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HumRRO Research in Training Technology

Presentations at
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U.S. Continental Army Command
Fort Monroe, Virginia February 1970

HumRRO

HUMAN RESOURCES RESEARCH ORGANIZATION

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.

The contents of this paper are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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Prefatory Note

This paper records the presentations made by members of the Human Resources Research Organization to the staff of Headquarters, U.S. Continental Army Command, Fort Monroe, Virginia, in February 1970. Current HumRRO research efforts in the application of educational technology were described.

The opening remarks were made by Major General D.R. Pepke, Deputy Chief of Staff for Individual Training, CONARC. These presentations were the sixth in a series of briefings on the education and training research and development programs of the U.S. Army Behavior and Systems Research Laboratory (BESRL), the Center for Research in Social Systems (CRESS), and HumRRO. The briefings are sponsored by the Office of the Chief of Staff for Individual Training, CONARC, and are planned to inform CONARC of work being done in training and related human factors research and development.

The introductory and background presentation was made by Dr. Meredith P. Crawford, President of HumRRO. The Project IMPACT presentation was made by Dr. J. Daniel Lyons, Director of HumRRO Division No. 1 (System Operations). The presentation on individual training was primarily written by Dr. Howard H. McFann, Director of HumRRO Division No. 3; it was prepared in final form and presented by Mr. Arnold A. Heyl, Director for Operations. The flight training devices presentation was made by Dr. Wallace W. Prophet, Director of HumRRO Division No. 6 (Aviation).

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HumRRO AND TRAINING TECHNOLOGY: AN INTRODUCTION

Meredith P. Crawford

The general theme of our presentation is Training Technology. Technology is defined in Webster's Unabridged as "any practical art utilizing scientific knowledge." The practical art we are speaking of involves a combination of people and things, of software and hardware—combinations that are designed to help students learn efficiently.

I have another definition that is applicable to our presentation. It is from the report of the Commission on Instructional Technology, a report that was delivered by the White House to the Congress a few weeks ago.[1] In this report, instructional technology was defined as "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on findings from research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction." A significant improvement of learning depends on our ability to organize our efforts in accordance with this definition.

This technology is in a constant state of evolution. New techniques of education and training are in the news. Much of what we hear tends to emphasize the more tangible aspects of the technology, that is, the hardware—projectors, moving pictures, animations, television, and the computer. These mechanisms are very important in bringing information to the learner in clear and vivid form. However, the technology is more than just the hardware. It is the application of learning theory, knowledge of human behavior, and practical experience.

For the past 19 years a cooperative effort has advanced the military aspects of training technology, a cooperative effort between the U.S. Continental Army Command (CONARC) and the Human Resources Research Organization. Personnel of CONARC Headquarters, Schools, and Training Centers have worked with the scientific and technical members of HumRRO in this common endeavor.

The purpose of our presentation is to report on some of the important developments now taking place within HumRRO which further the evolution of training technology. The HumRRO speakers will discuss selected aspects of completed and ongoing work in three of our Divisions, with implications for military use of the growing technology.

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[1]Commission on Instructional Technology. *To Improve Learning*, Academy for Educational Development, Washington, August 1969, p. 67.

To provide the general background for these statements, I will describe the HumRRO organization and its close association with the Army. I will also outline an approach to the development of training programs which form an important basis of a technology of training.

The Human Resources Research Organization, HumRRO, began in 1951 as a part of The George Washington University and was known as the Human Resources Research Office. In September, 1969, it became an independent, nonprofit corporation carrying out its program for the Army and other sponsors without interruption, employing the same staff and using similar operating procedures.

The general purpose of HumRRO is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. Improvement in human performance may be effected in several ways—HumRRO's main approach has been through the development of new or improved training programs.

The principal organizational setting in which we have done our work has been the Army, but within the last few years it has been extended to the organizations of other sponsors. Our particular mission for the Army is to perform research and development in training, motivation, leadership, and the requirements for training devices. In fulfilling this mission we have developed a number of successively improved general training techniques as well as particular programs for specific military skills and occupational specialities and for techniques of leadership. These new programs have brought about an increased motivation of soldiers to learn and to use acquired knowledges and skills in their duty assignments.

The current organization of HumRRO, particularly as it relates to the Army, is represented in Figure 1. The governing body of HumRRO is its Board of Trustees. Its membership includes a former Secretary of the Army, the Honorable Stephen Ailes; a former Commanding General of CONARC, General Hugh Harris; and a former Director of Army Research, Major General Chester Clark, as well as other distinguished representatives of university, business, and financial communities.

The overall monitorship and funding of the HumRRO Army program is provided by the Behavioral Sciences Division, Army Research Office, Office of the Chief of Research and Development, Department of the Army. Of the seven research Divisions, two are located in Alexandria, and the other five at Army Centers, as shown in Figure 1. They are collocated with the five Army Human Research Units, which are military organizations reporting to this Headquarters. These Units play a most vital role in support of the research, provision of enlisted research assistants, and help in the implementation of results. Our working contacts with CONARC are in the Education and Training R&D Division, the R&D Directorate of the Deputy Chief of Staff for Individual Training (DCSIT). There is daily communication between the CONARC staff and the HRUs and field divisions as well as with my office. Since 1951 there has been a strong working relationship between HumRRO and CONARC.

The current strength of HumRRO is about 230 persons, some 100 of whom are located in the five field divisions. As noted, they are

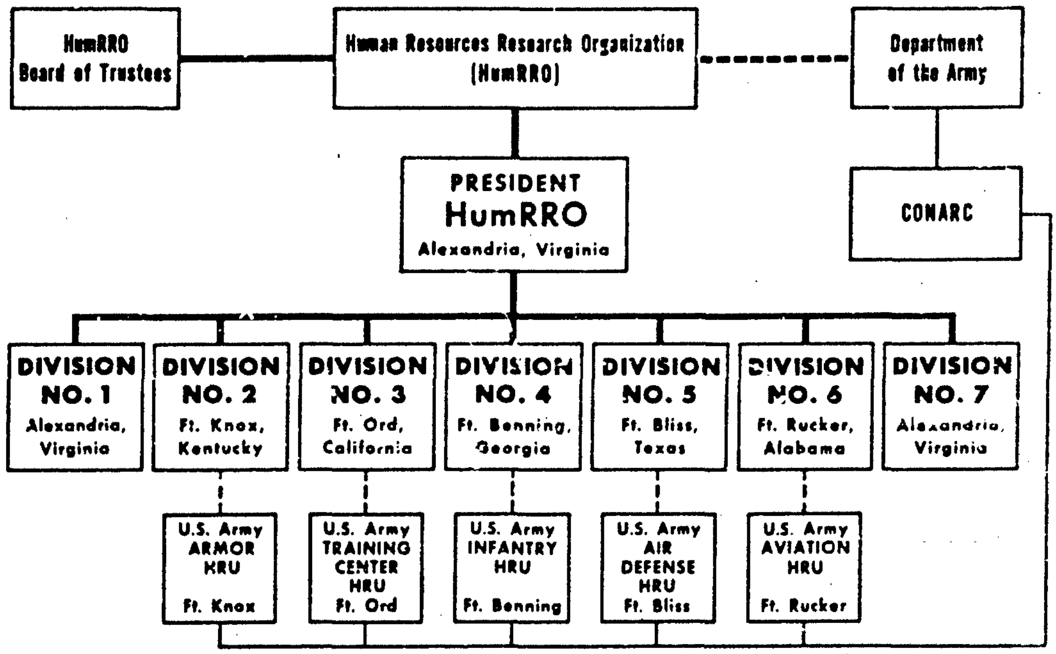

Figure 1

supplemented by the enlisted research assistants. Throughout HumRRO, and particularly in the field divisions, our contacts with Army personnel and military operations are very close. Research and development is conducted within the Schools, Training Centers, or in the field with the aim that the results be practical and usable.

