

# Teaching Life Science to Student Nurses: A Modular Approach

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**T**HE LIFE SCIENCE PROGRAM at the Washington (Pa.) Hospital School of Nursing was originally designed as an integrated, audiotutorial course incorporating the disciplines of anatomy, physiology, chemistry, and microbiology. This method of instruction was not an immediate success in terms of student achievement. It was not until 1973, with the implementation of a modular approach to instruction, that the students began to learn in our Life Science course at a level of mastery. As has been true on a nationwide basis, our use of modules evolved from the audiotutorial method of learning.

In nursing, as in other health-related professions, it is not enough for the student to attain partial competence. Many factors influence student achievement, such as individual differences among students, amount of time spent, and presentation of subject matter. According to Carrol (1963) and Bloom (1971), most students can achieve mastery if they are given sufficient practice and are willing to spend the necessary amount of time. In designing the life science modules, we considered these and other factors. To assure the



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attainment of a high level of mastery by all or most of the students, we used four principles as the basis for modular design: small steps, active participation, self-pacing, and reinforcement.

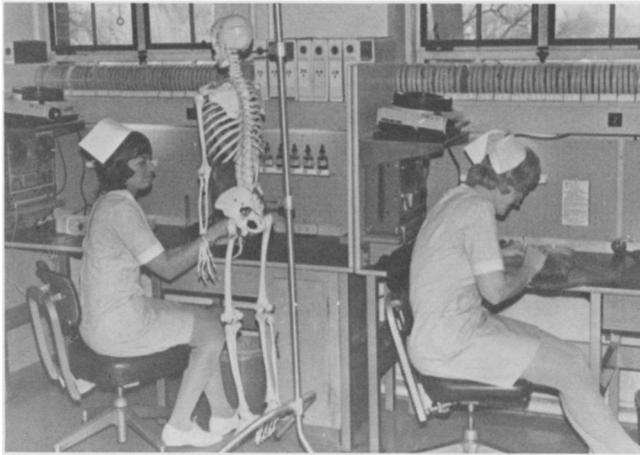
A team of three science instructors and a science coordinator designed and developed 90 modules for use in a course extending over four 12-week terms (Mentzer, Kuntz, Paterlini, and Scuglia 1973). Every module was designed to be a self-contained, independent unit of instruction focusing primarily on a single topic. Each module was composed of an audiotape, a study guide, and visual materials. The tape contained the narration of the subject matter and cues for student responses. The study guide provided objectives for student responses, and visual material consisted of such aids as 2x2 and microscopic slides, films, models, anatomical charts, and specimens (fig. 1).

The team's first task in the development of the modules was the identification of those scientific principles and concepts that would provide a meaningful science foundation for student nurses. Closely related principles and concepts were organized into concise topics that eventually became the module titles. The team then commenced to develop one module at a time, beginning with the formulation of a terminal objective for the selected module. The terminal objectives evolved were in the comprehension level according to Bloom's (1956) taxonomy. For example, the terminal objective for module one, "The Cell," is "to understand the structure and functions of the cell."

After a terminal objective was defined, the next task was to develop an organizational outline and a set of subordinate objectives. The outline emphasizes key points of the subject matter previously ascertained to be applicable to nursing. The subordinate objectives are designed to assist the learner with the accomplishment of the terminal objective. Gagne's (1970) learning hierarchy provides the basis for establishing the subordinate objectives. Some of the verbs used to express the desired cognitive outcomes from the subordinate objectives are *define, state, describe, identify, and explain*.

## Small Steps

Each module was structured into a series of small steps in accordance with the modular design. This was accomplished by arranging the subject matter into small units, called sections, each representing specific learning tasks. The set of subordinate objectives serves as a guide for the subdivision. The team arbi-



**Fig. 1.** Each module is a self-contained, independent unit of instruction composed of an audiotape, a study guide, and visual aids. (Photo by Frank Paterlini.)

trarily designated six specific learning tasks as the standard size for each division. Subject matter is thus presented in small steps throughout the taped narration and in the study guide. Learning is thereby made easier for the student by exposing him to small portions of content at one time.

### Active Participation

One of the most widely accepted principles of individualized instruction is that the student must actively participate in the instruction. Active participation enables the learner to practice the specific behavior to be learned. The primary learning task in each module is "to understand" the topic. Subordinate tasks are designed to allow the student to practice the behavior necessary for him to demonstrate his understanding. The subordinate tasks require the learner to make verbal associations, discriminations, and generalizations. The associations involve stating specific facts and naming anatomical structures. Learning tasks designed for students to practice association learning are assigned the verbs *name* and *state*. Since verbal association is low in Gagne's hierarchy and is not considered to be difficult, selective responses are used for association tasks. For example, in "The Brain," one of the subordinate objectives is to have the student name the two structures making up the diencephalon. In the study guide, the student is cued to select the correct option from a four item multiple-choice statement (fig. 2).

Discrimination tasks are concerned with the student's ability to make various identifications and classifications. Generalizations involve the explanation of functions and interrelationships between body systems. When performing these tasks, the student is cued to respond to behavioral verbs such as *define*, *describe*, *identify*, or *explain*. According to Gagne, this type of learning is of a higher order and is more difficult than association learning. The learner is, therefore, directed to make written responses for discrimination and generalization tasks. The assignment of constructed responses to these tasks is also substanti-

ated by several studies that show that students obtain superior achievement scores when they make written responses while learning difficult content (Williams 1963, 1965, 1966). Fig. 2 is an example of a typical constructed response.

