DOCUMENT RESUME

ED 070 929 AC 014 076

AUTHOR Weingarten, Kenneth; And Others
TITLE Development and Implementation of a Quality-Assured, Peer-Instructional Model.
INSTITUTION Human Resources Research Organization, Alexandria, Va.
SPONS AGENCY Office of the Chief of Research and Development (Army), Washington, D.C.
REPORT NO HumRRO-TR-72-35
PUB DATE Nov 72
NOTE 79p.; Work Unit APSTRAT

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Enlisted Men; *Individualized Instruction; *Instructional Technology; *Job Skills; *Military Personnel; Military Training; *Peer Teaching; Performance Tests; Student Attitudes; Teaching Models; Technical Reports; Training Techniques; Transfer of Training

ABSTRACT

This report describes the development and pilot testing of a low-cost, generalizable, quality-assured, peer-instructional model suitable to the training needs of men of varying measured aptitude. The report presents a brief overview of the project, followed by a detailed description of the APSTRAT model and the considerations that led to its development. The model is discussed in terms of the instructional principles incorporated and the practical constraints accommodated. The data comparing the performance proficiency, academic attrition and recycles, and costs of the conventional and APSTRAT systems indicate that APSTRAT students achieve greater proficiency with a reduction in the rate of academic attrition and a considerable savings in cost. (Author)

Technical Report 72-35

HumRRO TR 72-35

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The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

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Published
November 1972
by
HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street
Alexandria, Virginia 22314

Distributed under the authority of the
Chief of Research and Development
Department of the Army
Washington, D.C. 20310

FOREWORD

This publication summarizes and brings to a conclusion Work Unit APSTRAT, Training Strategies and Incentives Appropriate to Different Aptitude Levels for Selected Army Training Courses. The purpose of the project was to develop and test an integrated, low-cost, generalizable instructional model appropriate for training men of widely varying, measured learning aptitude.

The project, begun in July 1968, was performed at HumRRO Division No. 3, Presidio of Monterey, California. Dr. Howard H. McFann is Division Director. COL Ulrich Hermann, Chief of the U.S. Army Training Center Human Research Unit, colocated with HumRRO Division No. 3, provided valuable assistance in coordinating and obtaining support for the project.

Members of the HumRRO research staff were Mr Kenneth Weingarten, principal researcher, Mrs. Jacklyn E. Hungerland, and COL Mark F Brennan (USA, Ret.) Major contributions to the development of the APSTRAT model were made by the following members of the military staff SP5 R. Brent Allred, SGT Lee Knox, and SP5 Martin Pollyea. 1LT Dennis Mar of the Army Human Research Unit had a major role in preparing the Implementation Manual included in this report as Appendix A.

Other members of the military staff assigned to Work Unit APSTRAT, all of whom share the responsibility for the successful completion of the project, were: SP5 Roger Lyons, SSG Raymond Tosti, SSG Joseph Asbury, SSG Heberer, SGT Roy Reynolds, SGT Henry Cox, SGT Billy Hood, PFC Gerald Annen, PFC Allen Collier, PFC Abel Figueroa, PFC Roger Hickman, PFC Dennis Lynch, PFC Alvin Penry, and PFC Lawrence Zendle.

The cooperation of the officers and men of the Field Wireman Course at Fort Ord, California, where the pilot study was carried out, is gratefully acknowledged

The APSTRAT model, first piloted in the Field Wireman Course at Fort Ord, is now fully installed in the four other Training Centers where the course is offered. Acknowledgement is made of the role played by Mr. Paul Crick of the Southeastern Signal School (SESS) and SFC Robert Andersen of the Field Wireman Course at Fort Ord in facilitating this implementation.

Special recognition is due Dr Ralph Canter, who, as Director of Research of the Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs (OASD-M & R), provided encouragement, direction, and support for this project

HumRRO research for the Department of the Army is conducted under Contract DAHC 19-73-C-0004. Army Training Research is conducted under Army Project 2Q062107A745.

Meredith P Crawford
President
Human Resources Research Organization

PROBLEM

Wide variations in measured aptitude among students in Army Training Courses pose a difficult problem for instructional technology. The traditional lecture-demonstration-practice paradigm that characterizes conventional training programs cannot cope with this problem. A new approach to training is needed. Work Unit APSTRAT was initiated to develop a new low-cost, generalizable instructional model that would be capable of providing effective training for men across the aptitude spectrum.

APPROACH

The model developed is a quality-assured, peer-instructional system incorporating six principles essential to effective instruction, and accommodating severe practical constraints having to do with cost and the ease of implementation. The principles, derived from previous research by HumRRO and others, are as follows:

(1) Performance orientation
(2) Learning in a functional context
(3) Individualized instruction
(4) Absolute criterion
(5) Feedback to student and instructional manager
(6) Quality control

In the model, peer instruction is the sole instructional medium, and every student performs the roles of both learner and instructor. Cadre are mainly concerned with the maintenance of quality through rigorous, pass-fail performance testing at the 100% criterion. The model was tested in the Field Wireman Course (MOS 36K20) at Fort Ord, California.

RESULTS

Data comparing the conventional and APSTRAT systems were collected in the course of the pilot study at Fort Ord.

Performance Proficiency

The criterion for graduation in the new model is the attainment of 100% scores on all performance tests in the course. As a result, graduates of the APSTRAT system are markedly more competent in terms of job proficiency than were the graduates of the conventional system In the three instructional blocks in the Field Wireman course (field wire techniques, switchboard installation, and document distribution and radio monitoring) gains in the proficiency of graduates resulting from the installation of the new model were (a) field wire technique, 24%, (b) switchboard, 43%, and (c) document distribution and radio monitoring, 74% Proficiency was tested on the mastery tests developed as part of Work Unit APSTRAT

Academic Attrition and Recycles

Despite the model's demand for 100% mastery, the changeover from the conventional system to the APSTRAT system resulted in a reduction in academic attrition from 19 to 12.5% and in academic recycles from 30% to zero

Cost

The new model also results in a considerable cost savings. It costs the APSTRAT system about $262 less than the conventional system for each graduate. The basis for cost saving results mainly from decreases in training time and trainee attrition

CONCLUSIONS AND IMPLICATIONS

The data gathered in the pilot study indicate that the primary objectives of the project were attained—substantial gain in proficiency for men of all aptitudes, and reduction in academic attrition and recycles with considerable cost savings.

The success of the pilot study led the U.S. Continental Army Command (CONARC) to direct that the model be implemented in the four remaining Field Wireman courses (FWC) across the country. These implementations are now completed and are operating successfully. A number of other Army courses are engaged in the preliminary stages of converting to the new model.

The model has been successfully used by HumRRO in an exploratory study in a Public School in Carmel, California. It is also being used, in modified form, in a HumRRO project on office education in a Pacific Grove, California, high school.

Informal observation suggests that the system has a marked effect on the attitudes of trainees in terms of increased motivation, self-reliance, self-confidence, and group morale. This feature of the model, together with its low cost, ease of implementation, and high performance gain are important reasons for consideration of its use in a large variety of training and educational settings—both military and civilian. It also may account for the widespread interest in the model expressed by many individuals and organizations concerned with educational technology.

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INTRODUCTION

The training system in the Army poses an unusual challenge for educational technology. Each week, Army courses are confronted with incoming classes that must be taught a considerable amount of information in a short and relatively fixed period of time. Men who arrive for training are likely to form an extremely heterogeneous group with respect to educational background and learning aptitude. In a typical class, one can find functional illiterates and college graduates, men scoring near the lower limit of the Armed Forces Qualification Test and men scoring at or near the upper limit.

The conventional lecture-centered instructional method, which has characterized much Army training, is effective, at best, for a relatively narrow band within the larger educational and aptitudinal spectrum. The band to which lectures are oriented can be shifted to some degree by allocating more or less lecture time or by proceeding in smaller or larger steps. It cannot be substantially broadened, however, even if the training population is subdivided into several more or less homogeneous classes and lectures are prepared for each class. A multiple tracking approach of this kind would require complicated administrative arrangements, many additional instructors, and a larger physical plant. In addition, it would risk a decline in morale because of trainee placement.

Moreover, this approach cannot furnish a solution to the underlying problem. The lecture method is a compromise based upon unfavorable teacher-student ratios and is not an optimal training method for any educational or aptitudinal subgroup. Even with audiovisual training aids, the method is often inclined toward abstractness. It introduces an undesirable temporal separation between the presentation of information and the opportunity to practice what is learned; it is insensitive to the individual differences to be found even in the most homogeneous groups. While these deficiencies render the lecture method merely less than optimal for the better educated and brighter students, they become a formidable obstacle in learning toward the other end of the trainee continuum.

Screening devices are not likely to supply the needed solution. The attempt to screen out men of lower measured aptitude may prove to be both practically unworkable and socially undesirable. With the advent of improved training methods, it may prove unnecessary as well. In order to provide adequate instruction for all segments of a heterogeneous training population, new instructional strategies are needed. Work Unit APSTRAT was initiated in July 1968 to address this task.

The purpose of Work Unit APSTRAT (the code name derived from the terms "aptitude" and "strategies") was three-fold: (a) to identify or devise a set of instructional principles, methods, and techniques—or strategies—that would meet the diverse needs of hetero-aptitudinal training populations; (b) to combine these strategies in a complete training system; and (c) to test a prototype of this system within the "real world" constraints of a typical Army training course.

This report first presents a brief overview of APSTRAT, then a review, in several sections, of the history of the project, highlighting the considerations that led to the development of a quality-assured peer-instructional system. The system will be described and comparisons will be made between the effectiveness and cost of the conventional and the APSTRAT systems. The report will conclude with a brief summary of the aftermath of the project concerning the utilization of the APSTRAT system and implications for further research and development.

OVERVIEW OF THE PROJECT

APPROACH

At the outset of the project, the AP . adopted the multiple media or alternative media strategy. The reasoning u ng this decision is straightforward. Men high on the aptitude and educational scales are used to learning from lectures and written materials. men at the opposite end of the scales those ranking in mental category IV[1] cannot learn well from lectures, and find reading difficult. On the basis of this understanding we decided to design instructional packages covering the full curriculum of a typical Combat Support Training (CST) course.

All parts of the curriculum would be presented in at least two types of media (a) written programmed manuals and instructional booklets for men who could learn and preferred to learn by reading, (b) programmed audio or video tapes, tape-slide presentations, movies, picture books, and games for men who preferred to learn or could learn only through the use of one or another of these alternative media. Each student would work at a rate that he found comfortable.

The staff felt that, with nough effort, alternative packages could be developed that would be suitable to the needs and preferences of the great majority of students. This was the initial approach to providing effective training for men of all aptitudes.

It was necessary to select a course in which to carry out a pilot study. The course had to span a wide variety of skills and a full spectrum of aptitude in the student input. The Field Wireman course (FWC) satisfied these criteria, and the course given at Fort Ord was chosen.

The first step in carrying out the plan was to analyze the curriculum of the Field Wireman course in detail in order to determine what the instructional packages would contain. This was ultimately accomplished with the assistance of two FWC cadre who were assigned to the project to prepare behaviorally stated objectives for every task in the course.

The next step was to design instructional packages in alternative forms. This was a difficult and lengthy process, but after several months, several prototypes dealing with telephone installation had been developed to the point where they were ready for tryout in the laboratory. Samples of men who had just completed Basic Training and who, more or less, matched the input into the FWC were selected to serve as trainees. Although the brighter and better educated men learned fairly well regardless of the medium used, many of the men at the opposite end of these continua did not learn well even with those media thought to be particularly well suited to their needs. The prototypes that were developed for other parts of the curriculum produced about the same results.

These results were not pleasing but they were not altogether unexpected, because materials of the kind desired require, by their very nature, repeated tryout and revision. The APSTRAT staff became increasingly concerned with the amount of time and manpower that this process of revision required, since several packages per curriculum component would have to be revised. While this expense might be tolerable in a pilot

[1] Men in mental category IV had received a score of 10-30 on the Armed Forces Qualification Test (AFQT).

study, it was feared that the alternative media approach, however successful, might be too expensive for practical usefulness.

At about the same time, another medium was tested that ultimately allowed the staff to reach their objective of providing effective training for men of all aptitudes in a much more economical way. While the materials on telephone installation were being revised, another method of instruction was proposed. A number of very able cadre had been assigned to HumRRO, as content experts, to help in designing instructional materials. One cadreman was to train two men so that they could pass a strict performance test for phone installation. When they had passed this test, each man would train two more men. If these four subjects could pass the test, they, in turn, would teach the task to eight more trainees, and so on.

The research staff carried out the experiment for four generations, or to the point where 28 trainees had been trained by other subjects. Every trainee, regardless of aptitude, passed the test, and—what is more startling—the time required for a man to learn the task declined from generation to generation. The training of one student by another—or peer instruction—not only was just as effective as cadre instruction, but was also more efficient in terms of time.

The success of this experiment did not, at once, lead the staff to abandon alternative media in favor of the single medium of peer instruction. Our commitment to the former approach led us, instead, to conceive of peer instruction as an additional alternative medium. The recognition of the full potential of peer instruction required the catalysis of the further clarification of cost constraints and two unexpected findings in the Phase I experimental run.

PHASE I EXPERIMENTAL RUN

The overall strategy at that time called for the development of a model composed of three integrated components: a *skill center* where the curriculum elements to which the instructional packages were oriented were to be learned; an *operational system* in which individual skills would be realistically combined in interrelated job tasks; and a *control center*, which would manage traffic within and between the other two system components.

The Phase I experimental run was to test the first of three gradual approximations of this model. The skill center was to be established first in order to evaluate the instructional packages. When the pertinent information had been gathered, the skill center was to be closed and the operational system established. The principles and procedures of the control center (which was not to be formally instituted until the Phase II experimental run—the second-order approximation of the model) were to be determined on the basis of staff experience in managing the prototype skill center and operational system. The next step was to try out the alternative media approach under conditions more closely approximating those present in a regular course.

The run was conducted in October and November 1969, with facilities at Fort Ord. Twenty-five students, drawn from the regular input of the Field Wireman course, were assigned for training. The materials covered about half the full curriculum.

Two findings during the run led to a radical revision in strategy. Students invariably preferred direct "hands on" experience with actual equipment to learning via mock-ups and other "sophisticated" media. In addition, students reported a great deal of informal, unplanned peer instruction and stressed the value of peer instruction in their learning. These two findings, together with the experience with peer instruction in the laboratory and a set of considerations to be discussed in the next section, led the APSTRAT staff to abandon its previous strategy and to design, instead, a job-performance-oriented, peer-instructional model.

A third general finding in the Phase I experimental run suggested that this was no easy matter. The operational system had proved very difficult to manage, and since the new strategy placed even greater stress on the operational system (there was no longer to be a skill center), the formidable problem of how such a system was to be organized and managed had to be addressed in preparation for the Phase II experimental run.

The need for thorough and rigorous performance testing became critical. Unless a man has complete mastery of the skills his MOS calls for, he cannot reasonably be expected to teach them to someone else. The viability of a peer-instructional system thus rests, by definition, on the maintenance of high uniform standards of proficiency. Therefore, the cadre who had been assigned to the project were asked to assist in designing a full set of performance tests, including nothing unessential and leaving out nothing essential, that would define exactly what a man should be able to do in order to perform his job competently.

The curriculum had to be restructured, emphasizing groups of functional tasks rather than subject matter. This led to the delineation of three distinct subjobs or modules: field wire techniques, switchboard installation and operation, and message center. The necessary equipment and supervisory personnel then had to be allocated to each module.

The most difficult task was designing a manageable training sequence for each module, with sufficient time allowed for the slower learners to master the tasks, without exceeding the overall time limit for all the modules taken together.