That the results have been put to use is attested by a series of CONARC Pamphlets, issued each year since 1961 describing major applications of HumRRO findings to Army training. In addition to the programmed work of HumRRO, we have engaged in a good deal of what we call Technical Advisory Service, or TAS, in which we have provided the Army with best available answers to immediate problems in training and other human factors areas. More than a hundred instances of such items of TAS have occurred each year. HumRRO personnel have also served on Army boards and committees and the Directors of our field divisions at Forts Knox, Benning, Ord, and Bliss, along with the Chiefs of the Human Research Units, have been members of the Center teams. These kinds of close associations with the Army have promoted both the development of training technology and its application in ongoing training programs.

The HumRRO *Work Program* for the Army is developed each year in response to Army requirements that are solicited from major Army commands by the Chief of Research and Development. Many more requirements are received than can be included in the Work Program. Of the 33 elements in the FY 70 Program, 12 are sponsored by CONARC. Most of the remainder, while sponsored by other major commands or staff sections of the Department of the Army, are of interest to CONARC, because they relate in one way or another to training and the improvement of human performance. Approval of the Work Program is recommended to the Chief of Research and Development by the Army Human Factors Research and Development Committee. CONARC has membership on this committee.

I turn now to the topic of the technology of training—a continuously developing subject as new research data and practical experience are combined. The presentations by the other HumRRO speakers will describe specific developments that extend various parts of the technology. As a background, I wish to present a general framework that has evolved in HumRRO over the years. This framework ties together all parts of the technology in a seven-step procedure for the development of a training program (Figure 2).

Steps in the Development of Training

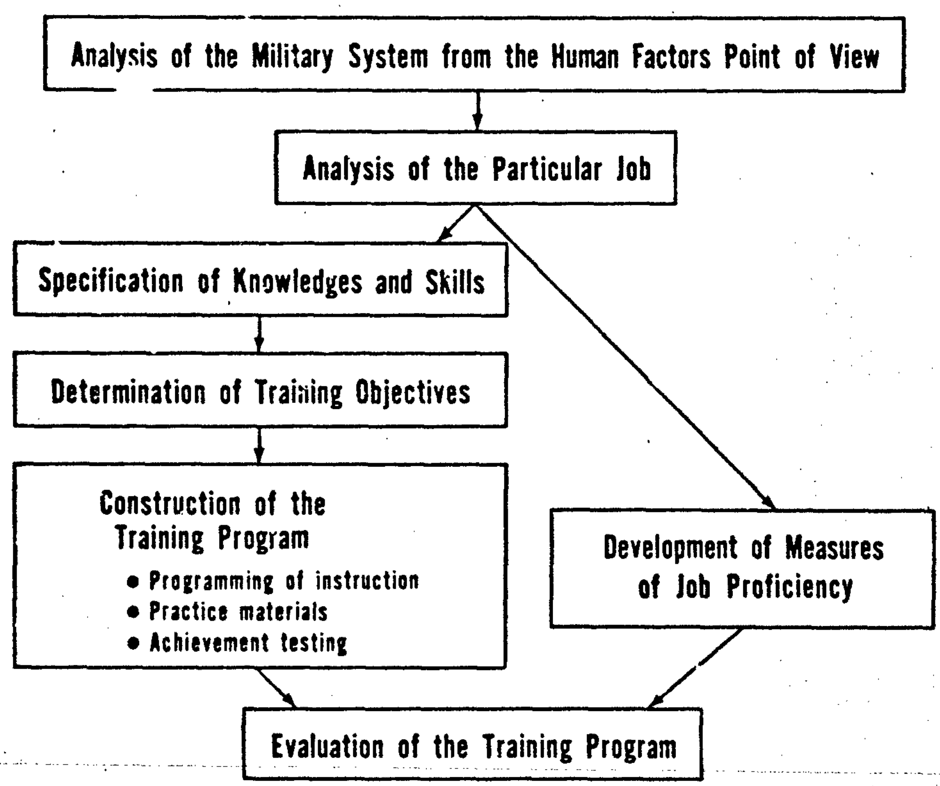

Figure 2

I should add that a framework very much like this one formed the basis of CONARC Regulation[1] 350-100-1 on the systems engineering of

[1]U.S. Continental Army Command. *The Systems Engineering of Training*, CONARC Regulation No. 350-100-1, February 1968.

training. While the exact steps in this regulation are somewhat different from those I will present, the general scheme and intent of both are the same.

From a military point of view, the effectiveness of an operation is judged largely in terms of the performance of units—units that are working combinations of men and equipment. These two components, human and hardware, taken together, produce an output. Design and production of the hardware component constitutes a complex interaction of military and industrial effort. By analogy, the human component is placed appropriately in the system through the operations of selection, classification, and training.

The purpose of training is to fit the man to play a proper role in this system, whether it be at an inconspicuous lower echelon position in the organization or at the apex of the system as its leader.

Therefore, the first step in building a training program is the analysis of the military system from the human factors point of view, to determine the exact role each man will play and the function he is to perform in the system. The system may be as simple as the man and his rifle. The unit of analysis may extend from the squad, the tank crew, the artillery battery, through company and battalion level or to a logistic support unit, to much larger units. The point is, we must identify the roles the man is to play in order to build training that will fit him to the system.

The next step is to analyze each job or duty position within the system to determine the inputs to the job from the rest of the system and what kinds of outputs must result from his job performance that go back into the system. The task here is to build a job model. The elements comprising the job model are the tasks the man must perform in the operating system—the terminal objectives of training. I should point out that a side benefit often occurs in carrying out these first two steps in training development. The system analysis and analysis of particular jobs sometimes indicates ways job duties can be rearranged or reallocated in an existing system to improve the efficiency of unit performance. Also, it is possible to define jobs for new systems by our analyses of hardware designs and mockups early in the hardware development cycle, as we are doing at HumRRO Division No. 2 at Fort Knox for the Main Battle Tank (MBT). Such early attention to the human factors in system design, as called for in AR 611-1,[1] saves costly mistakes in equipment configuration. It also anticipates training requirements, so that trained men can be ready when the equipment is ready. At Division No. 2 we are doing this kind of work for the operation of the new night-vision devices.

Examples of such analyses for four kinds of military performance were presented in a previous HumRRO briefing at CONARC.[2]

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[1]Department of the Army. *MOS Development and Implementation,* Army Regulation (AR) 611-1, Washington, January 1968.

[2]Presentations at HQ, U.S. Continental Army Command, Fort Monroe, Virginia, October 1968, *Use of Job and Task Analysis in Training,* HumRRO Professional Paper 1-69, January 1969.

After the analyses, the developmental process follows two parallel courses that will come together in the last step. As shown on the right side of the Figure 2 diagram, a set of proficiency tests are built from the job model. These tests call for performance as nearly like, and as complete as, that required in the operating system as is possible. Minimum standards of individual performance need to be set in terms of that performance level which will satisfy requirements for at least minimum output from the system as a whole. This is often not easy to do. It has been done by computer simulation; more often it requires a careful judgment by military experts and research personnel who estimate the consequences of errors and delays in individual performance on system performance.

Returning to Step 2, analysis of the particular job, we move down the other side of the Figure 2 diagram. The next step is specification of knowledges and skills, that is, a determination of what psychological processes the individual uses to respond to the inputs to the job and to generate its outputs. These are processes like sensing, discriminating, referring to short-term and to long-term memories, comparing, analyzing, projecting, and deciding. In short, this step is concerned with what goes on inside the man to get the job done. It is now becoming generally recognized that this "task and skill analysis" is a necessary prerequisite to the development of good training.

Determination of training objectives is in many respects the most important step in the whole process. Many training programs suffer because they have vague objectives or because they are directed at the wrong objectives. Here we are talking about enabling objectives—these are the knowledges and skills which are called for in performing the tasks comprising the job (the terminal objectives) (Step 2) and are measured in the proficiency test (Step 3). Objectives can be determined by a kind of subtraction technique. If we know what knowledges and skills a man brings to the training (which are sometimes called "entry characteristics"), we can subtract these from all that are required for performance of the job, and can confine our instruction only to those in which he needs to be trained. As will be noted in the subsequent papers, this is one of the important aspects of individualizing instruction—fitting the objectives to the needs of each individual student.

In the construction of the training program, the important point to note is that the system, the job, the knowledges and skills required, and the objectives have already been defined, and a performance goal has been specified before we get to this step. In other words, it is possible to build training to performance specifications.