### Self-Pacing

The student is provided with the opportunity to regulate his learning time and learning rate to ensure accomplishment of the terminal objective. Each student is given complete control over the instructional materials and pacing of instruction. The individual learner is able to spend as much time as needed listening to the narration, observing the visual aids, and accomplishing the learning tasks. Thus, through self-pacing, the student is able to proceed at his own rate toward mastery of the modular content.

An approximate learning time is given with each module to serve as an index for student pacing. We estimated that the time required for mastery of the individual modules is usually two hours. In certain instances, modular learning times vary considerably from the approximate times. Some students complete a module in one study session and others require multiple study sessions to master the content. Actual learning time per module ranges from 20 minutes to three

**DIRECTIONS:** LISTEN to the narration on the tape until you are directed to STOP. Then WRITE the correct response or CIRCLE the correct letter for the following objectives.

1. The diencephalon is located:
  - A. directly above the spinal cord
  - B. immediately below the cerebrum, being completely covered by the cerebral hemispheres
  - C. directly below the midbrain
  - D. between the cerebellum and the medulla
2. The two structures that make up the diencephalon are:
  - A. hypothalamus and thalamus
  - B. basal ganglia and corpus callosum
  - C. reticular formation and caudate nucleus
  - D. thalamus and medulla
3. Describe the location and composition of the thalamus.
4. Explain how the thalamus functions as a neural relay station.
5. Describe the location and composition of the hypothalamus.
6. The major function of the hypothalamus is:
  - A. control of the sympathetic and parasympathetic divisions of the autonomic nervous system
  - B. control the emotional expression of anger
  - C. regulate the heart rate
  - D. control the pain and pleasure stimuli from the body

**DIRECTIONS:** After you have responded to the objectives, re-listen to the narration on the tape to check the accuracy of your responses. Correct any wrong responses

**Fig. 2.** Sample page from a study guide, illustrating cueing directions. Numbers 1, 2, and 6 are examples of multiple-choice statements, and 3, 4, and 5 are examples of objectives requiring constructed responses.

hours. This large span in learning time is generally attributed to differences in the educational background, previous experience, and study habits of the students.

Not only is the student able to pace himself within each module, but he is also encouraged to complete all 90 modules at his own rate. Realistically, some time limit must be imposed to guarantee completion of the content. Therefore, the student completes a designated number of modules within each 12-week term and then takes a comprehensive examination. It is totally acceptable for the student to complete the assigned modules and to take the examination before the end of the term. Upon completion of the term requirements, the student can then progress to the next set of modules. Students who procrastinate are counseled and encouraged to increase their learning pace to guarantee completion of the requirements by the end of the term. Approximately 50% of the students complete the requirements early, with the remainder finishing by the end of the term.

### Reinforcement

Reinforcement is frequently equated entirely with test results. Reinforcement, however, also refers to any situation in which student behavior is modified as the result of a reinforcer, that is, any stimulus which immediately follows a response and serves to strengthen and maintain that response. Although both modes of reinforcement are employed, we emphasize the latter method in our approach.

The student is expected to master the subject matter as he progresses through each section of a module. Mastery of the material is demonstrated by his ability to make the correct response to the objectives in the study guide. In order to receive confirmation of correct responses, the student is directed by verbal cues on the tape and written cues in the study guide (fig. 2) to listen again to the tape and to correct any wrong responses. In this way, the narration on the tape and the student's written responses in the study guide are employed as reinforcers of the section. Even though the student is cued to relisten to the tape only once, he is free to review each section as often as desired.

To give the student an indication that the modular material has been learned, a self-quiz and answer key are provided at the end of the study guide. The self-quiz consists of five multiple-choice questions covering the content of the module. The attainment of a satisfactory score on the self-quiz is an index for mastery. Once the student feels confident that he has mastered the content, he can proceed to the retention quiz for the module. Retention quizzes, like the self-quizzes, are self-administered and include five multiple-choice questions. Each student scores and reviews his own quizzes. This procedure provides the student with an identification of short-term retention plus reinforcement of the modular content.

Reinforcement of the subject matter is also accomplished through the interaction between instructor and student. An instructor is available to provide assistance to the student throughout his learning sessions. Thus, any problems encountered by the student while

learning can be solved immediately. Students also attend weekly, one-hour discussion sessions which further enhance and reinforce their learning.

### Evaluation

The student's term grade is based on scores attained on five achievement tests and a final examination. Each achievement test compiles subject matter from five or six related modules, and contains 30 multiple-choice questions. The final examination is composed of 150 multiple-choice questions covering all the required modules in the term. All questions are criterion-referenced to the subordinate and terminal objectives of each module.

The desired level of mastery, as identified by the science team, was that each student attain at least 80% on the achievement tests and final exam. We considered this level of mastery to be essential to the administration of quality nursing care. After the modular approach had been used for one year, approximately 90% of the students each term had achieved scores of 90 or higher.

### Conclusion

Successful education of nurses cannot be accomplished through a program that results in only partial competence. Our strategy for mastery learning in life science has proved effective at the Washington Hospital School of Nursing. The 90% mastery after one year was far more than we had originally hoped to achieve as a result of implementing the program.

There is a need for individualized instructional programs in a variety of areas in which achievement at a high level of competency is essential. The modular approach is one form that should be considered, because it can be readily adapted to most educational programs and it provides for student achievement at a mastery level.

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