PHASE II EXPERIMENTAL RUN

The Phase II experimental run was scheduled as soon as these tasks had been accomplished and the staff had a performance-oriented, peer-instructional model ready for a preliminary test. The run began on 9 March 1970 and terminated on 30 June 1970. A total of 160 students drawn from the regular FWC input were assigned to the experimental course for all or part of their training. The run was generally successful. It provided insight into the need to maintain tight quality control, and indicated how this might be done.

PHASE III EXPERIMENTAL RUN

The Phase III experimental run was conducted in the FWC itself, and was manned by course personnel under the supervision of its proponent agency, the Southeastern Signal School. The APSTRAT staff served in an advisory capacity and in data analysis. This restricted role for the APSTRAT staff was adopted in order to assure that the results of the run would reflect normal course conditions. The goal was not merely to develop a new method of instruction, but to design a full and integrated system capable of coping with all contingencies—academic and administrative—that would have to be faced when the model was implemented in an ongoing course. The staff members wanted to know whether the model could "fly" without their intervention. By observing this process of implementation, they could gather information on the difficulties encountered and overcome. This information would be used in designing an implementation manual to serve as a guide for installing the model in a variety of courses.

The focus on task orientation, an essential component in the peer-instructional system, necessitated relief from the requirement to adhere to the Army Subject Schedule, since it is sharply oriented to lecture approaches. Immediately after the conclusion of

Phase II, an exception was requested from and granted by the U.S. Continental Army Command (CONARC).

Representatives of the Southeastern Signal School and the Field Wireman course at Fort Ord then met with the APSTRAT staff in July 1970 to begin the reformulation of course objectives, tasks, learning elements, and standards, and to establish a procedure for developing a full set of performance tests to measure proficiency.

The first use to which the tests were put was to gauge the performance proficiency of the output of the conventional course. This gathering of baseline data was begun in November 1970 and was completed in February 1971. Concurrent with the collection of baseline data, the gradual changeover to the peer-instructional system was also begun in November 1970 and completed in February 1971. Information on the results of the new system was collected from January to the spring of 1971.

The Phase III experimental run in the FWC is now complete. As a result of the pilot study, CONARC directed, in June 1971, that the model be implemented in the Field Wireman courses at all four of the remaining centers. The model is now fully installed and operating successfully in the five training centers.

THE DEVELOPMENT OF THE APSTRAT INSTRUCTIONAL MODEL

The previous section provided a brief overview of the history of APSTRAT The present section will recapitulate the earlier part of that history in somewhat greater detail, with emphasis on the experience and considerations that led to the development of a quality-assured peer-instructional model A description and discussion of the model itself will be presented in the next section.

CONSIDERATIONS: PRINCIPLES AND CONSTRAINTS

Previous research and the current state of the art can provide guidelines in the form of instructional principles that the designers of instructional models will seek to incorporate as their working strategy. This strategy is one of the two major factors that will shape the structure of the model; the second factor is the set of constraints that restrict design options. While designers normally begin with an instructional strategy and have some notion of the constraints they wish the model to accommodate, experience during the process of development often serves to clarify these considerations and to establish new emphases and tighter integration among them. The principles and constraints were not fully formulated at the outset of the project, but were clarified, extended, and integrated in the process of development. This gradual clarification, which was particularly true of the constraints, resulted from encountering the particulars of practical reality, about which educational technology—at this point in its development—has relatively little to say.

Principles

For several decades, HumRRO and other research agencies have been investigating human learning with the object of improving the technology of instruction. HumRRO also has focused its attention on the instructional principles appropriate for trainees at the lower end of the educational and aptitude spectrum. Many of these principles are suitable for all segments of the training population without respect to education or aptitude. However, while brighter and better educated students can learn a substantial amount even when these principles are violated, the less bright and less educated can learn relatively little. For the upper end of the continuum, then, the development of training methods that incorporate these principles would be desirable; for the lower end of the continuum, their development is urgent.

Performance Orientation. A clear specification of what the trainee is expected to learn, if he is to perform his job adequately, is the keynote of significant improvement in job training. The training process must focus on these job-performance objectives. The trainee must actively participate in the process, performing tasks rather than hearing or reading about them. The evaluation of proficiency must focus on the student's ability to perform the various tasks that make up the job rather than on his ability to answer questions about these tasks.

Learning in a Functional Context. In learning skills to be applied in particular circumstances, trainees will, in general, learn better and faster if those circumstances are present in the learning situation. Learning to operate a switchboard, for example, can be accomplished best if information about switchboard operation is presented while the trainee is actually operating a switchboard This would avoid an undesirable temporal separation of receiving information and putting the information into practice.

Individualized Instruction. For various reasons, including differences in aptitude, some people are capable of learning faster than others. Instructional methods, such as the lecture, that fix the pace at which learning must take place, leave some students behind and bore others. Although the need for self-pacing is less urgent for homogeneous groups (especially those composed of students who rank high on the educational and aptitudinal scales); no group of men is ever perfectly homogeneous Consequently, self-pacing is desirable in any instructional system.

Absolute Criterion. The weakness of fixed-pace training methods is clearly evidenced by the frequency with which large numbers of students fail to master the skills they are being taught. Low levels of achievement are an inevitable result of attempts to force people to learn at a rate faster than their capabilities permit. Generally, this weakness of instructional method is projected onto the students by grades that symbolize a position in a normative distribution; a passing standard then is established well below the 100% level (e.g., 70%). Students who barely pass this standard can graduate from a course even though their level of proficiency is closer to those who have failed than to those who are fully proficient.

Without individualizing instruction, giving slower learners the opportunity to reach complete competence in what they are learning, programs will continue to turn out large numbers of graduates with only marginal competence. One feature of the APSTRAT model was a passing standard of 100% for all necessary job skills. This standard is referred to as an absolute criterion, since, by definition, there can be no spread of scores among graduates.

Feedback to the Student and the Instructional Manager. Training methods that permit only delayed feedback to trainees (e.g., end-of-cycle exams) compound mislearning, and often produce negative effect on motivation. It is always preferable for trainees to experience a sense of security in what they have already learned, before they proceed to learn something else. This implies that accurate feedback should be presented to trainees at the earliest possible moment at each critical step of the learning process. Feedback, therefore, should be both rapid *and* detailed.

Detailed feedback to the training managers about the degree to which trainees are learning what they are supposed to be learning is essential for optimum effectiveness and efficiency in the training program In live instruction, immediate feedback will allow on-the-spot modifications of instruction that can prevent misunderstanding and mislearning, and the waste of time and loss of motivation that these produce. The enhancement of the feedback process is the major reason for the desirability of low student-teacher ratios. A training system can rationally achieve its prime function when there is access to detailed, rapid, and accurate information about how well learning is occurring.

Quality Control. Quality control, the set of procedures by which a system polices itself, is a mechanism for assuring that the stipulated objectives of a system are being attained. Regardless of the other properties of an instructional system, lax quality control leads to the lowering of standards and the degradation of the instructional product During the project, the APSTRAT staff became increasingly concerned with establishing a method of rigorous quality control as an intrinsic part of the APSTRAT model.

Constraints

The increasingly prominent role played in the planning by practical constraints was the result of two considerations: first, the general utility of the model to be developed would be considerably lessened if it violated certain common sense ground rules; second, the staff believed that the mission of training technology is to conserve resources—in

Buckminster Fuller's phrase, to do more with less. For these reasons the following constraints were used as fundamental parameters in designing the APSTRAT model.

1. Cost. The cost of implementing and operating a training model is of critical concern. This concern is greater when there is interest in its wide application (as in the case of a pilot study). Even moderate increases in the cost of a single course accumulate to a substantial sum when many courses are involved. Design decisions had to be examined very carefully with regard to the implications for the allocation of personnel, time, and equipment and the use of special instructional hardware and software.

a. Personnel. Many training courses are already undermanned. If the APSTRAT model were to require a significant increase in personnel, its general utility would be considerably reduced. The model was to require no personnel increase, but was to make more effective use of those already in the course.

b. Time. The proficiency gained as a result of training can be improved somewhat by lengthening the training period, but the model was to require no additional time.

c. Equipment. Many courses involve training in the operation of various types of equipment. These courses are issued such equipment in limited quantities. To be capable of wide application, the training model should not make excessive demands for equipment.

d. Instructional hardware. Many instructional innovations require the use of very costly hardware-computers, television, film, and other audio-visual recording and display equipment. The proper use of such equipment can enhance learning. However, the APSTRAT model was planned under the assumption that such equipment would not be generally available and, therefore, should not be required.

e. Instructional software. The production of educational software is extremely time-consuming and costly. Alterations in training objectives (e.g., those resulting from changes in equipment) require modifications of instructional materials that are also time-consuming and costly. A model relying heavily on instructional software, even if elaborate hardware were not required for its presentation, would have less general utility than one that could avoid this reliance.

2. Ease of Implementation. To the constraints of cost must be added those having to do with the process of implementation.

a. Training and orientation of course personnel. The introduction and effective operation of the model was not to require extensive retraining or reorientation of course personnel.

b. Ease of changeover. The difficulty normally encountered in incorporating a new model in an ongoing course can be reduced somewhat if the changeover can be accomplished gradually, without shutting down the conventional system. Adjustments then can be made in a revised segment of the course while normal output is maintained. There are substantial advantages to a model in which no segment in the conventional course is phased out until the corresponding segment in the revised course is operating satisfactorily.

Troubleshooting one segment at a time is generally more efficient than troubleshooting the whole system at once, and what is learned usually will provide more realistic guidelines for setting up additional segments. The tendency toward skepticism regarding the feasibility of training innovations can be alleviated by showing that the new model works in a succession of segments of the course.

c. Amenability of the model to improvement. Since a newly installed training system will almost always require modifications, a model that could avoid "locking in" its initial procedures would have a great advantage over one that could not.

d. Trainee output. When a new model is phased into an ongoing course, there is often a temporary reduction in output quantity and/or quality. The model to be devised should not require and/or permit such a reduction.

e. Accommodation of extra-instructional duties. Many housekeeping tasks in training centers are performed by trainees. These assignments have not always been well coordinated with training, and the quality of training has suffered as a result. Since KP and other details cannot be avoided, the model had to accommodate these additional duties without allowing them to interfere with training.

QUALITY, NUMBER, AND COST OF TRAINING OUTPUT

Because there is no agreed-upon way to compare the quality with the quantity of training output, it is a matter of opinion as to how much of one should be sacrificed to produce an increment in the other. The prime goal was to improve quality without a significant increase in academic attrition; preferably, academic attrition could be held constant or reduced.

A second question of trade-off is that between quality and number of training output and cost. A system that might prove more effective in terms of the training product might also be more costly than a less effective system. When quality and cost cannot be rendered commensurate in any compelling way, it is a matter of opinion whether any given improvement is worth the added expense. It would be preferable if the improvements could be brought about without a significant increase in cost. Furthermore, if these could be achieved while costs are held constant or reduced, many of the vagaries of cost-effectiveness evaluation could be avoided almost entirely.

SELECTION OF A REPRESENTATIVE CST COURSE

Since the purpose of Work Unit APSTRAT was to develop a model capable of wide application and not restricted to the course in which the model was first tested, the course selected for the pilot study had to meet two criteria. It had to (a) utilize a wide variety of skills, both motor and cognitive, in the curriculum, and (b) have a wide spectrum of measured aptitude among the students. To satisfy these criteria, the research staff selected the Field Wireman course (FWC) at Fort Ord.

The curriculum content of the course, as represented in the Army Subject Schedule, was reasonably diverse, and involved a full variety of skills and tasks, including cognitive, manual, and gross-motor elements and, in the case of pole climbing, a fear-inducing task.

The proportion of trainees entering the FWC in the lower part of the spectrum of measured aptitude (Mental Category IV) is substantial–24% in FY 67-68,[2] 28% in FY 71, and 40% in FY 72.

ANALYSIS OF CURRICULUM

Although the Work Unit was not concerned directly with curriculum content, it seemed reasonable to begin with the tasks actually performed on the job, in the field. Because a full systems analysis of the Field Wireman MOS was beyond the scope of the project, the APSTRAT staff accepted the course content, with the exception of the training block on cryptography which was scheduled for official elimination from the course.

[2] Ernest K. Montague and Morris Showel. *A Review of Combat Support Training*, HumRRO Technical Report 69-19, December 1969.

The staff requested and received the assistance of two FWC cadre in preparing behaviorally stated objectives for every task in the course. The objectives were then ordered into a descending hierarchy: job—duty position—job duties—enabling skills. Training materials were to be oriented to the enabling skills. The remainder of the hierarchy was to be associated with the development of an operational system that would bring together the individual skills in a functional simulated job context.

DEVELOPMENT AND TESTING OF ALTERNATIVE MEDIA

Upon completion of the curriculum analysis, several sets of alternative media (programmed manuals, tape-slide presentations, workbooks, games, simulators, etc.) were developed. In addition, a series of studies was conducted at the HumRRO laboratory in order to determine the relative merits of the various media in terms of time requirements, proficiency levels attained, and retention, and to guide the process of revision.

Trainees representing the full span of aptitude were selected from among graduates of Basic Training. One general finding was critical in reshaping strategy: men of lower measured aptitude were often unable to learn well from self-instructional media, even when these media required no reading or writing. When peer instruction was tested, the results were quite different. Three results were particularly striking:

(1) Men of all aptitudes were capable of mastering the task.

(2) There was no degradation of proficiency from generation to generation.

(3) There was a decided decrease in time-to-mastery from generation to generation.

Although successive generations of peers took less time to teach their students, their students performed the tasks as well as did the students who had been taught by experienced cadre or earlier generations of peer instructors. This was probably due to the improved signal-to-noise ratio in instruction resulting from a natural erosion of extraneous information in transmission. These findings with respect to peer instruction were critical in determining the ultimate direction of the project, but the full potential of this effective, efficient, and inexpensive medium was not fully grasped until the Phase I experimental run.

PHASE I EXPERIMENTAL RUN

Since the Phase I experimental run was purely developmental in function, only a brief summary of its purposes, procedures, and findings will be presented.[1]

The strategy at the time was to assemble the alternative media in a skill center and to provide a functional context for individual skills in an integrated operational system; eventually these two segments of the model were to operate concurrently. The curriculum was to be divided into a number of independent modules.

The students would have random access to these modules. Their progress through any module would begin with observing the tasks of that module performed in the operational system; they then would move into the skill center to acquire the task-relevant skills and report back to the operational system to "perform the job." The student would repeat this procedure with additional modules until he had completed the full curriculum. The operational system was to provide an initial and terminal functional

[1]The rationale of the Phase I experimental run is discussed in greater detail in *Functional Context Training in an Operational System*, by Kenneth Weingarten, Jacklyn Hungerland, Mark Brennan, Brent Allred, and Martin Pollyea, HumRRO Professional Paper 8-70, March 1970.

context for the skills to be learned, the output of the skill center was to provide the manpower for running the operational system.

In order to direct traffic in this complicated model, a control center was to be established. The full integration of these three segments of the model skill center, operational system, and control center—was to be approached through gradual approximation, in three phases. Phase I, the first approximation, was conceived as a developmental effort.

The run was divided into two sequential subphases. Phase I-A was a test of the instructional contents of the skill center. When this was completed, Phase I-B, a preliminary tryout of the operational system was attempted. There was no formalized control center during the run, indeed, one of the primary purposes of the run was to determine the rules and procedures to be incorporated in the control center in subsequent runs.

The run was conducted at Fort Ord from 27 October through 14 November 1969. The 25 trainees assigned to the experimental course for training were part of the regular input of the FWC. Eleven Category IV trainees and 14 Non-IVs were in the sample. Approximately one-half of the standard curriculum was presented during the run. When it ended, the experimental trainees were returned to the FWC for the remainder of their training.

Phase I-A was concerned mainly with the effectiveness of the previously prepared instructional materials, the expressed preferences of trainees at various aptitude levels among alternative media, the time required in training to reach mastery, and general administrative organization.