As indicated in Figure 2, this is where the programming of instruction takes place; whether it be simply the orderly presentation of major topics or the step-wise provisions of bits of information as in the "programmed instruction" techniques. The provisions of practice materials is done at this point. As will be described in the presentation on aviation training and training devices, it is only after all of the three preceding steps have been accomplished that precise design of a trainer becomes possible.

It is in the construction of the training program that use is made of all that we now know about the psychology of learning—of how decisions are made as to what next to present the student in an orderly learning sequence. This point will be stressed in the presentation on Computer-Administered Instruction.

Finally, in this step, achievement tests are built. These are measures of how well the student has mastered the sub-objectives or enabling objectives that are required before he can reach the terminal objectives that are required in the measure of job proficiency.

In the last box (Figure 2) the two lines come together for evaluation of the training program. Using the measure of job proficiency, a typical group of students is administered the new training program and tested for proficiency. Here we are testing the efficiency of the program, not the students as individuals. The suitable criterion to use is: Do a satisfactory number of students obtain minimum proficiency on the test? If so, the training program is a success—if not, "back to the drawing board."

The diagram in Figure 2, taken as a whole, is a summary of the essence of training technology. It is not particularly unique to HumRRO—there are many diagrams showing approximately the same steps. However, its orderly progression from the needs of the system to the performance of the individual is the essence of the new technology. While this diagram is several years old, improvements have been taking place in how to perform each one of these steps. It is the purpose of our briefings to illustrate some of the advances that are being made in the development of training.

TECHNOLOGY OF TRAINING: PROJECT IMPACT

J. Daniel Lyons

We might view this briefing, or any briefing, as a learning situation—a classroom—in which the briefer is an instructor and the listeners are students. Perhaps I should say *potential* learning situation, because each of us has attended briefings or, worse, presented briefings in which the communication of information was at best minimal, or at worst inaccurate, and the resulting behavioral changes were inappropriate.

The general topic of this period of instruction is "HumRRO research on the utilization of the computer in Army training." As an instructor, I am immediately confronted with the problem that each of you brings to this classroom a different pattern of interests, knowledge of the subject, and aptitude. That is to say, each of you has a unique set of "entry characteristics" as you come to this lecture. Even if I were the world's most competent instructor, I could not possibly present a lecture that would be appropriate for each of you. In fact, were I able to communicate with maximum effectiveness and efficiency with any single individual in this room, I would automatically fail with other individuals who have extremely different "entry characteristics."

Moreover, you differ markedly not only in these entry characteristics but also in your mode of learning. Among the variables which must be adjusted to the needs of each individual are order of presentation, amount of repetition, use of visual materials, timing and amount of feedback, availability of supplementary information, use of printed text, and so forth. The most effective path from knowledge state "A" to knowledge state "B" must be determined for each individual, if instruction is to be maximally effective, efficient, and economical.

To proceed effectively in our classroom here, I need to be able periodically to ask each of you, "What do you think I have said to this point?" "What have I communicated?" From each of you I would receive different answers. I think we could place these answers into three broad categories:

(1) Well-informed—that is, what I thought I said and what you heard were essentially the same items of information. For those individuals I should proceed directly to the next level of information, perhaps even accelerating the instructional process. I may be wasting your time because I am repeating information you have already acquired or because you have a particularly high degree of aptitude for the content of this course.

(2) Uninformed—that is, I am not communicating with you. In a phrase, your answer would be "You lost me." For those individuals,

we must try a different instructional strategy, a different approach because we have failed to provide an adequate foundation for further learning.

(3) Misinformed—that is, what I thought I said and what you heard were different, perhaps quite different. As the instructor's lament goes:

> "I know you believe you understand what you think I said, but I am not sure you realize that what you heard is not what I meant."

Again, an even different instructional strategy must be instituted quickly because we are following different roads which will probably diverge even more widely as the course proceeds.

At this moment, in this room, all three of these states of knowledge exist—well-informed, uninformed, misinformed. And they would exist to some extent no matter what the topic or my skill as an instructor, *despite* the fact that this is a relatively homogeneous group with regard to aptitude, interests, and prior knowledge.

Within an Army training course the momentary differences in state of knowledge are multiplied many times over because of the greater heterogeneity of the student characteristics and the increasing technical complexity of the subject matter.

By providing a tutor for each student, we could achieve highly effective instruction *if* the tutor had the following characteristics:

(1) He must be able to determine all of the relevant entry characteristics of the student, such as his interest, aptitude, educational level, prior exposure to the subject matter, the general nature of his learning pattern, and so forth.

(2) He must be able to memorize and store all of this information and to recall and utilize it as appropriate.

(3) He must be able to determine at any moment the state of the student's knowledge; to determine whether on a given point the student is well-informed, misinformed, or uninformed.

(4) He must then apply an instructional strategy which is appropriate to the entry characteristics and momentary state of knowledge of the student; that is, he must be able to make the correct instructional decision according to a model which he has previously developed.

(5) Must be able to apply all of his stored information and his instructional decision model to the particular subject matter which he is teaching.

Among the factors which the instructor must continuously consider for each trainee are:

(1) *Entry characteristics* of the individual trainee.
(2) *Educational level* and *background.*
(3) The *trainee's responses.*

(4) *Latency* (i.e., the delay with which the student gives his responses).
(5) The trainee's *response history* and *patterns* existing within the response record.
(6) *Prestored norms.*
(7) The *characteristics* of *subject matter* to be taught.

The goal of Project IMPACT is to provide this instructor to the Army in an economically feasible manner through computer-administered instruction. To accomplish this goal we are developing a prototype computer-administered instruction system with accompanying prototype programs of instruction incorporating the following objectives:

(1) To develop instructional effectiveness progressively to higher levels in a system capable of adapting more and more precisely to the specific momentary needs of each student.
(2) To develop competitive economics for an operationally implemented system.
(3) To reduce dependence on available competent manpower.
(4) To achieve administrative simplicity and management efficiency.

This system of instruction is to be capable of adapting to the capabilities, at any given moment, of each individual trainee. This adaptiveness will be based both on the "entry characteristics" of the trainee and on his long-term and immediate response patterns within the course, so that each step in the instruction will be fitted to his needs at that point in the process. The content of the instruction is to be directly relevant to specific job requirements.

The development involves four cycles, with the activities in each cycle grouped into four types of concurrent developmental activity:

(1) A set of instructional rules which we call the *Instructional Decision Model.*
(2) Development of *instructional programs.*
(3) The development of suitable computer *software.*
(4) Development of specifications for functional characteristics of the *hardware.*

The essence, the heart, of our effort is the development of this Instructional Decision Model. This is the means by which all of our information about the characteristics of the individual student and about the course content are brought together at a particular moment in time to determine the next step in his training. The computer itself is *not* the focal point of computer-administered instruction. It is rather a very powerful tool by which instructional decisions can be rapidly reached and implemented.

In order to insure the necessary integration of our activities we have assembled an interdisciplinary team drawing on a wide variety of specialities including research psychology, computer science, instructional programing, applied mathematics, and electrical engineering.

