheets, along with any additional details they might wish to add, gleaned from the discussion of each unit that was encouraged by the teacher before going on to the next one.

The lesson sheet system provided the students with a planned procedure to follow in learning about upper extremities components, it required them to be alert and active, both mentally and physically, and it led them into becoming active participants in the class discussion, rather than mere passive listeners. The teacher quickly learned to adapt his speed to the ability of the students to follow him as he could easily watch their progress in filling in their columns and giving them time to finish before proceeding to the next item.

Objective tests given to classes taught by this method showed an excellent improvement in learning, as compared to the test results obtained previously. Using the traditional lecture and note-taking procedure, the highest scores made on the test were by two students in the 70-74 interval; the median was fifteen students at 35-39. Using the lesson sheets, the lowest

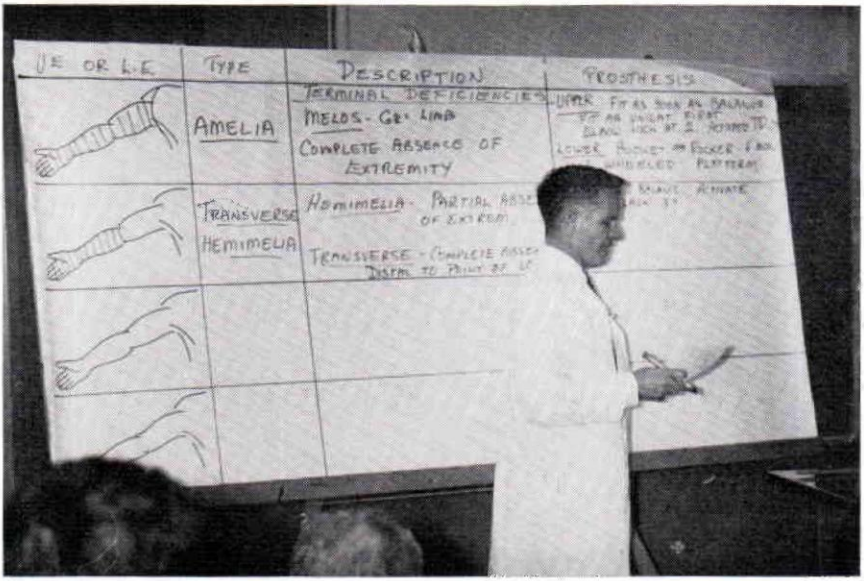

Figure 1. The instructor works with a "giant copy" of the lesson sheets used by the students.

scores were made by two students in the 70-74 interval, and the median was fifty students at 90-94. The differences in the groups would not account for such a large difference in scores, as they were both highly selected groups of physicians and therapists, well screened through a number of years of educational experience.

The "lesson sheet" principle of "learning by doing" was soon put into practice in as many presentations as possible, after the success of the initial trial of this technique. The result was an immediate increase in learning efficiency, as proven by test scores. As a result of improved teaching technique, much more learning was being accomplished without increasing the amount of time.

Not all topics were found to be directly amenable to the illustrated "lesson sheet" approach. For example, a presentation on "Pre- and Post-Operative Care of the Amputee" did not lend itself readily to the lesson sheet treatment. However, greatly increased efficiency of instruction was achieved through the simple device of organized blackboard outlining. The teacher listed the eight or ten major teaching points in his presentation down the extreme left hand side of the board. This gave the students an over-all picture of the topic, and a basis for outlining their notes. Seeing all the teaching points listed encouraged them to want to take notes as each one was developed. The teacher in his presentation took the first topic and outlined the sub-points for it on the right hand portion of the board, discussing each point as he lettered it in chalk, and giving the students enough time to get the points in their notes. (See Fig. 2) When he finished point one, he erased the sub-point material, and repeated the procedure with point two, and so on through the entire series of teaching points. This technique conserved time by keeping the teacher on the topic instead of wandering off into unrelated subject areas, it organized the material for the student, and it made it easy for him to direct questions to points he failed to understand.

Still other teaching situations arose in which words and drawings

were not enough to enable the students to get a clear understanding of the teaching points in the presentation. In the lecture on "Normal Human Locomotion" the path followed by the body's center of gravity is very complex, and the maze of curved lines drawn on the blackboard to illustrate this phenomenon helped, but did not quite develop, clear understanding. A simple model of the pelvis and legs, hinged to duplicate the hip joints, made it possible to demonstrate the rise and fall of the center of gravity so the students could actually see it happen. (See Fig. 3) The simple model eliminated all of the distracting movements that made it difficult to observe in a live model the particular movement being analyzed, and as a result, the students understood what was being presented much more clearly than before.