Phase I-B, the tryout of the operational system, was begun in the third week of the run. Each man was assigned to a duty position within the system and was required to perform, under the supervision of cadre, the functions called for in the position he was occupying. Because of a shortage of staff, job-proficiency tests were administered by the trainees who had previously passed them. When all job-proficiency evaluations were completed, the trainees were reassigned to new duty positions where the same procedure of performance and evaluation was followed. There was at least one such rotation of duty position for each man, however, many of the trainees rotated through more than two duty positions.

Findings in the Phase I Experimental Run

Among the findings in the Phase I experimental run, two were particularly important in a revision of strategy that led, ultimately, to the development of a quality-assured, peer-instructional model. Both of these findings were derived from comments by trainees during the course of the run and in after-action interviews.

(1) Even though there was considerable choice among media for various skills, trainees invariably preferred using the actual equipment to mockups, printed material, or more "sophisticated" media. This preference was by no means restricted (as might have been expected) to men of lower measured aptitude.

(2) Peer instruction was offered as a formal medium only in a few cases, however, a great number of trainees reported the spontaneous use of peer instruction in conjunction with and as a substitute for the other instructional packages. They stressed the advantages of peer instruction to themselves as learners (in acquiring skills) and as teachers (in solidifying and generating greater confidence in already acquired skills). In addition, several students commented on the sense of solidarity generated by an investment in one another's learning.

Student Comments

The following is a sampling of typical remarks by trainees comparing their experiences in the HumRRO experimental course with those in the regular Field Wireman course.

"In map, they (FWC) were teaching us stuff that we weren't even going to use there was an instructor up there and he's reading out of a book and we could do the same thing, because half of us were falling asleep in the class."

"I think the buddy system is better, because over there (FWC) you can't talk to whoever you're setting by to help him out. You have to raise your hand and ask the instructor, and then the instructor just if you don't listen the first time he doesn't say it again he doesn't repeat it."

"They (FWC) just teach you what they want you to know out of a book like today we were having classes on the TA 312 (telephone) and the TA 1 (telephone) and they were saying, 'Well, this has a transmitter, receiver and signaller; all right, anybody didn't understand that? Let's go on to the next phone.' Well, I mean, wow, that doesn't show you how to operate or nothing. I mean, they get the equipment, they aren't going to know what to *do* with it."

"Here (HumRRO) you get more time to work with the equipment—you get more time to think of what you're doing, and, you know, it really helps."

"I think what everybody is trying to say is that here at HumRRO, you had something to do all the time, you know, like it was on-the-job training you know. You could get something, grab it, do it, take your test, you had it maxed, then you went out to the field. And over there (FWC) they just lecture, lecture, lecture."

"Here (HumRRO) nobody would want to fall asleep—there was always something else he would want to do, like, you know, he would finish this, he'd want to go on, do something else on his own here at HumRRO you get interested in one thing and then you get interested in another, and you just keep going on—you want to learn more and more because you get more time to work with equipment and there's nobody around, you know, saying, 'Well, you're not supposed to be doing that now.'"

(Re Peer Evaluation and Self-Administered Achievement Tests) "You could cheat at any time you wanted to, but it wouldn't be any benefit to yourself."

"The trainee evaluation deal was really good, you know, because you could go through and test them and you could understand yourself what you were testing and you could learn it better yourself when you were testing him—it's just a double review."

"You're being taught (in HumRRO) on the concept of using your own mind, instead of someone else using your mind—I go over there (to the FWC), I feel like a goddamned computer. 'You stand over here, you stand this way, you can't learn this way, you can't do that.' Now, what kind of thing is that? I'm a human being. I wouldn't even want my family to come up here and see me being treated like that, I'd be embarrassed to hell."

The universal preference of trainees for "hands on" experience, the staff's increasing concern about the high costs of developing alternative media, the spontaneous emergence of peer instruction, and the experience with peer instruction in the laboratory studies combined to determine a new direction in strategy, the development of a quality-assured, peer-instructional model. The new model would dispense with the skills center and focus on peer instruction in an operational job setting.

A third finding during the Phase I experimental run that was fundamental in shaping staff thinking was the difficulty experienced in managing the operational system. Since the new model was to emphasize learning in a job-like context, the managerial problems of controlling the flow of trainees through the system had to be solved before the Phase II experimental run, a tryout of the new model, could be initiated. The change in strategy allowed the project staff to divert its attention from the development and revision of alternative media training packages and to concentrate instead on devising an operational system that could be managed without the difficulties experienced in Phase I.

A QUALITY-ASSURED, PEER-INSTRUCTIONAL MODEL

For several months following the termination of the Phase I experimental run, the project staff addressed the task of designing a performance-oriented peer-instructional model. It was at this stage that the network of constraints detailed in the previous section was clarified and brought to bear in the process of design.

This section will provide an overview and discussion of the main features of the model.[4] The best overall view of the model can be provided by beginning at the stage when the model is in full operation. (A more detailed treatment of the model, including the procedures for preparation, phasing in, and quality control, is presented in Appendix A, the Implementation Manual.)

ORGANIZATION OF THE MODEL

The model is organized on the basis of a series of instructional blocks or modules. Each module consists of a coherent grouping of tasks forming subjobs in the MOS. Taken together, the modules represent the various skills that are judged necessary and sufficient for job competence. In the Field Wireman course, there are three such modules: (a) Field Wire Techniques, (b) Switchboard Installation and Operation, and (c) Document Distribution and Radio Monitoring.[5] Another course might require a different number of modules.

The following is the five-step training sequence in each module.

(1) O Observation
(2) SA Skill Acquisition
(3) JP Job Performance
(4) PI Peer Instruction
(5) CA Course Administration

Observation

The first phase in the sequence is observation. Advanced students perform the job duties in each module, and new students, one for each job performer, observe them during this process. The job performers explain what they are doing and why. (New students are assigned to job performers on a random basis, except in the case of students who can communicate well only in a foreign language. In such cases, the module supervisor will pair the student, whenever possible, with someone with whom he can communicate.) During this observation period, the newcomers gain familiarity with the duties they will soon be learning to perform. The length of time devoted to this phase allows the new students to observe each task at least once and often several times. In

[4] The development of the model was gradual. In order to avoid confusion, the description that follows represents the end product of the developmental process. It should be noted, however, that many of the features of the model were refined during and after the Phase II and Phase III experimental runs.

[5] During the Phase II experimental run, the third module was Message Center. The name and context of the module were changed to Document Distribution and Radio Monitoring as a result of a reconsideration and revision of curriculum by the Southeastern Signal School and the Fort Ord Field Wireman course in preparation for the Phase III run.

most cases, the period will be no longer than one full training day. The relationship between observers and job performers is informal and conversational, allowing for a free flow of comments, questions, and answers

Skill-Acquisition Phase

After familiarization with the job duties of the module, the observers go on to acquire the skills and learn the tasks necessary to perform the job themselves. Their instructors during this period are the students whose job performance they have previously observed. The amount of time allocated to this skill acquisition period will vary with the number and difficulty of the skills to be mastered. When both the student and his peer instructor are convinced that he has mastered the skills necessary to perform a given task, they report to a cadre supervisor who administers a mastery test[6] to the student with the peer instructor observing. The tests are referred to as mastery tests, because the supervisor scores the student on his ability to perform the assigned task without error. If he makes any error, even one that might be regarded as relatively minor, he fails the test.

If the student passes the mastery test, he then proceeds with the next task in the module and repeats the procedure of skill acquisition and mastery testing until he has passed all the mastery tests in the module. If a student fails any mastery test, both he and his peer instructor are told where he has failed, and the student must review and practice until he and his instructor feel he is ready to be tested again. If the student fails the test repeatedly, he is dropped from the course, because repeated failure means that he is not competent in that part of the MOS, would not be able to perform that aspect of his job properly, and would not be a competent peer instructor. The cut-off for academic drops in the FWC is failing the same test three times.[7]

Job-Performance Phase

After he has passed all the mastery tests in a module, a student can be scheduled for his job-performance period. An incoming student now observes him as he performs the job. Job performers confront a situation as similar to field conditions as possible. They should have no access to materials or training aids that would not be available on the job.

Peer-Instructor Phase

At the conclusion of the job-performance period, job performers become peer instructors, and the men who have observed them enter their skill acquisition phase. Peer instructors are provided with simple guidelines, enumerating the major job elements that they are to teach their students, and checklists (copies of the mastery tests) for a finer breakdown of job elements. These guidelines and checklists serve the function of memory aids so that peer instructors will not inadvertently omit essential elements in their instruction. It should be noted that because of the different length of modules, peer instructors will of necessity be paired with different students in each module.

[6] Sample mastery tests are included in the Implementation Manual, Appendix A.

[7] An alternative approach to the problem of failure in a peer instructional system where the time constraint is not critical is described in a study by Jacklyn E. Hungerland on the utilization of a quality assured, peer instructional system at the primary and elementary grade levels in public schools.

Administrative Assistance Phase

When the peer instructors' students have passed all the mastery tests and are ready for their own job-performance period, peer instructors move on to become course administrative assistants. In this fifth phase of the sequence, assistants may perform a variety of functions. They may serve as substitutes for absent peer instructors, screen students on the mastery tests so that the testing load on the supervisors can be reduced, or be assigned a variety of other duties appropriate to any module that they have successfully completed. (In the switchboard module in the FWC, for example, course administrative assistants originate calls for job performers.) The period of time allocated to course administrative assistance may vary from course to course or module to module. In the FWC, however, one day in each module was allocated for this purpose.

When the student completes his administrative-assistance period in a module, he goes on to become an observer in the next module, repeating the entire cycle: observation, skill acquisition, job performance, peer instruction, and course administration. When he has completed the last module, he is ready for end-of-course processing and graduation.

THE APSTRAT MODEL: INSTRUCTIONAL POLICY AND CONSTRAINTS

The leading principle in the APSTRAT instructional policy was performance orientation. This principle not only dictates that trainees will be actively engaged in the learning process while they are learning to perform the skills required on the job, but also demands thorough performance testing. This creates a manpower problem. The only available personnel capable of reliable performance testing are the cadre. If cadre are engaged primarily in teaching a course, it will not be possible to supply the necessary manpower for testing without substantially augmenting, perhaps doubling, the number of cadre in the course. Since one of the constraints imposed on the model was that it should not require such augmentation, the only available means to provide for thorough performance testing was to free cadre from their instructional duties.

Relieving cadre of their instructional duties raises the question of what medium or media could be used to replace them. It would be quite natural, under the circumstances, to turn to self-instructional media; this was the original plan. However, the expense involved in the development of these media would have violated another constraint that had to be placed on the model: If it was to have practical utility, it must not require the use of expensive educational hardware and software. Alternatives were thus severely restricted, ruling out augmentation of currently available resources. It became necessary, instead, to employ them more effectively.

The new instructional medium had to be shaped from the student body. The principle of performance orientation coupled with the constraints relating to personnel and educational hardware and software limited the options to a single medium: peer instruction. Experience with peer instruction in laboratory tests and the Phase I experimental run pointed the way to this conclusion and gave the project staff confidence that a model based on peer instruction would work, if the managerial requirements of such a system could be worked out.

The decision to utilize peer instruction raised additional questions relating to the proficiency levels trainees were to achieve. The initial intention was to develop a model that would substantially raise trainee proficiency, particularly among slow learners, to, it was hoped, the level of mastery. At the outset of the project, the aim was to devise an instructional model that would require complete mastery by every trainee of every skill in the course. A peer-instructional model of the type that was eventually developed made this an absolute requirement, since trainees who could not master the skills they were being taught could not be expected to impart these skills to other trainees.

The demand for mastery, where mastery is, by definition, a very high level of [illegible] among all graduates, creates a potential problem with regard to the time [illegible]. Given a fixed time limit for the course, students who were unable to attain mastery [illegible] reasonable time would have to be dropped as academic failures. While reasonable [illegible] difficult to define precisely, some standard was necessary. The arbitrary standard adopted [illegible] the Field Wireman course was that any student who failed [illegible] test three times would be dropped.

Establishing such a standard raises a fundamental question with regard to the trade-off between quality and quantity. Was the higher quality of course graduates to be purchased at the expense of reducing the number who graduate? The issue of academic attrition was the prime empirical question in the Phase III experimental run.

The demand for mastery is not merely a desideratum of the APSTRAT model; it is a necessary condition for the viability of the entire system. In instructional systems of other types, relaxation of the demand for mastery will lower the quality of training output. In a peer-instructional system, the relaxation of this demand will degrade the training mechanism as well. This peculiar vulnerability of a peer instructional system calls for the most rigorous quality control to prevent laxity in the enforcement of the mastery standard. Fortunately, the peer-instructional model possesses a unique and more or less self-maintaining mechanism for assuring rigorous quality control. Since a tutor who has not attained mastery will be unable to bring his student to mastery, evidence of mastery on the part of any student is transitive along any ascending instructional channel; that is, his mastery is prima facie evidence of his peer instructor's mastery, his peer instructor's peer instructor's mastery, and so on. (Additional quality control procedures are described in the Implementation Manual, Appendix A.)

The manner in which the model [illegible]

[illegible] summarized briefly.

All learning takes place in a functional context; modules are arranged to [illegible] [illegible] and all information is presented when it is required for learning to [illegible].

The rate at which a trainee learns is determined by his own speed. A peer instructor [illegible] optimal position to speed up or slow down [illegible] appropriate to the needs of his student.

The [illegible] for student rate also allows for extremely rapid and detailed feedback to student and instructor. An additional source of feedback [illegible] is provided by the cadre-administered tests.

The model was designed to operate within the constraints of personnel, time and [illegible] hardware and software (the constraint having to do with peripheral equipment will be discussed in a later section). Another set of constraints [illegible] the problems of implementation. A brief description of the way in which the model [illegible] [illegible].

PHASING IN THE MODEL

[illegible] accomplished [illegible] [illegible] [illegible]

The reason for adopting this backward phasing-in process is that it permits change-over to proceed as rapidly as possible without interrupting student flow. (In the case of a newly established course, backward-phasing would not be appropriate, and modules would be started-up in the opposite order.) A great advantage of implementing one module at a time is that it allows course personnel to concentrate their effort and accumulate experience with the system in such a way that what is learned in one module can be used with advantage, in the next.

To start priming a module,* a cadre supervisor selects one student who has not received instruction in the subject matter of the module. He has this student observe him as he goes through the job-performance phase. He then instructs the student, as a peer instructor would, during the student's skill-acquisition period. Another cadreman administers the mastery tests. When a student has passed all his tests, he goes on to perform the job. If the student cannot perform the job adequately, the tests must be upgraded or the testing procedure improved. When a student can pass all the tests and can perform the job adequately, he repeats the job-performance segment with a new student observing him. He then becomes the new student's peer instructor.

All students who pass the mastery standard can be retained in the module, and together with the cadre, they instruct incoming students until the full flow of students can be accommodated. At this point, the cadre are phased out of their instructional role.

During the priming of the module, a cadre or peer instructor may teach two or three students at once to speed up the phasing-in process. At an appropriate time during the priming process, students who have completed their peer instruction function can be assigned course administrative duties.

The priming process is repeated in every module until the last module has been completely phased in. The process by which the model is phased into an ongoing course satisfies the implementation constraints that were imposed in designing the model.

DISCUSSION

Successful operation of the new model does not require retraining of personnel and is not contingent upon winning over the cadre. Job competence and the ability to judge job competence are the chief characteristics demanded of the cadre. Moreover, because the model does away with lectures, cadre who are to be newly assigned to the course will not have to receive training in pedagogical techniques. The cadre must be oriented to their specific duties in the new model, but minimal time is required for this.

For a variety of reasons, many of the course personnel may be expected to resist change. This was the case in the FWC at Fort Ord, where much of the resistance voiced by many of the cadre, was expressed in the disbelief that a system of "the blind leading the blind" could produce well trained graduates.