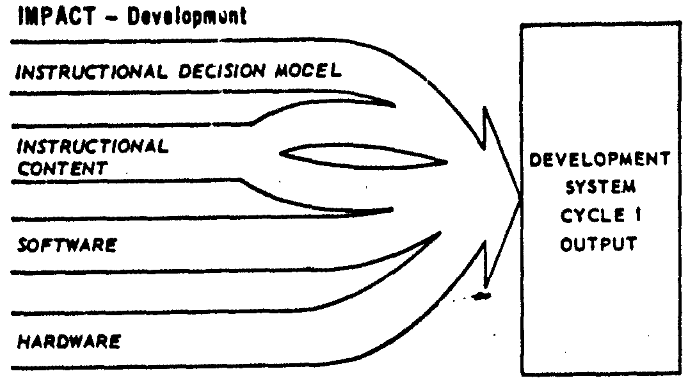
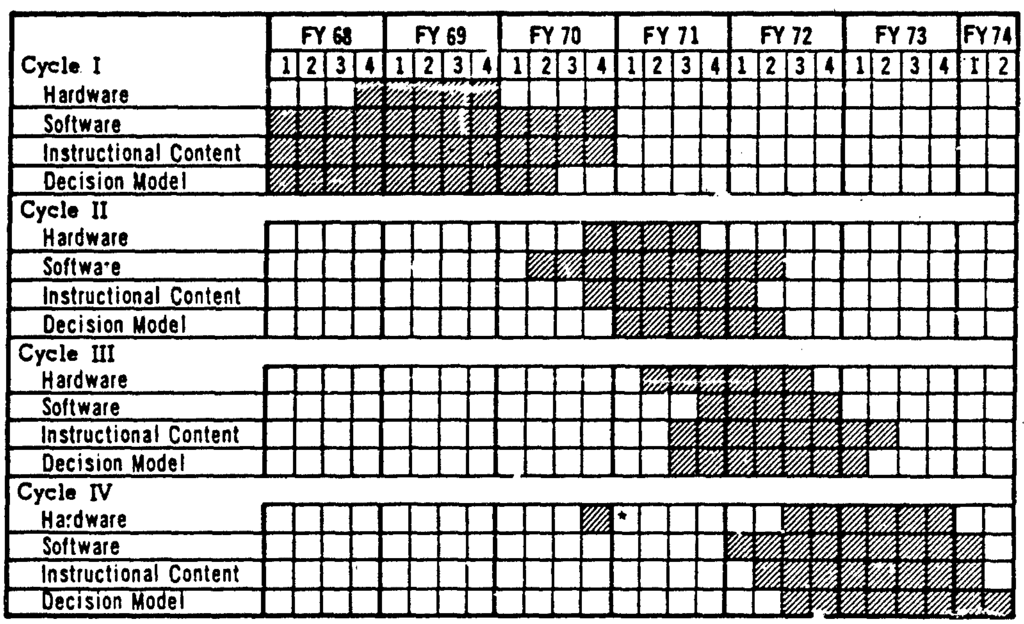


Figure 1

In Cycle I, off-the-shelf hardware, initial software, job-relevant instructional content information, student capability information, and an initial instructional decision model are being integrated into a provisional system with an accompanying prototype course. COBOL computer programming was chosen as the initial course content both because of a recognized widespread need for this type of training in the Army and Department of Defense and because we were already familiar with this type of subject matter from Work Unit METHOD. This phase will be completed in FY 1970. I will return to a discussion of the specific products of Cycle I later.

Planned Schedule of Development



* Preparation of specifications for purchase of second generation hardware

Figure 2

In Cycle II, this "breadboard" model will be tested for effectiveness and will be revised to produce a first-generation prototype of a CAI system which will be operationally implementable. The target date for completion of Cycle II, contingent upon funding levels, is the middle of FY 1972.

In Cycle III, a second-generation CAI system will be developed, and in Cycle IV effectiveness tests for the second-generation system will be used to assess long-range effects of CAI. Simultaneously, a third generation CAI system of upgraded and expanded capability will be designed and additional instructional programs will be developed.

Cycle I was initiated at the beginning of FY 1968. With the completion of this Cycle during FY 1970, the identifiable products will include:

(1) Twelve functioning student stations which house the computer terminals and associated equipment. Included in these stations are Cathode Ray Tubes for visual presentation of information and instruction, input typewriters, projection devices, and other audio-visual media.

(2) The preliminary version of an instructional decision model, programmed for computer utilization.

(3) A provisional COBOL course which has been administered to a limited number of students and which incorporates the preliminary version of the Instructional Decision Model.

(4) Interface equipment by which a number of auxiliary presentation devices can be used in conjunction with the Cathode Ray Tube and the film projector for presentation of information and instruction to the student.

(5) The preliminary operating version of a speech recognition system which will allow the student to respond by voice to questions posed by the various presentation devices.

(6) Provision for student response by means of hand-printed characters on a simulated COBOL programming sheet using an electronic pencil.

(7) A set of documents which can be used as preliminary specifications manuals for:

- (a) Hardware system design.
- (b) Training of Army instructional designers in CAI authoring techniques.
- (c) Development of system software directed toward generalization to other computer systems.

Our progress has been slower than originally predicted because, like most activities funded from military sources, funding has been considerably reduced, below the levels anticipated at the time the Technical Development Plan was approved. To date we have been able to maintain the program on the original track but at a somewhat slower pace than had been planned.

Our work has aroused considerable interest not only within the Army but also by the other services; we have been visited by representatives of the Navy, Air Force, Coast Guard, and Marines. Numerous other training

Student Using Electronic Pencil

Figure 3

and educational agencies—both U.S. and foreign—have expressed positive and continuing interest. A very tangible benefit of this interest is that it now appears that we will be able to obtain financial support for some of those portions of the project which the Army has been unable to continue to support. In particular, we have received assurances of grants from the National Science Foundation and the Cattell Foundation; we are continuing to explore additional sources of funding.

In summary, we believe that this effort will result in an effective, efficient, operationally implementable, and economical training system which can revolutionize training in the world's largest training and educational establishment, the United States Army.

If this is true, what then are the implications for the Continental Army Command? What actions should be taken now to prepare for the most effective use of computer-administered instruction? I do not have a definitive or detailed answer to that question; however, I should like to offer some suggestions for your consideration. First, I would suggest that hardware and software systems are *not* matters of prime importance at this time. The state-of-the-art of computer-administered instruction is not at a stage which warrants freezing the design through major investments in specific hardware or software systems. The computer is valuable as an instructional tool only to the extent that it is properly embedded in an effective total instructional system.

The most critical elements of an effective instructional system are a well-defined set of appropriate training objectives and an adequate repertoire of instructional strategies to reach those objectives. These elements remain central to the instructional process whether the primary tools are computers, slide projectors, simulators, or blackboards. I am, therefore, suggesting that the most appropriate actions by CONARC are to continue the emphasis on specification of behavioral objectives as exemplified by CONARC Regulation 350-100-1,[1] and to place an increased emphasis on the explicit statement, documentation, and evaluation of various instructional strategies or techniques.

In addition, continuing attention must be given to the development of a personnel management system which can effectively deal with proficiency-based graduation—that is, which can place individual students in appropriate duty positions as soon as they have mastered the objectives of a training program. The implications for CONARC may be summarized as:

(1) Leave options open on hardware and software.
(2) Continue emphasis on training objectives.
(3) Specify and evaluate instructional strategies
(4) Develop individualized personnel management.

Since my presentation has, of necessity, touched only the highlights of our work on computer-administered instruction, I certainly cannot claim to have led any of you into the well-informed category; I can only hope that I have kept the uninformed and misinformed categories to a minimum.

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[1]U.S. Continental Army Command. *The Systems Engineering of Training*, February 1968.

INDIVIDUAL TRAINING OF PERSONNEL OF DIFFERENT APTITUDES

Howard H. McFann and Arnold A. Heyl

This paper on training technology is limited to activities that occur in the Army Training Centers—individual training in the combat and combat-support MOSs. The population with which that training is concerned represents the complete spectrum, from the functional illiterate to the college graduate. The foundation for the paper is the experience gained in 18 years of HumRRO training research and development, and particularly in the current activities at HumRRO Division No. 3, Presidio of Monterey, California. The considerable amount of data that are being obtained in those activities will be dealt with only to the extent of mentioning their general objectives. Each activity is directly related to Project 100,000, and deals with training and utilizing Army personnel of low aptitudes.

In Work Unit UTILITY we are concerned with assessing the level of performance achieved by Project 100,000 soldiers who have been assigned to duties in MOSs as cooks, vehicle mechanics, armor crewmen, and supply clerks. Early results indicate clearly that Category IV men can and do perform successfully, given additional time to learn.

In Work Unit REALISTIC the literacy demands of selected MOSs are being determined. We are concerned with reducing the discrepancies between men's literacy skill levels and the literacy skill levels required for their jobs. Reading, listening, and arithmetic skills are being examined; it appears that men of lower aptitude learn more effectively through listening than through labored reading of material beyond their skill level.