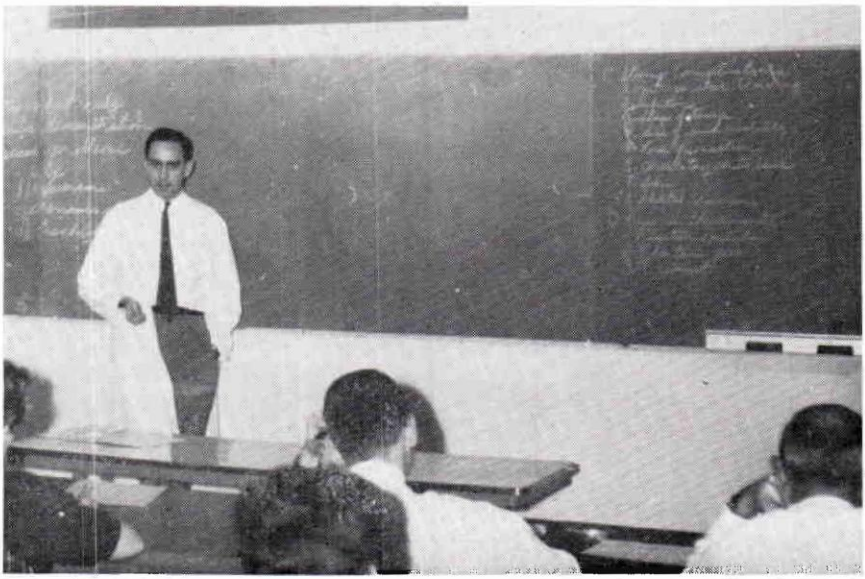

Figure 2. Organized blackboard outlines give the students a good idea of the basic outline form to use in their own notes, and also help the instructor to avoid wandering from the main topic.

Other models have been designed to demonstrate the relationship between moments of force around the ankle joint on a prosthesis with the forces tending to buckle the knee joint, and the relationship between the toe and heel lever lengths in the foot and the forces developed around the ankle in the foot. These ideas can be drawn on the blackboard with arrows and diagrams, without getting a clear idea across to the students, but when they see the spring scale readings on the model, they quickly get the point. Carefully planned working models provide a dynamic demonstration that cannot be equalled by static drawings, slides, or pictures.

The newest development in instructional technique, supposed to revolutionize teaching, is the "teaching machine." At first glance, this idea sounds wonderful, all you have to do is put the students in front of the machines, and they do the work. On more careful investigation, however, it turns out that the element that makes the machine work is the "programming"—the sequential presentation of information, arranged in the best learning order, with maximum clarity for clear understanding. It seems that developing the "program" is the big job, of course, and it turns out to be exactly the

same job all good teachers have been doing for years, except they call it "lesson planning." So things haven't changed much after all, neither the teaching machine nor the human teacher is much good without "programming" or "lesson planning," and neither can be done well through knowledge of the subject matter alone.

There are few experiences more enjoyable than teaching. The good teacher enjoys seeing his students gain new knowledge and understanding, and develop new skills and abilities, as a result of his efforts. In the Prosthetics Education Program at U.C.L.A. we feel that our students are important enough to "program" every presentation so they will learn the greatest amount possible in the least amount of time. We enjoy teaching that way, and we think our students enjoy learning that way.

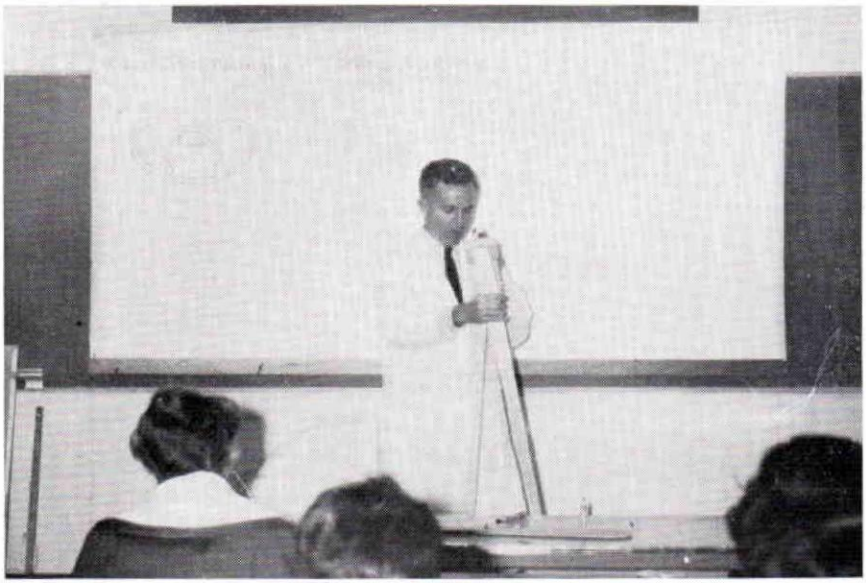

Figure 3. A simple working model of the pelvis and legs helps the students to understand difficult or complex mechanical concepts. The students "see what happens" and the instructor does not have to use up valuable teaching time in lengthy verbal explanations.