Paradoxically, it appears that these negative attitudes were a positive contribution to the transition to the new model. While they have no explicit data to prove this, observers among the APSTRAT staff and administrators in the FWC noted a tendency among cadre to attempt to demonstrate the unworkability of the new model by administering the mastery tests with extreme rigor. Since the maintenance of the mastery standard is not a threat to the system but a necessary element in its viability, the model converts resistance to change into an asset. Staff observations also indicate that most of the resistant cadre were in fact won over to the new model not as a result of attempts to persuade them, but rather as a result of experience in operating the system.

* [illegible]

The process of phasing in the new model is a gradual one. The conventional course need not be shut down during the changeover The model is phased in on a module-by-module basis, and each module is expanded gradually. If difficulties arise at any point during the priming of a module, the expansion can be halted until the difficulties are resolved. The implementation process, thus, rides on its own success.

Because the model does not use educational software, new training requirements can be introduced into the course without the delay entailed in a lengthy revision of materials. For example, in the case of equipment changes in the MOS, a revision of training requirements can be introduced as soon as the obsolete equipment can be replaced by the new equipment, and the cadre in the relevant module are trained in its use The cadre will substitute for peer instructors in that instructional segment In most instances, the changed requirements will be small in scope, and this repriming process will be of correspondingly short duration

In order to make clear how the model accommodates the requirement that trainees perform KP and other details, a closer look at the way trainees flow through the system is needed Figure 1 describes the student flow in a hypothetical course in which each trainee is required to perform four days of detail [1] In this course, there are only two minimum-day modules (i.e., modules requiring only one day for each step in the five-step training sequence)

Hypothetical Two-Module System

Module 1 | Module 2

Day	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F
Group 1	O	SA	JP	PI	CA	O	SA	JP	PI	CA	D	D	D	D	G
Group 2	D	O	SA	JP	PI	CA	O	SA	JP	PI	CA	D	D	D	G
Group 3	D	D	O	SA	JP	PI	CA	O	SA	JP	PI	CA	D	D	G
Group 4	D	D	D	O	SA	JP	PI	CA	O	SA	JP	PI	CA	D	G
Group 5	D	D	D	D	O	SA	JP	PI	CA	O	SA	JP	PI	CA	G

Module 1 | Module 2

D Details O Observation SA Skill Acquisition JP Job Performance PI Peer Instruction
CA Cadre Administration G Graduation

Figure 1

Trainees are assigned to Army courses in weekly classes In the APSTRAT system, every class is divided into five approximately equal-sized groups, one group entering the first module on the first day, and an additional group entering on each succeeding day. In the simplified hypothetical two-module system presented in Figure 1, Group 5, which enters the first module on Friday after having spent the first four days of the week on details, would finish the second module on Thursday of the third week and would graduate Friday Those in Group 1 would finish the second module on Friday of the second week they would spend the next four days on details and would graduate Friday

[1] The student flow in the Field Wireman course is presented in the Implementation Manual, Appendix A

along with Group 5. Those in the three other groups would have their four detail days split into two segments—preceding the first module and following the last: they, too, would graduate with their classmates.

The model as described in this section represents its final form; this form developed gradually. In the Phase II experimental run, which will be described in the next section, the training sequence—O-SA-JP-PI-SA—was tested. Many additional features, including the procedures for phasing the model into an ongoing course, were developed in the interim between Phase II and Phase III.

THE PHASE II EXPERIMENTAL RUN

The peer-instructional model was tried out first in the Phase II experimental run. This section will describe briefly the procedures employed and the information obtained during the run.

The first order of business in laying the groundwork for the Phase II experimental run was the preparation of realistic job-performance scenarios, instructor's guides (procedural step checksheets), and mastery tests. (Mastery tests and procedural step checksheets have essentially the same content.) When these three tasks had been completed, arrangements were made to obtain subjects from the regular input of the Field Wireman Course.

The Phase II experimental run started on 9 March 1970 and was terminated on 3 June 1970. Sixty-four trainees received all of their wireman training in the APSTRAT model, an additional 96 trainees received only part of their training in the model. The modules of instruction, in their order of introduction, were Switchboard Installation and Operation, Field Wire Techniques, and Message Center.

In the manner prescribed, the Switchboard module was phased in on a day-by-day basis. The process was completed without complication, and there was, consequently, no need to repeat or further refine any of the subsections of the module.

Complications did arise in phasing in the second module, Field Wire Techniques (FWT). By the third skill acquisition day, two problems became evident. The map reading portion of the curriculum could not, at that time, be worked into a job-performance context in a realistic fashion, and the second skill acquisition day needed major revision. Men who had progressed into the FWT module were returned to the regular course for the remainder of their training. The map reading component was made into a separate module (following Switchboard), and the second skill acquisition day was revised. This was done prior to the start of the next training day.

The experience in revising the FWT module confirmed the staff's belief that the model was amenable to improvement without creating difficult administrative problems. The ability to delay further expansion of the model until all the necessary corrections had been made allowed the project staff to concentrate its effort where it was most required.

The third module, Message Center, was phased in without incident.

After 16 four-man groups had completed all of their wireman training in the APSTRAT model, the experimental run was terminated. (Input to the first module had ceased some time before, and the modules were phased out in the order in which they had been phased in.)

An administrative day, during which the trainees were returned to the Field Wireman course for testing, was scheduled at the end of each module. They were given the conventional course tests appropriate to the modules they had completed. When failures did occur on these tests, they were most often in the paper-and-pencil tests rather than in the performance tests. Often the APSTRAT trainees did so well in the performance tests that they were passed, even if they did not reach the passing level in the paper-and-pencil tests. Consequently, after being returned from the experimental run, only a few trainees were held over their normal time in the course.

The fundamental purpose of the Phase II experimental run was to determine the operational feasibility of the model and to establish what improvements were required in preparation for full-scale testing of the model in the Field Wireman course. This was the ultimate objective of the project. Following are the results of the run that are relevant to this objective.

(1) In terms of the APSTRAT mastery tests and the conventional tests administered at the FWC, men at all aptitude levels were capable of learning and teaching the required skills at a predetermined level of mastery. APSTRAT students did considerably better on the performance tests in the conventional course than did conventionally trained students. The improvement was particularly striking among Category IV students in the two groups.

(2) The peer instructors' guides had to be pruned to bare essentials. Adding information to these guides had reduced the likelihood that poorer readers would use them at all.

(3) No special strategy for pairing instructors with students was required; incoming trainees were assigned randomly to job-performer, peer instructors.[10]

(4) The model satisfied the personnel constraint. The conventional FWC has a ratio of one cadreman to nine trainees; the APSTRAT Phase II experimental run had a ratio of one cadreman to 13 trainees. Sometimes this ratio was greater, depending upon cadre leave schedules. Once in the FWT module, *two* regular cadre were supervising 52 trainees per day in two different locations (about one mile apart), with diffuse deployment. The use of administrative-day trainees as assistants relieved, to some extent, the supervisory situation, but one cadreman was compelled to remain with the 24 trainees who were learning the pole-climbing technique. This left the other cadreman with 28 trainees under his supervision. Although these ratios were not optimal to the functioning of the system, they did not create insurmountable difficulties.

(5) As noted previously, it was possible to revise modules in mid-course without an interruption of input flow. This would not have been possible if the conventional course had not been running concurrently.

(6) A final, and vital, piece of information came out of this run: the absolute need for regular and rigorous quality control. In the first module to be phased in, Switchboard, peer instructors were given the responsibility of administering mastery tests to their own students as a way of compensating for personnel shortages. The result was a degradation of quality (as measured by the conventional course tests), presumably caused by the peer norms that proscribe flunking a buddy as well as by the fact that peer instructors were evaluating their own products. This situation was corrected when the testing function was returned to the cadre. This experience showed that proficiency tests and all other quality control measures *must be* conducted by supervisorial personnel.[11]

[10] The only exception to this rule was the case of Spanish-speaking students who were assigned to Spanish-speaking peer instructors. When written material was encountered that they could not handle, these students were returned to the Field Wireman Course for their normal drop procedures.

[11] There is, however, an intermediate measure, the use of peers as "screeners" prior to testing, which later developed and will be discussed further in the context of the Phase III experimental run.

THE PHASE III EXPERIMENTAL RUN

The Phase II experimental run was developmental in function, its main purpose being to refine the instructional model in preparation for a full scale test. This test was to involve the conversion of an ongoing course into the structure of the new model, with the major responsibility for the conversion placed within normal Army channels (i.e., in the hands of the course administrators and their proponent school). The APSTRAT staff was to assure that the basic concepts of the model were adhered to, provide technical assistance when required, and analyze data, but they were to have no direct management functions. The Phase III experimental run was intended to test not only the model's instructional efficacy and internal manageability, but also its "real world" feasibility.

RELIEF FROM REQUIRED ADHERENCE TO THE ARMY SUBJECT SCHEDULE

The Army Subject Schedule that governed instructional procedures in the training of Field Wiremen was oriented to the lecture-demonstration paradigm of the conventional course, and therefore was incompatible with the new model. Accordingly, at the termination of the Phase II experimental run, relief from the subject schedule was requested and the request was granted.

STIPULATION OF CONSTRAINTS

Approval of the Phase III experimental run was contingent upon agreement among CONARC, Fort Ord, and HumRRO concerning a set of ground rules. These ground rules were an explicit statement of many of the constraints described in a previous section. It was agreed that no additional personnel, equipment, facilities, or funds would be required beyond what was already allocated to the FWC, the regular input of the course would be maintained without interruption, and at no time would the quality of output decline below the existing level.

INVOLVEMENT OF THE PROPONENT SCHOOL

Since no full-scale trial of the model could be conducted without the sanction of the proponent agency, arrangements were made with the Southeastern Signal School (SESS) to have their representatives confer with FWC and HumRRO personnel in July 1970. These meetings resulted in an agreement on the division of functions in carrying out the following research and implementation plan:

Item	Responsibility
(1) Curriculum revision	FWC and SESS
(2) Preparation of mastery tests	FWC
Review of tests	HumRRO
Concurrence on tests	SESS

Item	Responsibility
(3) Collection of baseline data	FWC
(4) Design of overall course schedule	FWC (with HumRRO consultation)
(5) Design of modules	FWC (with HumRRO consultation)
(6) Preparation of peer-instructors' and supervisors' guides	FWC (with HumRRO consultation)
(7) Implementation of modules	FWC (with HumRRO consultation)
(8) Collection of data from modules	FWC
(9) Data analysis	HumRRO

1 Curriculum revision. Relief from the Army Subject Schedule had already been obtained through CONARC, and the SESS representatives and the FWC field-content experts were free to proceed with the reformulation of the course objectives, tasks, learning elements, and standards, and the composition of individual modules. It was at this stage, for example, that the content of the third module was revised and the name of the module changed from Message Center to Document Distribution and Radio Monitoring. This project was completed during the week in July when SESS personnel were present.

2 Preparation of mastery tests. During the July conference, it was decided that the SESS would prepare the appropriate mastery test guidelines.[1] One week later this plan was revised; the FWC would prepare the test guidelines and forward them to HumRRO for review and concurrence as to form (i.e., to assure that the test guidelines were unambiguous). HumRRO then would forward the tests to the SESS for concurrence as to content. This latter procedure was followed with all test guidelines. Only minor revisions were suggested by SESS once the guidelines had been reviewed and approved by the HumRRO research staff.

There were 13 mastery tests altogether (five in the FWI module, and four each in the other two modules). By agreement between the FWC at Fort Ord and the SESS, mastery of the tasks measured by these 13 tests was the operational definition of competence in the Field Wireman MOS. In some instances, the FWC used the Phase II prototypes for reference.

3 Collection of baseline data. Before each module was phased [illegible] a sample of students who had successfully completed the parallel subject matter in the conventional course were given the new mastery tests. This was done in order to determine the extent to which the conventional course was attaining the performance objectives and to provide a standard of reference for gauging the impact of the new model on performance capability. The tests were administered by FWC cadre and the data were [illegible] HumRRO for analysis.

[1] [illegible] APSTRAT [illegible] Appendix A

4. Design of overall course schedule. Before the individual modules were designed, the full eight-week time block had to be mapped out. This included not only the three modules, but driver training, Commander's time, details, field training exercise, graduation, and outprocessing.[1] This was done by the FWC in close consultation with HumRRO.

5. Design of modules. The FWC had the chief responsibility for designing the instructional modules on the basis of the guidelines established by HumRRO. The job-performance phase of the module had to be designed so that none of the skill components included in the mastery tests were omitted. Approximate times, in terms of numbers of days, had to be assigned to the skill-acquisition phase. Physical arrangements and necessary equipment for the job-performance and skill-acquisition phases had to be determined, and supervisory procedures, including the assignment of personnel, had to be established.

The preparation of mastery tests, the collection of baseline data, and the design and implementation of each module were accomplished on a module-by-module basis. The process began with the terminal module of the course—Document Distribution and Radio Monitoring. The purpose of introducing the modules in reverse order was to provide an uninterrupted flow of students through the course during the process of changeover, and to prevent the premature exhaustion of the supply of trainees trained entirely by the conventional method, before the baseline data were collected.

6. Preparation of guidelines for peer instructors and supervisors. Before any module was phased in, explicit guidelines had to be prepared. These described administrative procedures and responsibilities for each module phase for the supervisors, and outlined the major job elements for the peer instructors. In addition, peer instructors were to be provided with detailed checklists, essentially a listing of the performance items in the mastery tests, to remind them, when necessary, of what they were to teach their students. The FWC prepared these items.

7. Implementation of modules. The implementation of each module proceeded in a set pattern: First, each module was "dry run," during which allocation of equipment and time were checked empirically, and the mastery tests were validated with respect to the job-performance phase of the module. One trainee was selected at random from those entering the equivalent portion of the conventional course; he observed a cadreman in the job-performance phase. The cadreman then became the trainee's peer instructor. When the trainee had passed all the mastery tests in the module, he performed the job. (In the event that students who pass the tests cannot perform the job, the model calls for repeated reexamination and revision of the tests until passing the tests is a valid indicator of the ability to do the job. In the FWC, none of the tests required such upgrading.) A new student then was selected at random and assigned to observe the job performance, and then he proceeded through the skill-acquisition, job-performance phases. The dry run was continued for several generations.

When all the required adjustments were made in the module, it was gradually expanded until the full input was accommodated in the peer-instructional process. During the expansion, cadre and peer instructors often taught more than one student at a time in order to accelerate the installation of the module. Although HumRRO advised and observed the process of implementation very closely, the FWC was in charge of its management.