The research personnel in Work Unit APSTRAT are attempting to develop training strategies appropriate for various levels of aptitude and to evaluate them in the operational setting. Operationally, Category IV personnel will be trained with non-Category IV personnel and training systems suited for use with such diverse groups are required. Emphasis will be placed not only on the organization of methods and materials to be used, but also on the organization of instruction.

In Work Unit SPECTRUM materials and methods of instruction for men of differing mental aptitude are being studied extensively in a laboratory setting. In addition to developing methods and materials in selected content areas, criteria are being established that can be used in selecting appropriate methods and materials in other content areas. Materials and methods developed in SPECTRUM will be used whenever possible in the work units mentioned earlier.

This presentation, divided into three major sections, deals with what training technology has to offer. The sections are: (a) how to determine what you wish to teach—the training content for individuals; (b) how to evaluate the training of individuals; (c) how to teach individuals.

How to determine what you wish to teach, or what the content of a particular course should be, is spelled out in CONARC Reg 350-100-1.[1] Basically, that regulation describes a systematic method or procedure which allows for insuring that the content in a course is related to the requirements of the Army job. An examination of present course content leads one to believe that such a procedure is needed.

Clearly, what is taught in a course depends on the characteristics of the trainees, the kinds of skills and knowledges they have when they come to take the training. Our examination of combat and combat-support courses indicates that a great spread in aptitude level exists among the soldiers who enter almost any course offered. Ideally, in that situation, training administrators would like to have a program planned so that each man would receive only that training required to bring his initial knowledges and skills up to the level of the course objectives or goals. Thus, a person who enters training with a knowledgeable background in a particular area would be able to get credit for his past experience and training and move rapidly along to new material. This is done, in essence, when men are assigned directly to MOSs without prior school training.

Direct assignment assumes that one has a good evaluation procedure to assess the incoming individual's skills and knowledges that are appropriate for the particular course. The extent to which valid evaluation procedures can be established depends directly on the quality of the analysis of the particular job requirements—the "breaking out" of particular tasks that are required of the individuals, and of the skills and knowledges required to perform these tasks. Once this has been achieved, then solid evaluation procedures can be obtained.

In addition to the initial assessment of the individual, there are two other components of evaluation that must be taken into account. The ultimate evaluation of the course must reflect the requirements established in the previous analysis of content. A statement of the particular performance or tasks that are to be performed, and conditions and standards to be met in performing them, is required if there is an absolute standard; that is, if the administrators of instruction have specified the performances that are demanded and students are evaluated on a pass-fail basis. Either the individual is able to perform the particular task under the conditions specified or he is not. This is quite different from a relative performance standard in which, for example, a score of 70% is considered passing.

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[1]U.S. Continental Army Command. *Systems Engineering of Training*, CON REG 350-100-1, February 1968.

A third aspect is the continuous evaluation that should take place during a program of instruction. This involves assessment of the student's progress, providing him information on how well he is mastering material, and providing information to the instructional staff on how well they are instructing. Emphasis is placed on mastery of material rather than partial learning of material after exposure to it for a specified period of time. Emphasis is placed on individual mastery of skills and knowledges that are prerequisites to a higher level task. A careful analysis of the skills and knowledges required for each task is, of course, required.

Before leaving these first two areas of how to determine the content and how to evaluate, it should be reiterated that the training technology or the methodology required for obtaining answers to these two questions is laid out very well in CONARC Reg 350-100-1. There is ample evidence to indicate that when this systematic approach is applied to the establishment of training courses, considerable gain is obtained not only in making sure that the course is relevant for the particular job, but also in establishing meaningful evaluation procedures with much heavier emphasis on performance than on paper-and-pencil testing.

It is in the third area, technology of training applied to the teaching process, that the majority of ongoing research at Division No. 3 is centered. Considerable impetus for this research resulted from the decisions to lower AFQT standards[1] and rescind student deferments. This produced a training population characterized by an even greater spread of individual ability, ranging from high Category I personnel through low Category IV personnel.

Inspection of combat-support courses indicated that although formal selection procedures narrow the input to a course, wide differences in entry level skills and abilities still exist. These differences notwithstanding, inspection of the Army training system indicates that most courses consist of a single-track system with a specified minimum achievement level prescribed as the standard for graduation. Trainees enter together, they receive the same program of instruction, and are programmed to graduate together. But not all trainees make it through the course the first time. Some are "washed back" or recycled and generally receive a repetition of the same instruction. The general method of instruction is a lecture-demonstration-practice paradigm, with the content being sequenced by subject-matter block.

In numerous studies, researchers have related aptitude level to successful acquisition of the skills required for satisfactory performance of a variety of military tasks. From them, we can conclude that efficient training of men at all levels of aptitude will depend on (a) the recognition of individual differences in aptitude, and (b) the design of instructional programs that are compatible with these individual differences. No one single training program, particularly one

[1]Armed Forces Qualification Test scores: Category I, 93-99; Category II, 65-92; Category III, 31-64; Category IV, 16-30; Lower Category IV, 10-15.

committed to the group instruction model, can effectively accommodate the spectrum of aptitude ranging from Category I personnel down to Category IV. Further, there is sufficient evidence to indicate that although AFQT score will provide an overall group indicator, if one were to select input to courses such as those offered in Army Training Centers solely on the basis of AFQT scores, great injustice would be done to many of the men who were ruled out. We have found consistently in our laboratory studies and also in our examination of on-the-job performance that there are large numbers of men labeled low-Category III or Category IV when they enter the service, who are good performers and who perform at a level comparable to Category II and Category I personnel.

I will now discuss some factors that are pertinent in teaching. First, *structuring and sequencing of content* in ways appropriate to the trainee group has proven consistently to be beneficial. This organization and sequencing of material is helpful for the high ability trainee but is most important for the low ability person. One aspect of this structuring is the establishment of relevance or meaningfulness of the material to be learned. The establishment of such relationships is an essential characteristic of what we in HumRRO describe as the principle of *functional context*. Functional context sequencing and structuring requires that training content be organized so that the intended use of new instructional material is established for the learner prior to the introduction of the material itself. The principle follows simply from the fact that people learn and retain best those new things that can somehow be tied in with something already known. Ancillary to the principle are certain working rules: (a) go from the concrete to the abstract; (b) go from the specific to the general; (c) go from practice to theory; (d) go from the familiar to the unfamiliar.

This principle implies that subject matter material is arranged and integrated into meaningful tasks. It is task- or problem-oriented rather than subject-oriented. An example may help clarify this. In electronic maintenance courses, instead of initially presenting a block of instruction on theory of electricity, followed by a block in use of test equipment, then starting on troubleshooting or maintenance procedures, the instruction begins with the job-related problem or task to be done and only the relevant theory and test equipment required in the job for the solution of the problem is taught. You teach all of the theory that is needed and also all of the use of tools and test equipment that are needed *in the job*, but you do so in the context of meaningful tasks so that their relevance is apparent to the learner.

When this principle has been applied to courses as different in content as electronics maintenance training, medical training, radio operator training, and vehicle maintenance training, there has been a consistent gain in performance, especially for lower aptitude persons. This has usually also resulted in improved motivation and attitude on the part of the trainee. Basically, I think a form of apprenticeship training is incorporated into a formalized instructional model so that the trainee has an opportunity to practice various tasks required on the job under the guidance of a supervisor. Additionally, the trainee has a chance to make corrections and continue practice until he is proficient in each of the job tasks.

A second factor that we have found to be very important and one that should be taken into account is examination of the *complexity level of the written materials,* such as job aids, or Field Manuals and Technical Manuals. Recent information that we have collected in which the reading ability of the trainee and also the job incumbent is compared to the readability, or difficulty level, of the material that he is to use, indicates that there is considerable discrepancy between what the average trainee can comprehend and the level of complexity of the written material he is required to use in training.

Further, there is information indicating that when the material is written at a level that the trainee can comprehend, he will use the material. Time does not permit going into greater discussion of this general area of examination of material, but, clearly, the format of the material as well as the complexity level and difficulty level of the written words are all very important and need to be considered. Presently, we are trying to develop a handbook of guidelines and methodology that not only will give general guidelines as to how best to present and arrange material, but also will spell out step-by-step procedures to be followed in the design of materials.

