Air Force..... RESULTS OF PI STUDY

By Gabriel D. Ofiesh
Colonel, USAF

Programmed instruction has caught the attention of the United States Air Force as probably no other development in education has done in the last few decades. It has been the first effort that has provided a realistic hope for the emergence of a true instructional technology.

In September of 1961, the Air Force Headquarters Staff directed a transition of programmed instruction from its (the AF's) research and development stage to the operational test stage. Air Training Command got the job.

The requirement for a "fair experiment" was obvious. If this instructional technology had anything to offer, and the evidence was preponderant that it did, then the problem facing the Air Force was not to determine whether it would work or not, but where and under what circumstances could it be put to most productive and economic use in the numerous training programs. In finding the answers to these questions, Air Training Command trained over 300 instructional programmers for the Air Force. Within the Air Training Command over 100 experimental programs, covering from 2 to 30 hours of conventionally-taught topics, were prepared and field-tested for Air Force training.

The application of this technology showed that its use would result in a fair reduction of cost and a substantial increase in the quality of training. In April, 1963 the results were so gratifying that plans were immediately established under ATC's concept of concurrency for the full exploitation of this new instructional technology. In comparison with conventional instruction, the programmed packages resulted in average mean reduction of 33% in training time and a gain of 11% in achievement. This was accomplished with limited resources and experience.

A. F. Programmers **Three Air Force programmers from Lowry Air Force Base, Colorado, are shown here trying out a program on installation of the A-28 Camera Mount. After carefully testing this program it was discovered the beginning students could assemble this valuable piece of equipment without the supervision of an instructor. Total cost of training was thus reduced.**

Those units to be programmed were selected on the basis of identifiable training objectives, estimated man-hours to develop the program, the stability of course content, student flow, and adaptability of subject matter. A total of 107 programs were approved for development throughout all training activities of the Air Training Command. Some programs covered entire courses of instruction, while others were designed as modules designed to "instruct" small segments of existing courses.

The evaluations of programmed instruction versus conventional training methodologies were conducted under operational training conditions. Procedures for conducting these evaluations were forwarded to supervisory personnel. Variations dictated by unusual training conditions, academic facilities, or an unusual student flow were reported and treated as another variable. Essentially, the design of each evaluation followed the following pattern: students were randomly divided into a control and experimental group.

Where class size prohibited obtaining an adequate sample for each group, two similar classes were used for evaluation. Students for specific courses were selected on the basis of similar academic background and attitudinal characteristics. This procedure resulted in highly similar populations. Control groups were trained in the conventional manner and experimental groups used programmed instructional materials. Comparable pre-tests covering course objectives were administered to both groups to establish initial repertory. Both groups adhered to the same training schedule, class lengths were constant, and post-tests were administered whenever possible at the same time. Due to lack of facilities and scheduling problems in some instances, one group was administered the post-test a day later. Retention testing was accomplished with both groups two- to four-weeks later. The analysis procedure used was the test for significance of the difference between means.

The times required for both groups to complete the training were carefully recorded. In a number of instances, locally devised questionnaires to extract a favorable-unfavorable index were administered to the trainees and instructors.

RESULTS OF PHASE I EVALUATION

Of the 107 packages approved for development, 13 packages were not completed because of personnel changes and losses. Thirty-two programs are still in the development stage. Sixteen programs have been through the developmental testing process but have not undergone comparative testing. Fourteen of these on which data is available indicate a mean reduction in student time of 45% in favor of the programmed materials.

Forty-six programs have been compared with conventional instructional techniques in the actual training situation. In comparison with conventional instruction, the programmed packages indicate an average mean reduction of 33% in training time and a gain of 9% in achievement.

The 62 programs that have been through developmental testing (N=46) covered a total of 494 conventional hours of instruction. The average program length is equivalent to eight hours of conventional instruction. The man-hours spent in programming one hour of conventional instruction averaged 137 hours. This figure compares favorably with

estimates used by commercial programmers when costing contract proposals. As instructional programmers gain experience, a decrease in this time will be realized.

CRITERION TESTS

It is of some importance to describe, briefly, the types of criterion tests that were used in the majority of the programs which are presently in the process of developmental testing, and which were used to make the comparative study between the programmed materials and conventional institutional techniques.

The criterion test items were designed to extract measurable behavioral characteristics. Nearly all the test items required a constructed response which measured the degree of acquisition of the learning outcome required by a specific training objective. In appropriate courses, both paper-and-pencil and performance-type tests were administered.