8. Collecting of data from modules. Conventional course data were collected for the scores on mastery tests and conventional tests, and on academic attrition rates and

[1] Nine days were allocated to these additional activities, leaving six weeks and two days for training in the three modules. The course schedule presented in the Implementation Manual, Appendix A shows the way in which these activities were programmed.

aptitude categories The FWC also collected data from each module after it had been fully installed These included pass fail records on the mastery tests, number of retests and time to mastery, recycles and academic attrition rates, and aptitude categories Data aside from the mastery test scores for the trainees in the conventional course, were all normal by-products of both courses. All these data were collected by the FWC

9 Data analysis The baseline and APSTRAT system data were collected by the FWC and were supplied to HumRRO for analysis The findings of this analysis are presented in the next section

These nine activities, often overlapping in time comprise the major elements in the Phase III experimental run The time schedule of events (omitting data analysis) is presented in Figure 2

Schedule of Events—Phase III Experimental Run

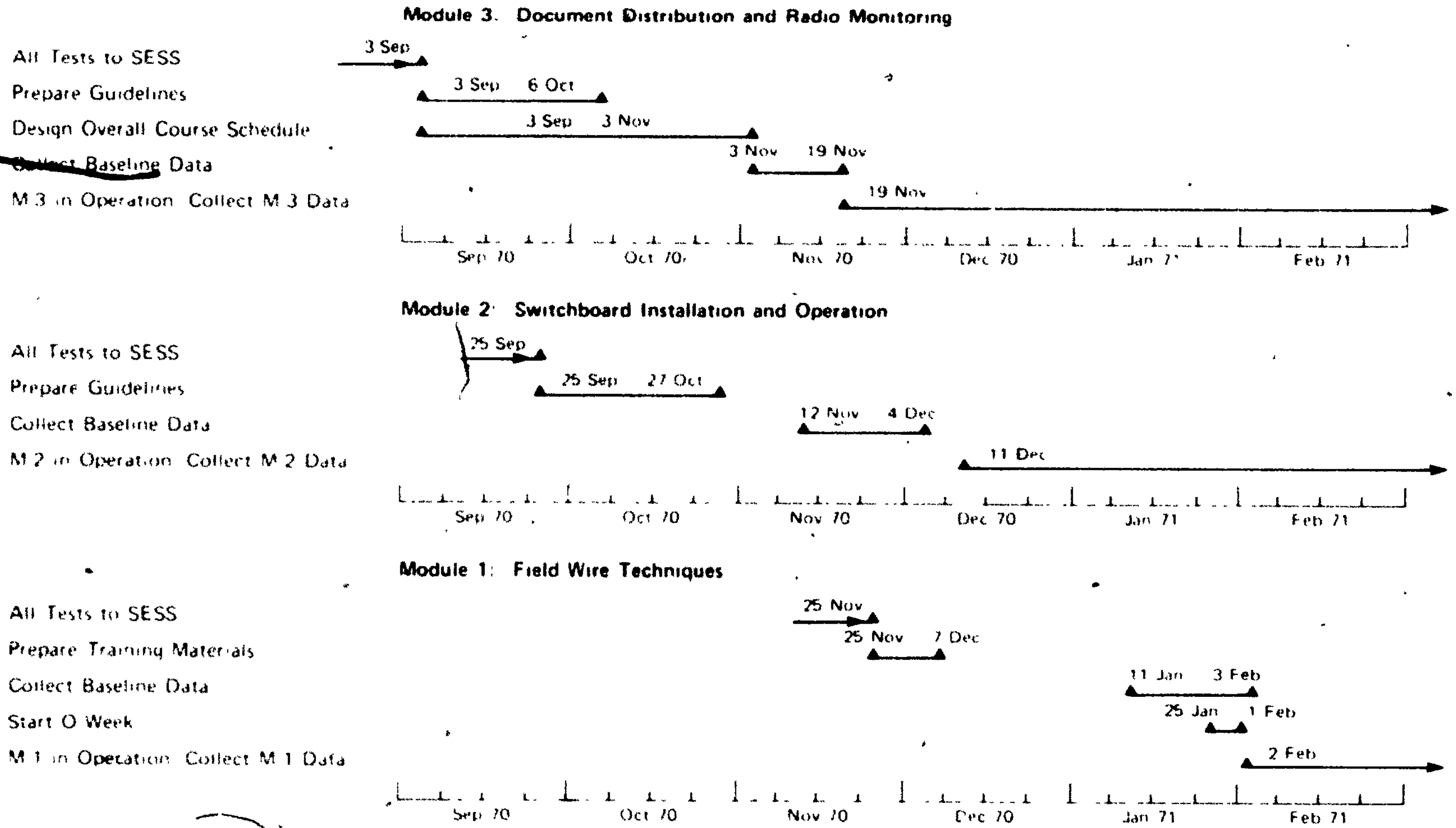


Figure 2

FINDINGS

In an earlier section, the two primary objectives of the project were discussed: (a) to develop a model that would raise the performance level of graduates of the course to the level of mastery (defined as 100% scores on all mastery tests) without a significant decrease in the number of graduates, and (b) to accomplish this objective without a significant increase in cost. The data gathered during the Phase III experimental run were organized in terms of these two objectives.

THE TRAINING PRODUCT

The mastery tests used in the FWC were designed by representatives of the FWC in close cooperation with representatives of its proponent agency, the SESS, as measures, in their judgment, of competence in the Field Wireman MOS. (Samples of these mastery tests are included in the Implementation Manual, Appendix A.) The mastery tests were first administered to students in the conventional course, upon the completion of the parallel portions of the conventional curriculum. Subsequently, these tests were introduced as standard elements in the new modules. Table 1 summarizes performance data in all three curriculum areas or modules.

None of the conventional course students in either aptitude group passed the mastery tests at the 100% criterion The mean scores for the groups analyzed are substantially below this criterion, ranging from 77% in Field Wire Techniques to 23% in Document Distribution and Radio Monitoring. These data represent the performance capability of men who, according to the criteria of the conventional course, had successfully completed the indicated parts of the curriculum.

Since the criterion for successful completion of a module in the APSTRAT system is the achievement of 100% scores on all tests, the two right-hand columns are as much a matter of definition as of empirical findings. If the mastery tests are valid indicators of job competence (as the FWC and the SESS intended), then every graduate in the APSTRAT sample is better prepared for the job than anyone graduating from the conventional course The scores of the conventionally trained students on the conventional system tests, although generally higher than those on the mastery tests, are still well below maximum, as Table 2 shows.

In Tables 1 and 2, three general patterns emerge with respect to students trained in the conventional system

(1) They do better in those parts of the curriculum that already have a strong performance component (Field Wire Techniques and Switchboard) than in those parts heavily loaded with cognitive content, (Document Distribution and Radio Monitoring).

(2) Category IV students show consistently lower achievement than Non-IVs

(3) The differential achievement of the two aptitude groups is greater in the more cognitively loaded areas Under the APSTRAT system, with its insistence on mastery, this pattern disappears

Table 1

Comparison of Scores on Mastery Tests, FY 71
(Percent)

Mastery Test	Level of Achievement	Conventional Category IV	Conventional Non IV	APSTRAT Category IV	APSTRAT Non IV
Field Wire Techniques		(N 20)	(N 29)	(N 23)	(N 35)
	100	0	0	100	100
	90 99	15	31		
	80 89	30	21		
	70 79	25	21		
	60 69	20	10		
	50 59	0	7		
	40 49	10	3		
	30 39	0	7		
	Mean	75	77	100	100
Switchboard		(N 23)	(N 34)	(N 14)	(N 43)
	100	0	0	100	100
	90 99	0	0		
	80 89	0	0		
	70 79	0	3		
	60 69	30	47		
	50 59	39	35		
	40 49	22	12		
	30 39	9	3		
	Mean	54	59	100	100
Document Distribution and Radio Monitoring		(N 10)	(N 32)	(N 20)	(N 32)
	100	0	0	100	100
	90 99	0	0		
	80 89	0	0		
	70 79	0	0		
	60 69	0	0		
	50 59	0	9		
	40 49	10	22		
	30 39	30	31		
	20 29	20	19		
	10 19	10	13		
	0 9	30	6		
	Mean	23	30	100	100

Table 2

Scores of Conventionally Trained Students on Conventional System Tests FY 71

(Percent)

[illegible]	[illegible]	[illegible]	[illegible]
[illegible] Techniques	100	0	0
	90 99	[illegible]	40
	80 89	[illegible]	48
	70 79	[illegible]	10
	60 69	[illegible]	0
	50 59	4	2
	Mean	83	[illegible]
[illegible]	100	4	[illegible]
	90 99	33	63
	80 89	[illegible]	35
	70 79	[illegible]	2
	Mean	88	91
Document Distribution and Relay Monitoring	100	[illegible]	8
	90 99	4	[illegible]
	80 89	15	[illegible]
	70 79	[illegible]	[illegible]
	60 69	[illegible]	[illegible]
	50 59	[illegible]	[illegible]
	40 49	[illegible]	8
	30 39	4	0
	Mean	[illegible]	[illegible]

Academic Attrition Rate

The demand for mastery in the APSTRAT mode [illegible] but what does it imply for the academic attrition rate? A trainee in the APSTRAT system is dropped as an academic failure if he cannot achieve 100 [illegible] any test. The procedure in the conventional course was less stringent and [illegible] out. A comparison of the academic attrition rates shows that [illegible] of the [illegible] trainees in the conventional course were academic drops and 12 [illegible] of the [illegible] APSTRAT course were dropped (p .05).

- Students who entered the APSTRAT system had a somewhat greater likelihood of graduating than had conventionally trained students despite the higher performance standard for the former. The reduction in the academic attrition rate cannot be explained on the basis of differential aptitude composition of the two samples [illegible] contained the same proportion of Category IV men (28 [illegible] 28 in the APSTRAT course).

More recent data drawn from the [illegible] are shown in Table [illegible]. Between FY [illegible] and FY 72 the proportion of Category IV personnel increased from 28 to [illegible] and the overall attrition rate for the [illegible] [illegible]

Academic Attrition Rates for Category IV and Non IV Personnel in the APSTRAT Course FY 72

Academic Recycling

Results

Table [illegible]

Number of Retests to Achieve Mastery in the APSTRAT Course, by Aptitude Group

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] 8[illegible]
		4[illegible]	[illegible]
		[illegible]	[illegible]
	Mean	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
	Mean	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] 90
	Mean	[illegible]	[illegible]

[illegible]

Relationship Between Measured Aptitude and Mastery Time

[illegible] measured aptitude and time [illegible] mastery. The [illegible] difference because of aptitude. The other two [illegible] expected direction [illegible] each module. The [illegible] more time to complete the [illegible] complete Document Distr[illegible] [illegible] hour difference in terms [illegible] significant.

[illegible] differences with respect to the [illegible] surprising. While the performance [illegible] under optimal feedback conditions

Table 5

Time of APSTRAT Students to Achieve Mastery During the Skill-Acquisition Phase, by Aptitude Group

Mastery Test	Time to Achieve Mastery (hours)	Category IV (%)	Non-IV (%)
Field Wire Techniques		(N = 23)	(N = 35)
	9.0 - 11.2	22	17
	11.2 - 13.4	35	49
	13.4 - 15.6	35	14
	15.6 - 17.8	4	14
	17.8 - 20.0	4	6
	Mean time (hours)	13	13.18
Switchboard		(N = 14)	(N = 43)
	15.0 - 15.8	14	40
	15.8 - 16.6	7	30
	16.6 - 17.4	36	21
	17.4 - 18.2	14	7
	18.2 - 19.0	29	2
	Mean time (hours)	17.23	16.24
Document Distribution and Radio Monitoring		(N = 20)	(N = 82)
	4.0 - 5.8	5	2
	5.8 - 7.6	20	30
	7.6 - 9.4	15	54
	9.4 - 11.2	50	12
	11.2 - 13.0	10	2
	Mean time (hours)	9.25	8.[illegible]5

that characterizes the APSTRAT model would be expected to minimize the differences between Category IV and Non-IV trainees, three features of the model should be considered in interpreting the data in Tables 4 and 5: (a) the policy for determining academic drops, (b) the absence of an incentive for rapid learning, and (c) the random matching of peer instructors with students. It would seem likely that more substantial differences would have emerged between the two aptitude groups if students were not dropped after three failures but were carried to criterion, if differential reinforcement were provided for attaining mastery rapidly, or if peer instructors were matched with students at the same measured aptitude level.

Summary

The data presented conform to project objectives in both the number and quality of the training output. The academic attrition did not rise as a result of the model's demand for mastery; in fact, it fell. Furthermore, the number of retests and time to mastery were well within manageable limits.

COST

Since there is no clear way to assign a dollar value to [illegible] product in the FWC, the APSTRAT staff omitted this [illegible] from its calculations. However, the operational cost of the improvement [illegible] discussed.

The APSTRAT course required no more overall time than did the [illegible] course. The cadre-trainee ratio remained essentially what it was in the [illegible] course.

The constraint with regard to allocation of equipment was [illegible] with the exception of telephone poles and field wire. Because the new mode [illegible] performance, men are now getting more practice climbing poles and laying wire, with the result that these expendable materials must be replaced more rapidly than [illegible]. The added cost per year for poles and wire in the FWC at Fort Ord is about $21,000.

Offsetting this increase are the savings associated with three factors: the reduction [illegible] academic attrition, the reduction in the amount of time required to identify and drop academic failures, and the elimination of recycling. The following argument [illegible] premise that any time spent in the course by a man who fails and is eventually dropped is wasted time. Correspondingly, the excess cost of avoidable academic recycles [illegible] regarded as waste. The reduction of these two types of waste [illegible] saving to the FWC at Fort Ord. Table [illegible] gives the [illegible] and Table 7 for recycles.

Reduction in Academic Drops

Because the conventional course has a higher academic attrition rate than the APSTRAT course, it requires a student input of [illegible] to turn out 3,000 graduates, a typical year's output of a Field Wireman's training installation. The APSTRAT course requires a student input of [illegible] to produce the same number of graduates a year. The two courses also differ in the average amount of time men who eventually will be dropped spend in the course before they are dropped. Over [illegible] days are spent in the conventional course [illegible] the APSTRAT course. The APSTRAT [illegible] would reduce by 20,640 days a year the number of days wasted by [illegible] academic [illegible]

Table [illegible]

Savings With Respect to Academic Attrition for a Hypothetical Output of 3,000 Men Per Year

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]		[illegible]
[illegible]		[illegible]
[illegible]		

[illegible]

Table 7

Academic Recycles for an Output of 3,000 Men Per Year[a]

[illegible]	Conventional	APSTRAT
Number	900	0
Days per recycle	7	7
Recycle X days	6 300	0
Days saved per year		6,300
Dollars saved per year ($30 per day)[b]		$189.000

[a] The figure 3,000 is a rounded estimate

[b] Thirty dollars per day per man in training is a rounded estimate. The estimates received ranged from $28 to $36

At an estimated cost of $30 per day per trainee, this results in a savings of $619,200 from the reduction in academic attrition.

Reduction in Academic Recycles

Table 7 develops the information on savings for academic recycles. The reduction of recycles from 30% in the conventional course to zero in the APSTRAT course means that for a 3,000-man yearly output, the APSTRAT course would save 6,300 days; at the estimated cost of $30 per day, this would yield a saving of $189,000. Table 8 contains a summary of the cost-savings information, and indicates a net saving of over three quarters of a million dollars for a 3,000 man-year output—about $262 savings for every graduate.

Table 8

Cost Summary for the APSTRAT System for a 3,000-Man Yearly Output

Category	Amount
Savings on academic drops	$619,200
Savings on academic recycles	$189,000
Subtotal	$808,200
Additional equipment costs	-$21,000
Total net savings	$787,200

Results

The data in this section suggest that the two fundamental objectives of the Work Unit were attained. Students achieved much greater proficiency with a reduction in the rate of academic attrition and at a considerable savings in operating cost. A general discussion of these findings and their implications for future research and development is presented in the next section.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

In this section of the report, some of the attitudinal effects of the model will be discussed, and the aftermath of the project with regard to its present and potential impact on Army and civilian training and education will be described. There also will be comments about the developmental strategy underlying the project, and some of the implications for future research and development.

EFFECTS OF THE MODEL ON STUDENTS' ATTITUDES

Many observers of the model in operation in the FWC have been struck by what they view as an unusual attitudinal "set" among students. This set includes absorption in the training process, self-confidence, and group morale. Although no attempt was made to measure these variables, the consensus among observers and the comments by the trainees suggest that these attitudinal gains are substantial. While it cannot be said with certainty exactly how these gains are produced, speculations on this question might be appropriately introduced at this point.

The term "peer instruction" has been used to designate educational practices quite different from the one described in this report. Two common variants are the tutoring of younger students by older students, and the use of faster learners to assist regular instructors. In both instances, the peer instructor is generally employed as an ancillary device; in the APSTRAT model, he is the sole instructional medium. As noted in an earlier section, this central feature dictates the model's requirement for 100% mastery. Its impact on the attitudes of trainees may be equally profound. The model makes men responsible for one another's learning. This responsibility is not shared by cadre or self-instructional media. When a man masters new skills, he has only himself and his peer instructor to thank. In its very nature, the model would seem to encourage self-confidence, a sense of responsibility, and mutual confidence and trust among peers.