A third general area in the instructional process concerns the *methods of instruction or the media* that are to be employed. As might be expected, the methods or media employed with a high aptitude subject or learner are not nearly as important as for individuals with lower aptitude. One view, hopefully facetious, is that in spite of our methods of instruction the brighter, more able person will learn. This cannot be stated, even facetiously, for the less able person. In fact, data we have indicate that method of instruction becomes extremely critical in determining whether or not the lower aptitude individual can or will learn the material.

If material is presented at a level that he can comprehend, if it is presented in the functional context manner, if it is individually paced, if he is provided considerable support, if he is in a learning situation where he can ask questions and receive answers, if the material is organized so that he is learning small bits of information at a time, and if he is given an opportunity to practice and participate actively in the learning process, then he will be able to learn and will learn material that varies considerably in complexity.

It is apparent that there is no one medium or method that is appropriate for all individuals. Ideally, then, one wants to present a variety of methods or media so that the individual can choose those most appropriate. Peer instruction is a method that seems to show great promise, being relatively inexpensive, highly motivating, and surprisingly effective. The use of listening skills rather than reading skills, through employment of media such as tape/slide presentations, video, and television, is highly effective with personnel of lower aptitude. The basic points seem to be to have active participation of the learner, to provide options for him to get information from a variety of sources, and to provide knowledge of how well he is absorbing the required materials.

I will comment briefly on the area of *motivation and the use of incentive systems.* We have tested formally in the laboratory the effects of tying incentives directly to the learning process. We established a point system for learning of different kinds of content. The number of points an individual earned depended on how rapidly he learned the material. In turn, he could "cash in" these points for permission and time to engage in particular activities such as going to the PX, to a movie, or watching television in the evening. This system appears to work very effectively. It has been tried out in a variety of nonmilitary situations and found to be effective; it would appear to be equally advantageous to employ this system in the military.

Pertinent Factors in Teaching

Structuring and sequencing of content

Complexity level of written materials

Methods or instruction or media

Motivation – incentive systems

Figure 1

Presently we are working with the Headquarters staff at Fort Ord, California, helping to establish and test out this concept of incentive systems. We are also providing consultation on how and where to establish peer instruction at Fort Ord.

The foregoing points on what training technology has to offer to the teaching process are given with different degrees of certainty as to immediate utilization. The information on structuring and sequencing instruction can be applied immediately and should be. This principle runs quite counter to the way Army Subject Schedules are now interpreted. Specified numbers of hours are prescribed for a given topic, and subject matter orientation, rather than task or functional orientation, prevails.

Information on literacy level or complexity level of materials is available in sufficient detail and the procedures are sufficiently worked out so that action could be taken in this area. On the question of methods and media of instruction, I think the most important point to recognize is that there is no one method or medium which is most appropriate. The factors of individual differences need to be taken into account and provision must be made for individual pacing.

This implies that a single-track system is not efficient and that classroom centered instruction which usually employs a predominantly lecture-demonstration-practice paradigm is not most efficient for teaching. A system must be established which will allow the individual learner to move at a rate best for him, which will insist on mastery of material at each level, which will allow for a variety of instructional media, which will provide for functional training with an emphasis on performance, and which will incorporate sound evaluation procedures. Administrative aspects of such a system must be arranged so that large

Implications for Training

Structuring and sequencing of content:
CON-Reg 350-100 1 provides
adequate basis for action

Complexity level of written materials:
Procedures available to allow
revision of materials

Methods of instruction or media:
Select from variety of methods
allow individual pacing, emphasize
performance, incorporate evaluation

Motivation – incentive systems:
Principle sound, system should be
developed and evaluated

Figure 2

numbers of men who vary in aptitude level, and who are in training in a variety of types of courses, can be managed. We have under way new research concerned with testing out, in an operational situation, such a program. As might be expected, the major problems are related to determining how to manage such a flexible system.

On the employment of incentive systems, since there is no question about the soundness of the principle, the problem is to work out an effective and feasible system.

I have touched on some major points of application of educational technology in HumRRO research concerned with the relationships among aptitude level, training content, and instructional procedure. We have much more to learn before we can speak with any degree of certainty as to how best to design instructional systems for personnel with different aptitude levels. We are, however, optimistic that we are getting better approximations to a definitive answer as our activities progress.

SYNTHETIC FLIGHT TRAINING DEVICES

Wallace W. Prophet

During World War II and in Korea, Army aviation operated out of areas adjacent to Division artillery units, and Army aviators flew aircraft only a little more sophisticated than the Spads, Nieuports, and Fokkers of World War I.

With a requirement to train aviators to fly such simple aircraft as the World War II L-4 Piper Cub, the Korean conflict O-1 Bird Dog, and the present primary trainer, the T-41, the Army had little need for synthetic flight training devices. The only use for such equipment was in instrument training programs, and even there, the relative cost of flight versus synthetic flight training of only about 2:1 did not appear to justify device development costs. Finally though, the Army obtained—almost free—some obsolete surplus 1-CA-1 devices from the Navy. These devices, which unfortunately still constitute the make-do backbone of Army synthetic training, were designed about 30 years ago and, from the aviation as well as the training technology standpoints, are more suitable for museum display than for aviator training.

1-CA-1 Training Device

Figure 1

The Army has been aware of the inadequacies of this equipment for over 15 years, and several attempts have been made to correct many of the deficiencies. Because Army aviators and aviation training specialists typically were not knowledgeable in relevant areas of training technology, assistance was sought from procurement agencies whose responsibility was the design and development of training equipment.

Turning the problem over to a procurement agency resulted inevitably in a changed emphasis in the requirement, however. Instead of a concern over the implementation of training technology suitable to a specific application or training requirement, emphasis shifted to engineering advances and delivery schedules. It must be remembered that no procurement agency has responsibility for the conduct of operational training programs. The evidence would seem to suggest that only the user cares that the device, once delivered, will allow him to conduct the training for which the device was ordered in the first place.

Two device development activities will illustrate the dilemma. In the mid-fifties, the Army recognized a requirement for more efficient pilot training for the expensive-to-operate H-37 helicopter. The appropriate procurement agency, with the help of numerous Army aviators and the better part of the simulation industry, designed what would have been an engineering marvel had it been successful. Instead, it was a very expensive lesson learned.

No attempt was made to define the human factors requirements of the training system. It was assumed that the only requirement was to simulate the H-37, and training would take care of itself. The concept that

H-37 Helicopter

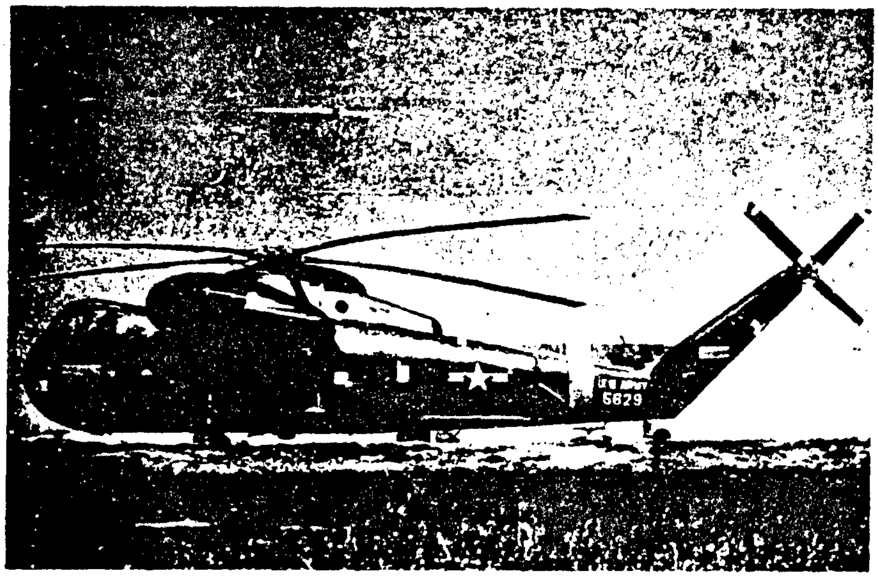

Figure 2

human factors analysis and research should identify relevant training technology design features to be included in the simulator could not have been implemented then, even if it had occurred to anyone. At that time there were no human factors personnel who were familiar with the relevant training requirements to conduct the necessary human factors research. Had the training device requirement been stated in meaningful terms—terms which included the identification of relevant training technology considerations—the procurement agency would not have felt compelled to attempt to simulate impossible-to-attain features of the helicopter and the world in which it operates.