Following the developmental testing phase, results were analyzed to determine to what extent course objectives had actually been measured. Test items that did not identify the instructional weaknesses in the materials were eliminated, and new items were prepared by subject-matter experts and training managers before comparative testing was accomplished. This procedure increased the difficulty level of the test instruments administered during the comparative testing phase, with an anticipated decrease in achievement on end-of-course measures. In all cases in the operational field test, the criterion test was administered to the students both before and after the course of instruction in both the programmed and conventional instance.

CONCLUSIONS

An analysis and summary of the effectiveness of the Phase I operational evaluation of programmed instruction as an appropriate educational technology resulted in the following findings:

1. Most programmed instructional packages evaluated under controlled operational conditions resulted in as high or higher achievements on standardized test instruments.

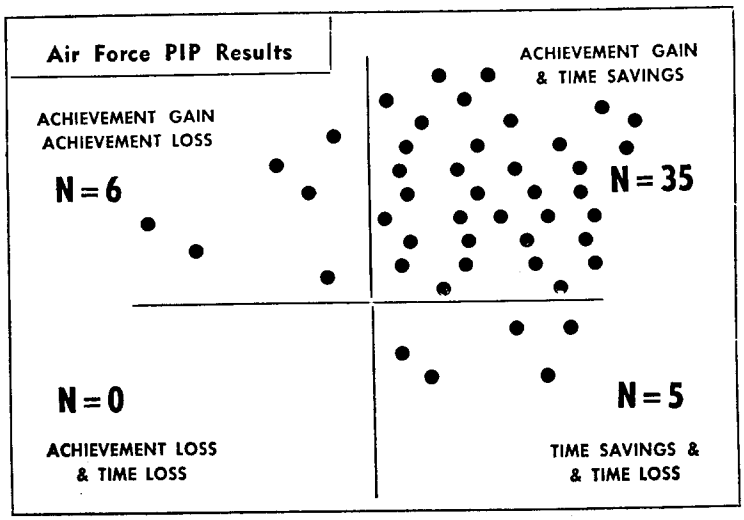
2. The programmed instructional packages resulted in substantial savings in academic/instruction time when compared to conventional instructional techniques.

3. The man-hours spent in programming one hour of conventional instruction averaged 137 hours. As instructional programmers gain experience, a decrease in this time will be realized.

4. Attitudinal rating scales administered to trainees and instructional personnel, measuring individual reaction to the use of programmed materials, were favorable in a great majority of the cases. In many instances, suggestions made by the students to open-ended items on these questionnaires led to revisions or modifications that increased the programs effectiveness.

5. Use of the programmed instructional techniques stimulated the maintenance of a standardized presentation with qualitative and quantitative controls without the constant use of instructors and supervisory training personnel.

6. Programmed instruction is considered the first true application of a complete and systematic instructional technology brought about through the science of learning. It has raised questions regarding every facet of the instructional process as no other recent concept. It has led to the emergence of the systems developmental approach to instructional materials. Instructional programmers can be more productive when organized into teams to apply the systems approach to the development of programmed materials.



RECOMMENDATIONS

The following areas require additional exploration and evaluation:

1. Further refinement of the programmed materials developed during the operational test with extensive and timely use of these materials in exisiting courses.

2. A continuing analysis of existing courses to determine those areas in which programmed materials or other instructional media may be introduced with an increase in training effectiveness.

3. Continued efforts will be directed to study those variables that influence the extent, ease, and rapidity of learning in training environments. Such factors as educational level, aptitudes, motivation, and the skills and knowledge in an entering student's repertory must be studied in an attempt to isolate the effects of these variables during training.

4. The increasing complexity of training requirements dictates that studies should be conducted to determine those variables predictive of the high degree of proficiency in those perceptual-motor skills required in the operation and maintenance of complex systems. Such studies would involve the use of simulators and task and part-task trainers.

5. The role of teaching machines must continue to be evaluated. Although these devices permit the preparation of subject material in discrete steps or units, require active participation, provide feedback to the student, may have a random access capability, and allow progression at an individual's optimal rate, some questions exist as to motivational characteristics and achievement when a machine presentation and programmed text with the same content are compared.

6. Evidence exists that manipulation of attitudes through indoctrination and instruction prior to formal training increases learning. Although such gains are structured to some extent by individual ability, motivation and task parameters, evaluations should be conducted to determine the attitudinal changes which may result from the use of various educational technologies in the same academic area.

7. Follow-up studies will be conducted in the field on those graduates who have been trained with programmed materials versus those graduates conventionally trained.

8. Management studies must be conducted to determine