Another difference between most other peer-instructional methods and the APSTRAT method has to do with the expectancy to teach. In the APSTRAT model, not only the faster learners but all students (with the exception of those who cannot pass the mastery tests and are consequently dropped from the course) teach, and they teach what they have learned as soon as they have learned it, not months or years later. It is likely, then that the expectancy of teaching conditions the learning process and provides a salient functional context for learning, complementing that of the job itself. This feature of the model would seem to encourage a sense of responsibility not only when instructing someone else, but during the skill acquisition phase as well.

IMPACT ON ARMY TRAINING

Experience with the installation of the model in the FWC at Fort Ord encouraged CONARC to direct the SESS to implement the model in the other Field Wireman courses under its jurisdiction at Fort Dix, Fort Jackson, Fort Leonard Wood and Fort Polk.

To facilitate this process, a workshop was conducted during the week 13-17 September 1971 by the Fort Ord Field Wireman course and HumRRO (under [illegible] sponsorship of the Southeastern Signal School The purpose of the workshop was to familiarize FWC personnel from Forts Jackson, Dix, Polk, and Leonard Wood with the operational aspects of the APSTRAT instructional model in order to facilitate the implementation of the system at those posts.

This was a participating workshop that placed all attending personnel into active involvement in all modules of instruction, with additional concentration on activities in their special areas of competence In this respect, the workshop constituted a skill-acquisition phase for participants—their peer-instruction phases would start when they returned to their posts to impart what they learned to FWC and ATC personnel

The SESS held discussions with participants about the technical and administrative aspects of the pending implementation—personnel and equipment allowances, use of facilities, course inputs, and the new Subject Schedule.

HumRRO personnel were on hand to give guidance on the development of the instructional guide and answer questions about the model Copies of an earlier draft Implementation Manual (Appendix A) were distributed to workshop participants early in the week.

The model has been fully installed in all these posts, and informal information obtained directly from each post, as well as through the SESS, has confirmed the Fort Ord experience. The model was phased in without unusual difficulty at each ATC and is operating as expected.

CONARC, in line with its growing emphasis on performance-oriented training, also has encouraged a consideration of the feasibility of the model for other courses. A number of courses and proponencies have responded with interest, and several have completed the preliminary stages of the changeover process.

IMPACT ON CIVILIAN TRAINING AND EDUCATION

Although the quality-assured, peer-instructional model was designed and tested in the context of Army MOS training, the potentialities of the model extend into the civilian sector. HumRRO has already established the applicability of the main elements of the model in a short-term exploratory study in a public school in Carmel, California, in grades K-5.[14] Another HumRRO project in California made use of a modification of the model in a field study of improved instructional systems in office education at the high school level.[15]

Other civilian educators and industrial trainers also have expressed interest in the applicability of the model to their areas of concern. Further utilization of the model in the civilian sector thus seems likely.

THE DEVELOPMENTAL STRATEGY—GENERAL REMARKS

The purpose of the Work Unit was to develop an integrated instructional system, effective for men of varying aptitudes, that would meet the constraints necessary in order to produce a high likelihood of incorporation into a wide variety of courses—both

[14] Jacklyn E. Hungerland, "Utilization of a Quality-Assured Peer-Instructional System at Primary and Elementary Grade Levels," in preparation

[15] Jacklyn E. Hungerland, Eugene R. Michaels, and John E. Taylor *Development and Pilot Test of a Career-Oriented Peer Instructional Model in the Office Cluster of Business Occupations* HumRRO Technical Report 72-28 October 1972

ongoing and newly established. The major [illegible] comparison of the new and conventional systems with regard to the [illegible] of the training output and the cost of producing [illegible]. The [illegible] section derive from a methodology adapted to this [illegible]. The [illegible] strategy also was devised to limit the number of external [illegible] placed burdens on the implementation and management of the new mode [illegible] from the straightforward nature of the pilot study. The data-gathering procedures, therefore, were restricted to the activities that are a [illegible] part of [illegible] implementing, and managing the instructional system. [illegible] preceding section were gathered in this manner.

One basic question with regard to the meaning of the [illegible] the last section is the extent to which the APSTRAT staff was [illegible] peaches." By deleting extraneous "nice to know" information from the [illegible] were the SESS and the FWC, in effect, changing the curriculum so that the [illegible] were not a fair measure of the conventional system's [illegible]

A fundamental point to keep in mind when considering this [illegible] elements of a training system are not ends in themselves. Their validity [illegible] actual, not assumed, relevance to competent job performance. Thus [illegible] the FWC [illegible] knowledge of Ohm's Law had been assumed to constitute an enabling skill [illegible] installation and maintenance of switchboards, and time in the course was taken up with the attempt to teach this law to trainees. If knowledge of Ohm's Law is not required for competent task performance (and with respect to the duties of a Field Wireman [illegible] not), the conventional course was in some sense filling up time that could have been spent on raising job competence. One of the functions of the mastery test was to give a precise operational definition to job-performance requirements that would allow for and, given the other properties of the model, compel the elimination of extraneous material. If we assume that the creation of job competence is the fundamental purpose of a training course, then scores on the mastery tests are as appropriate for determining the effectiveness of the conventional training system in the FWC as they are for the APSTRAT system.

IMPLICATIONS FOR FUTURE RESEARCH AND DEVELOPMENT

One result of the "minimum intervention" strategy is that a number of experimental controls and the intensive observation that would have been useful in teasing out the effects of subelements of the APSTRAT system were ruled out. Consequently the experience with the model raises a number of intriguing questions that the project staff is not in a position to answer at this time.

Unlike most instructional systems using peer instruction, the APSTRAT model places *every* student in the role of instructor, as a normal and expected element in the learning sequence in each module. As mentioned earlier, this expectancy to teach undoubtedly influences the learning process, and it may very well be that this influence is profound. (Casual observation and discussions with trainees suggest that this is true, especially in the case of men of measured low aptitude.) Experimental studies that could control for expectancy would be very valuable in testing this hypothesis and in revealing some of the underlying dynamics of the APSTRAT model.

Another aspect of the model that would merit deeper study is the instructional dyad itself. We know very little at present about what happens in the interchange between peer instructors and their students; casual observation of the dyads has failed to clarify the question. Alphonse Chapanis's comments on communication modes in relation to problem solving capture the reaction of many observers of the APSTRAT system:

> Almost all linguistic and psycholinguistic research today is being done with what I would call immaculate prose. Immaculate prose consists of messages that are grammatically pure and correct. These are messages that have been carefully laundered, sanitized, starched, and pressed. Every word, phrase, and punctuation mark has been carefully selected, set into place, and then pinned out firmly on the printed page or writing tablet. It is literally immaculate writing.
>
> When one looks at the typewritten protocols of what happened in our communication-rich oral voice modes, one's first and almost immediate reaction is: What in the world were they talking about? At first glance, natural interactive communications between people convey the impression that they follow no grammatical, syntactic, or semantic rules. And yet obviously there are rules, for meanings do get across and problems do get solved.

Systematic study of the instructional dyad in terms of its general process and the influence on this process of the various aptitude pairings would be of great value in understanding a central element in the new model which, at the moment, is essentially a black box.

In the APSTRAT system, a man practices performance skills in preparation for mastery tests. He practices them again when he is being tested, and again during the job performance phase, and again during the peer instructional phase. During his administrative phase he may practice them once more. The effects of various amounts of practice on retention and time to regain mastery have been studied before, but to our knowledge, no research has been undertaken as regards the interaction between amount of practice and the functional role (e.g., solitary practice versus practice as an instructor). Research of this sort would help to clarify the relation between the elements of the system.

Appendix A

QUALITY-ASSURED, PEER-INSTRUCTIONAL SYSTEM IMPLEMENTATION MANUAL

by

U.S. Army Training Center
Human Research Unit
and
HumRRO Division No. 3

October 1971

Human Resource Research Organization
HumRRO Division No. 3
Presidio of Monterey, California 93940

1-1. Purpose. ... is designed to teach ... This pamphlet is a guide for ... instructional method ...

1-2. Principles. ... special emphasis to ...

a. Performance orientation ... those tasks necessary for ...

b. Learning in a ... job-like situation. ... individual demonstration and ...

c. Self-pacing. ... than others. Self-paced ... behind and boring others.

d. Insistence on mastery. ... high level of performance ...

e. Rapid feedback between ... knows about how each ... his methods for greater effect ... his performance, the ... performance.

1-3. Techniques. These principles ...

a. Peer instruction. ... When he has mastered the skill, ... instruction allows one teacher ... tor teaches by demonstration, ...

b. Pass-fail performance ... tested. If the student is taught ... test will consist of installation ... by qualified course supervisors. ... Either he does the entire task correctly ... his peer instructor work together until ... he fails one test repeatedly, he should ... The purpose of the tests is not to ... numerical grade. The tests control ... has learned the task and that he ... Without strict testing, the quality of ...

[illegible]

[illegible]

Chapter 2

COURSE PLANNING

2-1. Specifying performance objectives.

a. All educational planning must begin with the same questions.

(1) What duties and tasks compose the job?

(2) What tasks should be taught in the training course?

(3) What standard of performance should the student attain for each task?

b. The results of such an examination are the building blocks of the successful training course. The best procedure is a complete systems analysis of the course as stated in CONARC Regulation 350-100-1. In place of a systems analysis, a group of experienced supervisory personnel and proponent agency personnel may agree on a list of duties and tasks that constitute the job and what standards of performance should be reached.

c. The soldier's job may be made up of several duties. Within each duty are tasks. For example, one duty in the job of an auto mechanic is tuning the engine. Tuning an engine includes the tasks of adjusting the carburetor and removing, cleaning, adjusting, or replacing the spark plugs.

d. The planner takes the duties and tasks to be taught and organizes them into an outline. Each task is listed under its appropriate duty. The same task may be listed many times. Care should be taken to keep the descriptions of tasks at the same level of generality. If "replace carburetor" is a task, then "turn wrench" is not a task but an enabling skill. This outline is called a task inventory. Figures 1 and 2 show an example from the Army Field Wireman course.

e. If a systems analysis exists for a course, the task inventory will already be complete. In any case, the planner must take the task inventory and list the enabling skills for each task. The enabling skills form the step-by-step procedure for accomplishing the task. Many of these procedures will be listed in FM's or TM's. An example from the Field Wireman course is given in Figure 3. In this manner, every action the student will take is listed. Nothing will be overlooked in this way.

f. The planner takes each duty and lists the training conditions and the standard of training required. Training conditions should be like job conditions. The student should not have any aids he will not have on the job. Attainment of these standards of training will be the goal of the student. Figure 4 gives an example from the Field Wireman course.

2-2. Designing performance tests. Everything the student is taught must be organized into performance tests. In most cases the step-by-step enabling skills can be written into a check list. The format will allow

Job		[illegible]				
Duty Positions	[illegible]	Switchboard Operator		[illegible]		
Duties	(Installs SB 22 PT)	(Operates SB 22 PT		Installs SB 86 PT	(Operates SB 86 PT	
Tasks	(Installs Batteries)	(Connects Power)	Perform Pre Operational Checks	Assembles	[illegible]	[illegible]
Enabling Skills				Step by step procedures for assembly of equipment		

Figure 1 [illegible]

Duty Position Switchboard Operator

[illegible] SB 22 PT

[illegible]

Headset

Ground

2 Installs [illegible]

3 [illegible]

[illegible]

Operates [illegible]

4 [illegible]

Figure 2 [illegible]

... supervisor calls ... of this step is ... given in Appendix

... tested on the perform... change in existing ... course graduate. ... who have completed

... tests to these people. ... result.

... established standards, ... indicated. If the graduates meet ... required although it may be ... reasons.

... insure that the tests are conducted ... training should be given to ... ity of testing and scoring is

... tests are given, they should be dry-run ... test and the objectivity of the graders.

... are grouped into blocks or modules of ..., the student goes through the same five- ... is summarized in Figure 5.

... new student watches his peer instructor ... learn. The newcomer gains familiarity with ... performed in a job-like situation.

... (SA) The peer instructor teaches the duties ... formerly the observer. Since everything the ... the performance test, the peer instructor teaches ... student and peer instructor are convinced that the ... the tasks, they report to a supervisor for the ... test. The test should be given in the presence of ... provides both the student and the peer instructor ... about the student's performance. If the ... continues to practice with his peer instructor until ... retest. There is no firm rule about the number of retests ... before he is dropped from the course as an academic ..., ... cut-off point should be established by course administrators ... the peer instructor continues to teach until the student ... all the performance tests for that module or is dropped.

... performance (JP): The student now becomes a job performer. He ... student who observes him perform the job duties. The ... at random. Random assignment simulates the job situation ... must work together. The job performer demonstrates ... to the observing student.

... Peer instruction (PI): The job performer becomes the peer ... for the student who observed him previously. The peer ... continues with the student until the student has passed all

Module Phase		Student Activity
O	[Observation]	The student [illegible] should see the [illegible] being performed [illegible]
SA	[Skill Acquisition]	The student [illegible] for each task [illegible] test or complete [illegible] each task [illegible] he should [illegible] for all the task [illegible]
JP	[Job Performance]	[illegible]
PI	[Peer Instruction]	[illegible]
CA	[C[illegible] A[illegible]]	[illegible]

[illegible]

his perf[illegible]
see that a [illegible]
reassign the [illegible]
could [illegible]
peer instr[illegible]
design[illegible]
[illegible]

[illegible]

... repeat the entire cycle of ... until ... students have been trained successfully by peers. ... keep note of the time required for the SA phase. This will ... student to student and will probably decrease over time.

8. Use the successfully trained students plus ... supervisors as are necessary to expand the module to accommodate the regular

Chapter 4

COURSE MANAGEMENT

4-1. Establishing quality control measures. Unlike other instructional methods, quality-assured, peer instruction requires effective quality control to function successfully. Quality control measures are not secondary. If these measures indicate any problems, course supervisors must take positive action to remedy the situation. There are three levels of quality control necessary to assure that the system is producing well-qualified graduates: the performance test level, the module supervision level, and the course supervision level.

a. Quality control at the performance test level: The supervisors who administer the performance tests in the modules bear the primary responsibility for the quality of the graduate. No student may be passed [illegible] because the test administrator may think that the student knows the [illegible]. Each student is required to demonstrate that he has learned the [illegible] performing each step of the task correctly. If a student [illegible] through," he will not perform his job competently nor will he [illegible].

[illegible] control at the module supervision level:

[illegible] every [illegible] students who complete the SA phase, select at random [illegible] of five students.

[illegible] all the proficiency tests of the module before [illegible] to go on to job performance.