H-37 Simulator

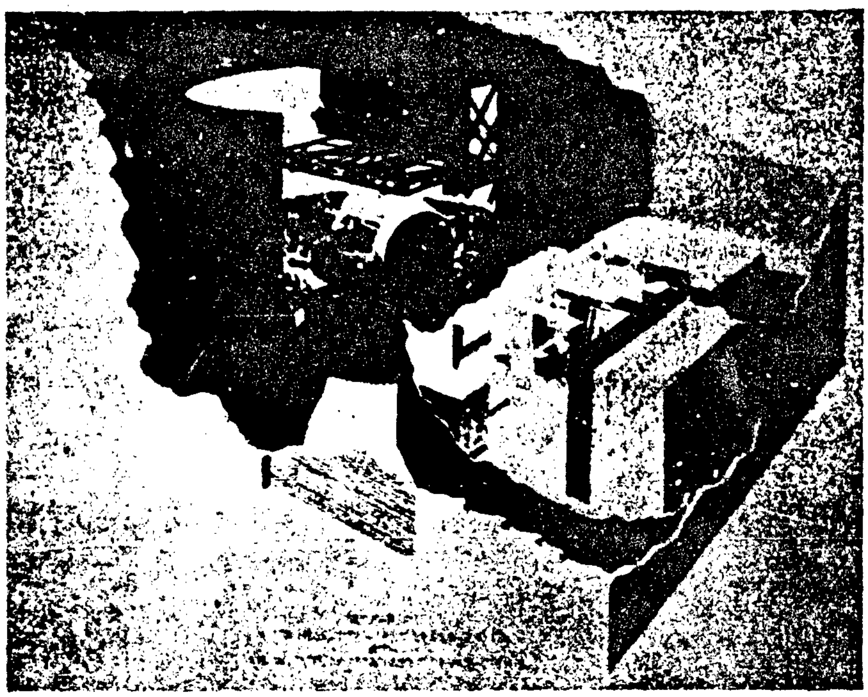

Figure 3

The next Army aviation device development activity began in 1957 when it was recognized that the recently acquired surplus Navy synthetic trainers would have to be replaced. The procurement agency was advised that the required device should simulate a single-engine, turbo-prop, fixed wing aircraft whose performance would equal that of the twin-reciprocating engine L-23 Army aircraft, plus 10%. The requirement was ambiguous and fictional, but more importantly, it did not include any human factors or training considerations. Eventually, the device was delivered, at a cost of about half a million dollars. It was tested, found to be unsuitable for the Army training requirement, and placed in storage.

Device 2-B-5

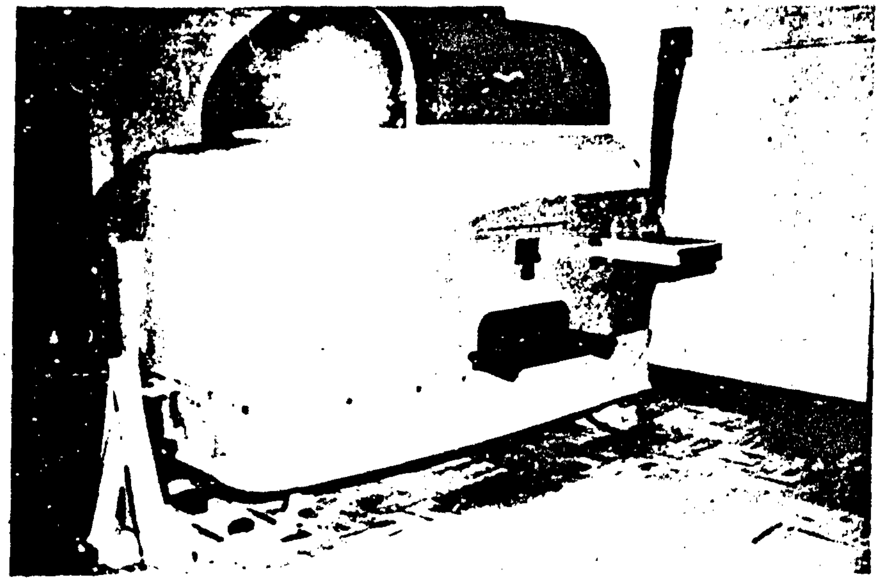

Figure 4

Since money had been appropriated to acquire a number of these trainers, the Army bought and tested a commercially available device to see whether it would provide the training needed. The tests indicated that, while not optimum, this device would be better than the old Navy devices, so a procurement agency was asked to obtain a large number of them. The agency was advised, however, that the Army would like a few minor changes, such as an increase in the simulated navigational area from 70 miles square to 160 miles square. Unfortunately, this "minor" change required an almost complete redesign of the device, and the production contract was awarded to another manufacturer.

Again, there were no Army human factors personnel involved in the redesign and procurement of the device. The result was a piece of hardware which had the desired physical features, but which incorporated none of the features of the commercially available device that had made it useful for training. Two years later, when the device was delivered and evaluated, it too was found not be be usable for training. In fact, its operation required the development of flight techniques which would be fatal if used in the operational aircraft. Another two years and hundreds of thousands of dollars were spent in attempts to salvage this device. It is now in use at the Aviation School and at several Army aviation field units and is generally considered to be a minimally acceptable device.

HumRRO did not become heavily involved in the Army's aviation training device research and development program until about 1962. An early activity was a human factors analysis of this fixed wing device and a systematic comparison of its capabilities with the training requirements.