[illegible] in all the tests may proceed [illegible]

[illegible] more steps on any test must be [illegible] originally passed the student [illegible]

[illegible] the supervisor to whom [illegible] see that they are retrained [illegible] or are dropped from the [illegible]

[illegible] strator's reliability [illegible] tightening [illegible]

[illegible] the students [illegible] students--in [illegible] phase will [illegible]

[illegible] they [illegible]

[illegible] to [illegible]

4-4. [illegible]
all test [illegible]
should be [illegible]
scoring procedure [illegible]
established [illegible]

4-5. Establishing [illegible]

a. Organization [illegible]
quires an even fl[illegible]
If the course is [illegible]
close coordination [illegible]
required to assure [illegible]

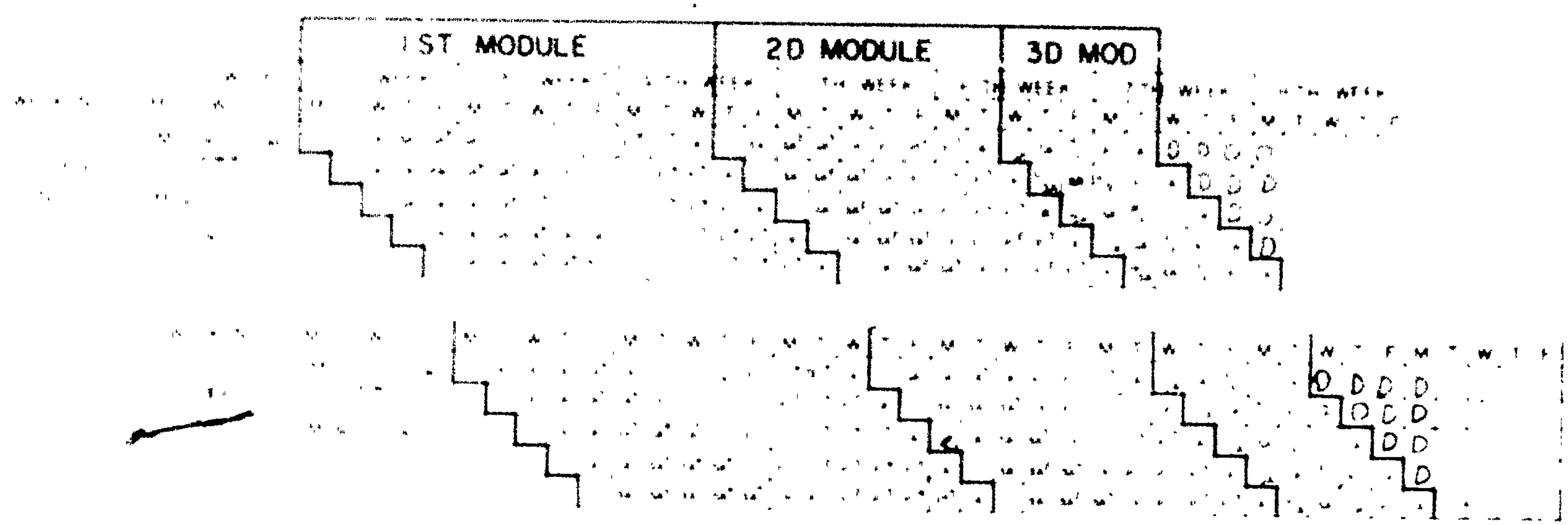
b. Student rec[illegible]
broken down into [illegible]
each trainee containing [illegible]
card contains spaces [illegible]
test plus the number of [illegible]
are also maintained by each [illegible]
units (their training [illegible]
card is presented as Appendix [illegible]

(1) If a student must [illegible]
or administrative [illegible]
out of his weekly [illegible]
put back a day for [illegible]
rarily to the following [illegible]
filed in relation to [illegible]
the student is [illegible]
rejoins his initial [illegible]
him.

(2) The supervisor of the [illegible]
daily groups, and [illegible]
constituted at the [illegible]
informed daily of any [illegible]
keeps the course [illegible]

FIELD WIREMAN COURSE

TENTATIVE SCHEDULE



Appendix B

HAND FIELD WIRE SPLICE

LEARNER____________________

INSTRUCTOR____________________

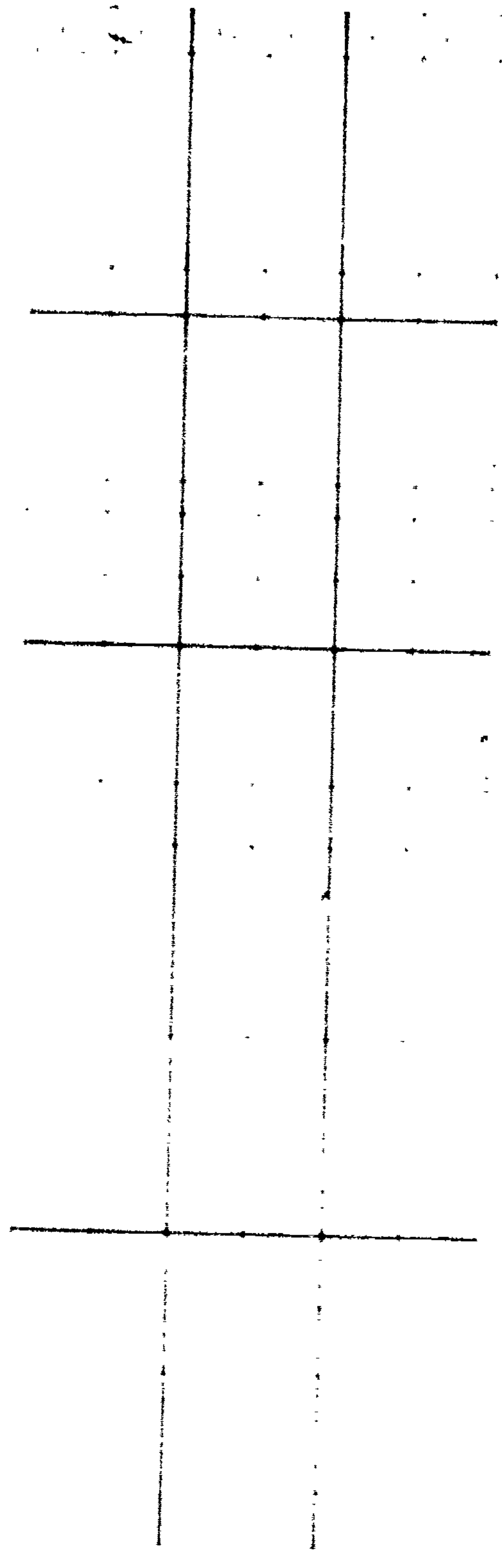
EVALUATOR____________________

DATE____________________

Proficiency Check

Check Points	1 Pass	1 Fail	2 Pass	2 Fail	3 Pass	3 Fail
STAGGERING SPLICE						
1. Cut off the ends of both pairs of wire to insure that both conductors of each pair are equal length.						
2. Cut one conductor of each pair 6 inches (one plier length) from the end.						
REMOVING INSULATION						
3. Measure 6 inches (one plier length) on all four conductors and mark (with large hole on TL13-A).						
4. Remove 6 inches insulation from each conductor by section.						
5. Pull last section of insulation only to the end of each conductor, leave on end.						
TYING SQUARE KNOT						
6. Join the end of the long conductor of one pair and the end of the short conductor of the other pair.						
7. Tie square knot, to connect wires.						
8. Splice no longer than one inch, pull knot tight.						
9. Remove last section of insulation from both conductors.						
SEIZING SPLICE						
10. Separate the steel strands from the copper strands.						
11. Cut steel strands at the end of the insulation.						
12. Cross the left hand copper strands over the crest of the square knot, wrap copper strands over bared portion, wrap two more turns on the insulation on the right hand side, cut off excess wire.						

[illegible]



HAND FIELD WIRE SPLICE

Check Points	Pass	Fail	Pass	Fail	Pass	Fail
25. Start taping at center of splice, using steady pull.						
26. Tape about 1 1/2 inches beyond the insulation at one end, work back over knot, to 1 1/2 inches beyond the insulation at other end, reverse and stop at center.						
27. With friction tape start 1/2 inch beyond the electrical insulation tape across splice to 1/2 inch beyond the electrical insulation rape at the opposite end.						
28. With friction tape start 1/2 inch beyond the electrical insulation tape across splice to 1/2 inch beyond the electrical insulation tape at the opposite end.						

2. MECHANIZED TRAINING: ARMORED PERSONNEL [illegible] STARTING [illegible]

Test Situation: "You have performed [illegible] nance services [illegible] using the check [illegible]

Test Condition. The soldier [illegible] of the APC [illegible]

Necessary Equipment: Armored Personnel [illegible]

		[illegible]	[illegible]	[illegible]
Performance Measure 1:	The soldier applies and locks brakes by pulling back on steering levers and depressing the brake lock buttons on top of the hand grips.			
Performance Measure 2:	The soldier puts the transmission in neutral by placing the range selection shift lever in neutral range, in the "N" position.			
Performance Measure 3:	The soldier visually inspects the switches to the lights and radios to insure they are in the OFF position.			
Performance Measure 4:	The soldier turns the master switch handle ON by pulling on the handle and turning it to the [illegible] ON position.			
Performance Measure 5:	The soldier visually insures that the master switch ON indicator light is ON.			
Performance Measure 6:	The soldier visually insures that the battery generator indicator needle is in the red or yellow zone.			

		Pass	Fail	Pass	Fail	Pass	Fail
Performance Measure 15:	The soldier visually checks the engine oil low pressure warning light to insure that it is not on.						
Performance Measure 16:	The soldier will, after operating engine for 2-3 minutes, decrease engine speed by turning the hand throttle control clockwise and pushing it in.						

- End of Test 2 -

		Pass	Fail	Pass	Fail	Pass	Fail
[illegible] Measure [illegible]	[illegible] pressure on the appropriate digital pressure point [illegible] the soldier [illegible] pressure [illegible]						
Note	The [illegible] shall not fail if he reverses the sequence of Performance Measure [illegible]						
Performance Measure	The soldier continues to exert pressure and maintain limb elevation and apply pressure on the digital pressure point until the bleeding has stopped, or for at least 5 minutes.						
Note	The examiner announces, "The bleeding has not stopped. Take further appropriate action."						
Performance Measure 6	The soldier protects the wound by wrapping the tails of the dressing around the edges and tying the tails.						
Performance Measure 7 (optional)	The soldier treats the patient for shock: (The order in which steps a, b and c are performed is optional):						
	a. he elevates both legs 6 to 8 inches,						
	b. he loosens clothing and removes pack, if present,						
	c. he wraps the casualty with available cover.						

Note. Performance Measure 7 is optional in this test situation. The soldier who omits it does not fail.

- End of Test 2 -

Appendix C

PREPARATION OF SWITCH BOARD SB-22/PT FOR OPERATION

Proficiency Check

Directions to Evaluator

Test Objective:

To test the the student's ability to prepare Switchboard SB-22/PT for operation.

Prior to Testing:

1. Test position will have the following:
   a. One each Switchboard SB-22/PT.
   b. One each Telephone Set TA-312/PT.
   c. Six each Batteries BA-30.
   d. A grounding device.
   e. Three incoming local lines.
   f. Two incoming trunk lines.
   g. One grease pencil.
   h. One lead pencil.
   i. Two pre-cut lengths of Wire W[illegible] with ends stripped or a sutiable wire sub[illegible].
2. Check equipment at test position.
   a. Install Switchboard SB-22/PT [illegible] check for proper installation.
   b. Perform operational [illegible] line signals drop, line signal tests [illegible]
3. Check peer instructor [illegible] taught all subject matter.

During Testing:

1. Prepare [illegible]

[illegible]

d. A student successfully completing a test phase as indicated by heavy line in pass/fail block need not be reevaluated on that test phase by the evaluator on a subsequent retest.

e. Do not aid the student during the test except to correct administrative problems.

f. No credit will be allowed the student on any item on which assistance is given.

After Testing:

1. Be sure all equipment is placed back in original condition.
2. Critique the student on his performance.

Directions to Student

<u>Task</u>:

This is a test of your ability to prepare Switchboard SB-22/PT for operation.

Standards:

To successfully pass the performance test you must pass all of the check points of the proficiency check. You have [illegible] minutes to complete this test.

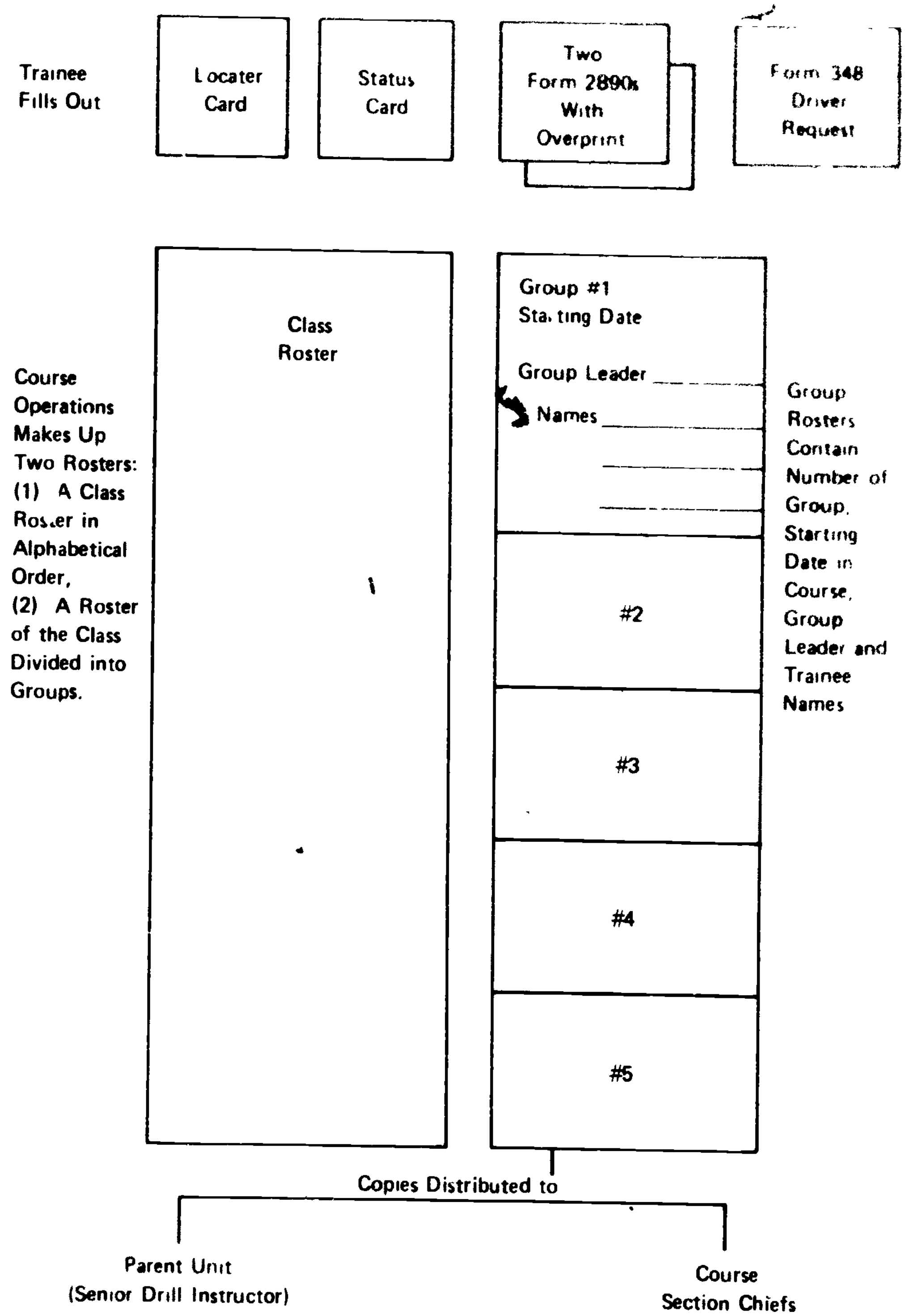
Procedures

1. [illegible]
2. [illegible]

[illegible]

[illegible]

Appendix D


Trainee Fills Out
Locater Card
Status Card
Two Form 2890s With Overprint
Form 348 Driver Request
Course Operations Makes Up Two Rosters: (1) A Class Roster in Alphabetical Order, (2) A Roster of the Class Divided into Groups.
Class Roster
Group #1
Starting Date
Group Leader
Names
#2
#3
#4
#5
Group Rosters Contain Number of Group, Starting Date in Course, Group Leader and Trainee Names
Copies Distributed to
Parent Unit (Senior Drill Instructor)
Course Section Chiefs

[illegible] entry into the course

[illegible] card [illegible] location [illegible] file

[illegible] of trainee [illegible]

[illegible] date

[illegible] and [illegible] assignment of trainee groups [illegible] name, group number, [illegible] date, trainee's [illegible] group [illegible] daily record [illegible] absence from training

[illegible] form [illegible] for [illegible] training [illegible] regulations

[illegible] training

[illegible] Operations [illegible] the status of a trainee, it must be known to all [illegible] telephone or in person [illegible]

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author) Human Resources Research Organization 300 North Washington Street Alexandria, Virginia 22314	2a REPORT SECURITY CLASSIFICATION Unclassified 2b GROUP

3 REPORT TITLE

DEVELOPMENT AND IMPLEMENTATION OF A QUALITY-ASSURED, PEER-INSTRUCTIONAL M...

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5 AUTHOR(S) (First name, middle initial, last name)

Kenneth Weingarten, Jacklyn E. Hungerland, and Mark I. Brennan

6 REPORT DATE November 1972	7a TOTAL NO OF PAGES 73	7b NO OF REFS 5
8a CONTRACT OR GRANT NO 19-73-C-0004 b. PROJECT NO 2Q062107A745 c d	9a ORIGINATOR'S REPORT NUMBER(S) HumRRO TP-72-35 9b OTHER REPORT NO (S) (Any other numbers that may be assigned this report)	

10 DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11 SUPPLEMENTARY NOTES Work Unit APSTRAT; Research performed by HumRRO Division No. 3, Presidio of Monterey, California	12 SPONSORING MILITARY ACTIVITY Office, Chief of Research and Development Department of the Army Washington, D.C. 20310

13 ABSTRACT

This report describes the development and pilot testing of a low-cost, generalizable, quality-assured, peer-instructional model suitable to the training needs of men of varying measured aptitude. The report presents a brief overview of the project, followed by a detailed description of the APSTRAT model and the considerations that led to its development. The model is discussed in terms of the instructional principles incorporated and the practical constraints accommodated. The data comparing the performance proficiency, academic attrition and recycles, and costs of the conventional and APSTRAT systems indicate that APSTRAT students achieve greater proficiency with a reduction in the rate of academic attrition and a considerable savings in cost.

DD FORM 1473 1 NOV 65

Unclassified

Security Classification

Unclassified

Security Classification

KEY WORDS

*Instructors

*Motivation

*Performance evaluation

*Quality control

*Transfer of training

Feedback

Hetero aptitudinal population

Individualized instruction

Instructional model

Job simulation

Low aptitude

Peer instruction

Performance oriented

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10 CG USA FORCES SOUTHERN COMD ATTN SCARCD CZ
2 CG US ARMY EUROPE APO 09403 NY ATTN OPNS DIV
1 CO ARMY TRANS RES COMD FT EUSTIS ATTN TECH LIB
1 CG USA AD COMD ENT AFB ATTN ADGPA COLO
4 CG 1ST ARMY ATTN DCSOT FT MEADE MD
1 CG 3RD ARMY ATTN DCSOT FT MCPHERSON
4 CG SIXTH ARMY PRES OF SAN FRAN ATTN AMOPS-T2
1 CG USA ATTN AG-AG APO 96301 SAN FRAN
1 DIR HEL APG MD
1 CG USA CDC EXPERIMENTATION COMD FT ORD
2 ENGMR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
4 TECH LIB ARMY NATICK LABS NATICK MASS
2 INST OF LAND CBT ATTN TECH LIB FT BELVOIR VA
1 CO FT HUACHUCA SPT COMD USA ATTN TECH REF LIB
1 SIXTH USA LIB DEPOT BLDG M 13 14 PRES OF SAN FRAN
5 CG FT ORD ATTN G3 TNG DIV
1 CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
1 LIB DEF SUPPLY AGCY CAMERON STA VA
2 CO USA CDC AG AGCY FT BENJ HARRISON IND
1 CO ARMY CDC INF AGY FT BENNING
1 CO ARMY CDC ARMOR AGY FT KNOX
1 DIR OF INTERN TNG USA LOG MGT CTR FT LEE
3 CO USA TNG CTR (FA) ATTN AKPSITC-TT FT SILL
1 CG USA TNG CTR & FT LEONARD WOOD ATTN ACOFS G3
1 CG USA INF CTR ATTN AJIGT-T FT BENNING
1 CG USA TNG CTR INF ATTN ACOFS G3 FT DIX
1 CG USA TNG CTR ATTN ACOFS G3 FT JACKSON
1 CG USA TNG CTR INF ATTN ACOFS G3 FT LEWIS
1 CG USA TNG CTR INF & FT ORD ATTN ACOFS G3
41 CG USA TNG CTR INF ATTN ACOFS G3 FT POLK
5 CO USA MED TNG CTR ATTN DIR OF TNG FT SAM HOUSTON
28 CG USA AD CTR ATTN G3 FT BLISS
1 CG USA TNG CTR INF ATTN ACOFS G3 FT CAMPBELL
3 LIB ARMY WAR COLL CARLISLE BKS
1 COMDT COMD + GEN STAFF CO FT LEAVENWORTH ATTN ARCHIVES
1 DIR OF MILIT PSYCHOL + LDRSHP US MILIT ACAD WEST POINT
1 US MILIT ACAD WEST POINT ATTN LIB
1 COMDT ARMY AVN SCH ATTN DIR OF INSTR FT RUCKER
2 COMDT ARMY SECUR AGY TNG CTR + SCH FT DEVENS ATTN LIB
1 STIMSON LIB MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON
10 COMDT THE ARMOR SCH ATTN DOI FT KNOX
1 COMDT USA CHAPLAIN SCH ATTN DOI FT HAMILTON
1 COMDT USA FIN SCH ATTN CHF DOC DEV LIT PLN DIV DDOI IND
1 USA FINANCE SCH FT BENJ HARRISON ATTN EDUC ADV
4 COMDT ADJ GEN SCH FT BENJ HARRISON ATTN EDUC ADV
1 COMDT USAIS ATTN EDUC ADV FT BENNING
1 COMDT USAIS ATTN AJIIS-D-EPRO FT BENNING
1 HQ US ARMY ADJ GEN SCH FT BENJ HARRISON ATT COMDT
1 LIB ARMY QM SCH FT LEE
1 COMDT USA QM SCH FT LEE ATTN EDUC ADV
1 COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1 CO USA SEC AGY TNG CTR & SCH ATTN IATEV RSCH ADV FT DEVENS
1 COMDT USA MIL POLICE SCH ATTN PLNS &PROG DDOI FT GORDON
2 COMDT US ARMY SOUTHEASTERN SIG SCH ATTN EDUC ADV FT GORDON
1 COMDT USA AD SCH ATTN DOI FT BLISS
1 CO USA ORD CTR & SCH OFC OF OPD ATTN AMON-O APG MD
5 ASST COMDT ARMY AIR DEF SCH FT BLISS ATTN CLASSF TECH LIB
3 CG USA FLD ARTY CTD & FT SILL ATTN AVN OFCR
1 COMDT DEF INTELL SCH ATTN SIAAS DEPT
1 COMDT ARMED FORCES STAFF COLL NORFOLK
1 COMDT USA SIG CTR & SCH ATTN DOI FT MONMOUTH
1 COMDT JUDGE ADVOCATE GENERALS SCH U OF VA
1 DPTY COMDT USA AVN SCH ELEMENT GA
1 DPTY ASST COMDT USA AVN SCH ELEMENT GA
1 USA AVN SCH ELEMENT OFC OF DIR OF INSTR ATTN EDUC ADV GA
1 EDUC CONSLT ARMY MILIT POLICE SCH FT GORDON
6 COMDT USA ENGR SCH ATTN EDUC ADV AMBBES-EA FT BELVOIR
2 COMDT USA SCH EUROPE ATTN EDUC ADV APO 09172 NY
1 OFC OF DOCTRINE DEV LIT & PLNS USA ARMOR SCH ATTN AMBAAS-DM
1 COMDT ARMY AVN SCH FT RUCKER ATTN EDUC ADV
1 DIR OF INSTR US MIL ACAD WEST POINT NY
1 DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1 COMDT DEF MGT SCH FT BELVOIR
2 COMDT USA MSL & MUN CTR & SCH ATTN CHF OFC OF OPS REDSTONE ARSNL
2 COMDT US WAC SCH US WAC CTR ATTN AJMCT FT MCCLELLAN
2 HQ ABERDEEN PG ATTN TECH LIB
1 CO USA INTELL CTR & SCH ATTN DIR OF ACADEMIC OPS FT HUACHUCA
1 CO USA INTELL CTR & SCH ATTN DIR OF DOC & LIT FT HUACHUCA
1 COMDT USA C&GSC OFC OF CHF OF RESIDENT INSTR FT LEAVENWORTH
1 COMDT USA CA SCH ATTN OFC OF DOCTRINE DEVEL LIT & PLNS FT BRAGG
1 COMDT USA CA SCH ATTN DOI FT BRAGG
1 COMDT USA CA SCH ATTN EDUC ADV FT BRAGG
1 COMDT USA CA SCH ATTN LIB FT BRAGG
1 COMDT USA SCH & TNG CTR ATTN ACOFS G3 TNG DIV FT MCCLELLAN
1 COMDT USA SCH & TNG CTR ATTN ACOFS G3 PLNS & OPS DIV FT MCCLELLAN
10 COMDT USA INST FOR MIL ASSIST ATTN DOI FT BRAGG
8 COMDT USA FLD ARTY SCH ATTN DOI FT SILL
1 COMDT USA ARTY SCH ATTN EDUC SERVICES DIV FT SILL
1 COMDT USA ARTY SCH ATTN EDUC ADV FT SILL
1 COMDT USA TRANS SCH ATTN DIR OF DOC & LIT FT EUSTIS
1 COMDT USA TRANS SCH ATTN LIB FT EUSTIS
1 USA INST FOR MIL ASST ATTN EDUC ADV FT BRAGG
1 COMDT USA C&GSC ATTN ATSCS-DJ (SPWAR)
1 COMDT ARMY QM SCH OFC DIR OF NONRESID ACTVY ATTN TNG MEDIA DIV VA
1 COMDT USA ARTY SCH ATTN LIB FT SILL
1 CG USA SCH & TNG CTR ATTN ACOFS G3 FT GORDON
1 DIR OF GRAD STUD & RSCH ATTN BEHAV SCI REP USAC&GSC
1 COMDT USA AD SCH ATTN AKBAAS-DL-EA FT BLISS
1 CG USA SIG CTR & SCH ATTN ATSSC-DP-COB FT MONMOUTH
1 SECY OF ARMY, PENTAGON
1 DCS-PERS DA ATTN CHF C+S DIV
1 DIR OF PERS STUDIES & RSCH ODCSPER DA WASH DC
2 ACSFOR DA ATTN CHF TNG DIV WASH DC
1 CHF OF ENGNRS DA ATTN ENGTE-T
1 HQ ARMY MAT COMD R+D DRCTE ATTN AMCRD-RC
1 US ARMY BEHAVIOR & SVS RSCH LAB ATTNCRD-AR ARL VA
1 OPD PERS MGT DEV OFC ATTN MOS SEC (NEW EQUIP) OPOMD
1 PROVOST MARSHAL GEN DA
2 DIR CIVIL AFFAIRS DRCTE ODCSOPS
1 OFC RESERVE COMPON DA
12 ADMIN DDC ATTN: TCA (HEALY) CAMERON STA ALEX., VA. 22314
1 CHF OF R+D DA ATTN CHF TECH + INDSTR LIAISON OFC
1 CO USA CDC MED SERV AGCY FT SAM HOUSTON
1 USA BEHAVIOR & SVS RSCH LAB ATTN CRD-AIC ARL VA
2 TNG & DEVEL DIV ODCSPERS
1 CAREER MGT BR ATTN R DETIENNE CAMERON STA ALEX VA
1 USA LIB DIV-TAGO ATTN ASDIRS
15 CG CONARC ATTN ATIT-STN FT MONROE
2 CG CONARC ATTN LIB FT MONROE
1 CO ARMY CBT DEVEL COMD MILIT POLICE AGY FT GORDON
1 CHF USA AD HRU FT BLISS
1 CHF USA ARMOR HRU FT KNOX
1 CHF USA AVN HRU FT RUCKER
1 CHF USA INF HRU FT BENNING
1 CHF USA TNG CTR HRU PRES OF MONTEREY
2 CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN AC OF .3
1 55TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
1 TEXAS NG 49TH ARMORED DIV DALLAS
3 CG ARMY ARMOR CTR FT KNOX ATTN G3 AIBKGT
3 CG 82ND ABN INF DIV ATTN ACOFS G3 FT BRAGG
1 CO 197TH INF BRGD FT BENNING ATTN S3
5 CG 1ST INF DIV ATTN ACOFS G3 FT RILEY
1 CO USA PARTIC GP USA TNG DEVICE CTR FLA
2 DA OFC OF ASST CHF OF STAFF FOR COMM-ELCT ATTN CETS-6 WASH
1 DIR ARMY LIB PENTAGON
1 CHF OF MILIT HIST DA ATTN GEN REF BR
1 CO USA 10TH SPEC FORCES GP FT DEVENS
1 US ARMY GEN EQUIP ATTN TECH LIB FT LEE
10 CG III CORPS & FT HOOD ATTN G3 SEC FT HOOD
30 CO 1ST ARMORED DIV ATTN G3 SEC FT HOOD
30 CG 2D ARMORED DIV ATTN G3 SEC FT HOOD
25 CO 13TH SUPT BGDE ATTN S3 SEC FT HOOD
1 CG USAFAC & FT SILL ATTN AKPSIGT-TNTN
20 CO III CORPS ARTY ATTN G3 SEC FT SILL
15 CO 1ST AIT BGDE ATTN G3 SEC FT BLISS
8 CG USATCI & FT POLK ATTN AKPPO-DCOT
1 RSCH CONTRACTS & GRANTS BR ARO
1 BESD ARO OFC CHF OF R&D WASH DC
1 CHF OF R&D DA ATTN SCI INFO BR RSCH SPT DIV WASH DC
1 CINC US ATLANTIC FLT CODE 312A USN BASE NORFOLK
1 COR TNG COMMAND US PACIFIC FLT SAN DIEGO
5 TECH LIB PERS 11B BUR OF NAV PERS ARL ANNEX
3 DIR PERS RES DIV BUR OF NAV PERS
1 TECH LIB BUR OF SHIPS CODE 210L NAVY DEPT
3 CO + DIR NAV TNG DEVICE CTR ORLANDO ATTN TECH LIB
2 CO FLT TNG CTR NAV BASE NEWPORT
1 CO FLEET TNG CTR US NAV STA SAN DIEGO
1 PRES NAV WAR COLL NEWPORT ATTN MAHAN LIB
3 CO SERV SCH COMD NAV TNG CTR SAN DIEGO
1 CHF OF NAVL RSCH PERS & TNG BR (CODE 458) ARL VA
1 DIR US NAV RES LAB ATTN CODE 5120
1 DIR NAVAL RSCH LAB ATTN LIB CODE 2029 WASH DC
1 CHF OF NAV AIR TNG TNG RES DEPT NAV AIR STA PENSACOLA
3 OIC NAV PERS RES ACTVY SAN DIEGO
1 DIR PERS RES LAB NAV PERS PROGRAM SUPPORT ACTIVITY WASH NAV YD
5 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
1 US MARINE CORPS HQS HIST REF LIB ATTN MRS JADOT
2 COMDT HQS 8TH NAV DIST ATTN EDUC ADV NEW ORLEANS
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
1 CHF OFCR PERS RES + REVIEW BR COAST GUARD HQ
1 CO US COAST GUARD TNG CTR GOVERNORS ISLAND NY
1 CO US COAST GUARD TNG CTR CAPE MAY NJ
1 CO US COAST GUARD TNG CTR & SUP CTR ALAMEDA CALIF
1 CO US COAST GUARD INST OKLA CITY OKLA
1 CO US COAST GUARD RES TNG CTR YORKTOWN VA
1 SUPT US COAST GUARD ACAD NEW LONDON CONN
1 AIR TNG COMD/XPT RANDOLPH AFB
1 TECH DIR TECH TNG DIV(HRO) AFHRL LOWRY AFB COLO
1 CHF SCI DIV DRCTE SCI + TECH DCS R+D HQ AIR FORCE AFRSTA