Device 2-B-12A

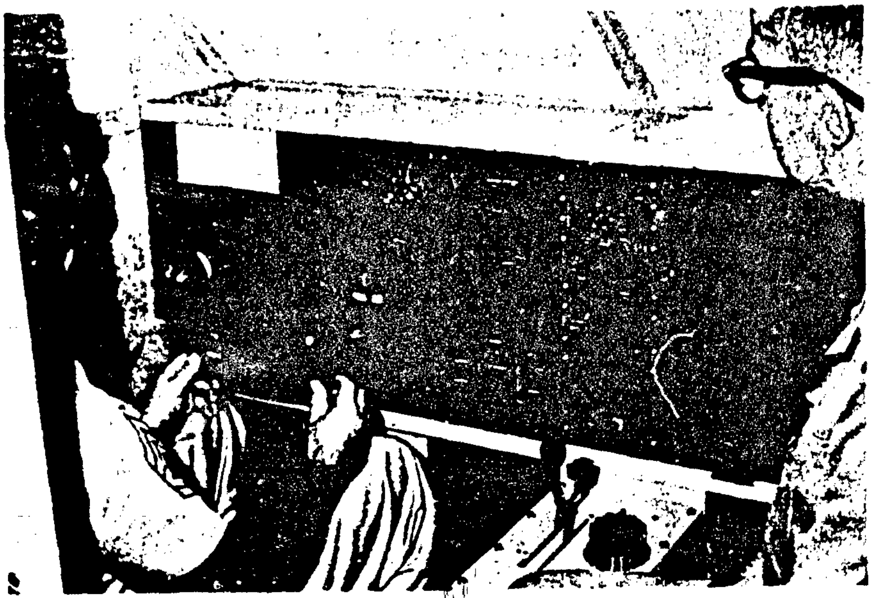

Figure 5

Device 2-C-9

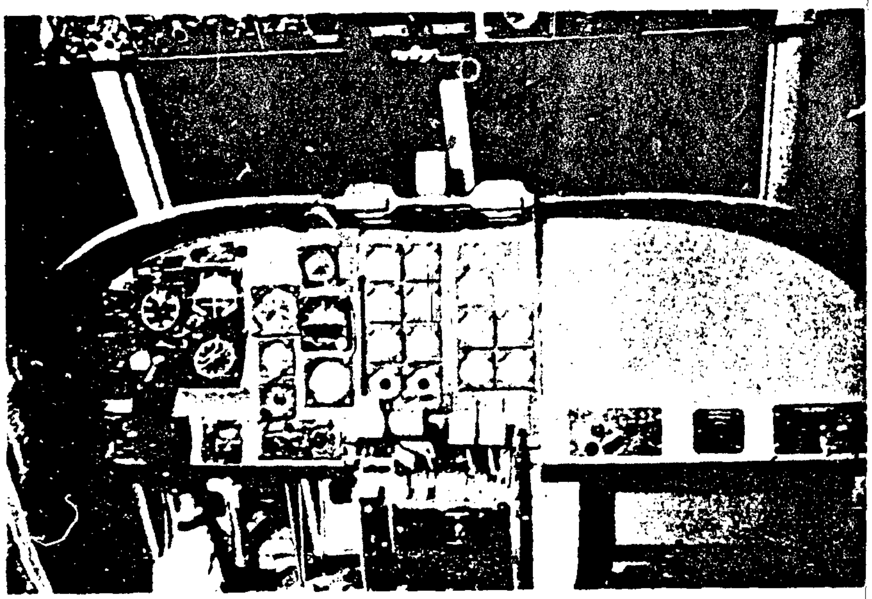

Figure 6

It was this HumRRO study which provided the human factors and training design data that eventually permitted modification of the device for Army use. However, it was necessary to cure the problem after the fact, rather than to prevent the problem through specification of human factors and training technology design features appropriate to the Army's often unique training requirement.

About the same time, we undertook the evaluation of another device which had been designed without human factors input. It was the 2C9, a procedures trainer for the OV-1 Mohawk aircraft which cost about $100,000. We built another device to our own design—a design which considered only those factors necessary to provide the intended training. It cost us about $35. Three groups of students were trained, one in each device, and the third group in the aircraft itself.

The group trained in the aircraft acquired the desired skills. So did the group trained in the 2C9. The group trained in our low-cost

Mockup, OV-1 Mohawk Cockpit

Figure 7

device did equally well. In fact, when their performance in the aircraft was compared with that of students trained in the expensive device, they were slightly better, as can be seen in the right-hand portion of Figure 8.

Training and Aircraft Performance in Device 2-C-9, OV-1 Mockup, and OV-1 Aircraft

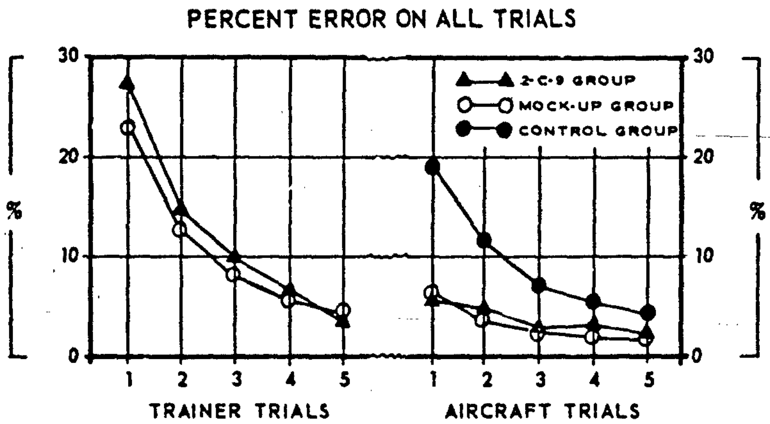

Figure 8

As a result of this study, the Aviation School canceled plans to procure two more copies of the expensive device. However, our inexpensive mockup was not adopted for training; apparently it is hard to believe that training with such a cheap, simple device could be as valid as the same training with an impressive-appearing device.

Almost three years ago, the Aviation School was faced with the problem of procedures training for the U-21 aircraft and asked HumRRO to suggest a low-cost approach until something better could be developed. We designed, and the Third Army Training Aid Center at Fort Rucker constructed, this U-21 procedures trainer (Figure 9) which is currently in use by the Fixed Wing Department. It cost $4,300, but subsequent items of a similar nature probably would cost no more than half as much. This trainer is more expensive and elaborate than the $35 mockup we made for the Mohawk, although it has little more training value. Seemingly, instructors are more likely to believe that a device will be useful for training if it looks expensive.

We made another trainer for the U-21—a trainer made of paper. Although the instructor might have to work harder, all relevant U-21 procedures can be learned with this paper trainer also. Each U-21 student at the Aviation School is given one of these devices as a study aid, and the skills he develops with it contribute to the efficiency of the training program.

Cockpit Procedures Trainer, U-21 Aircraft

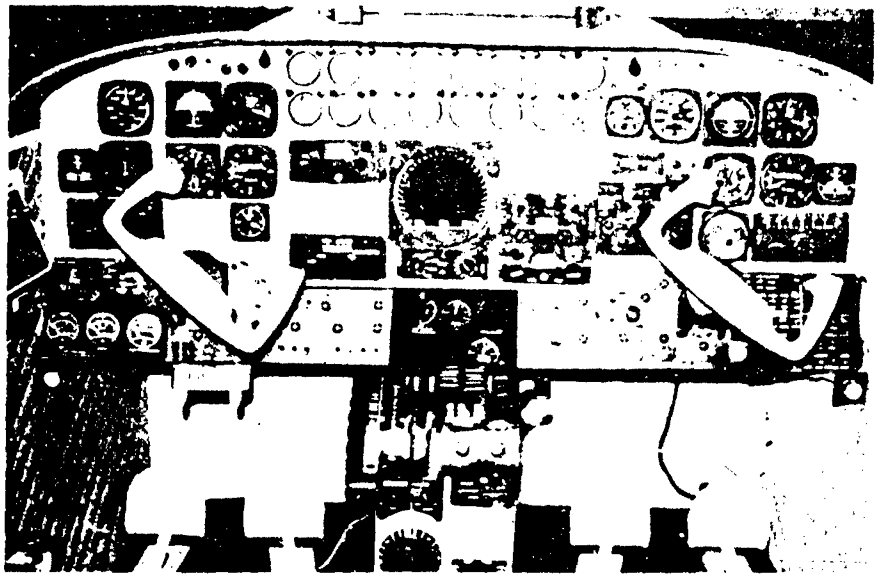

Figure 9

Paper Trainer, U-21 Aircraft

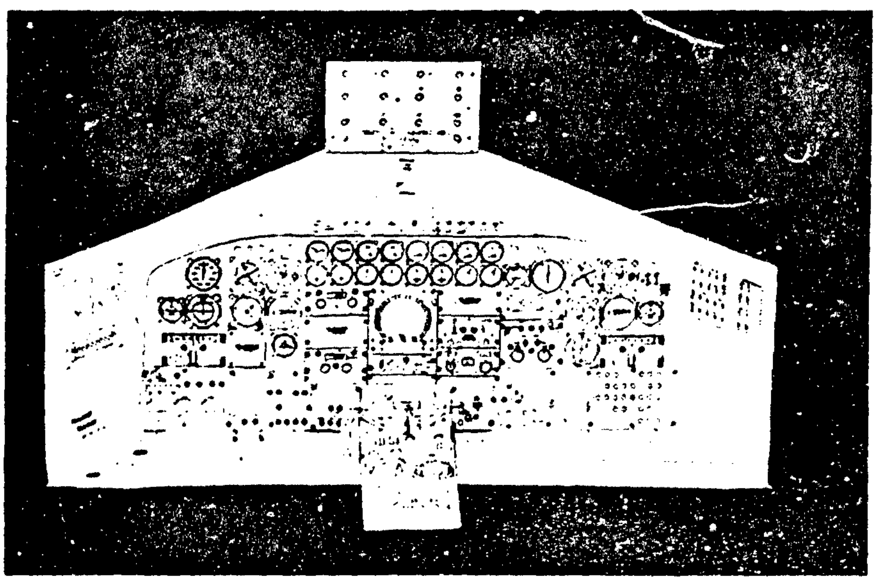

Figure 10

U-21 training is a 25-flight-hour program. Prior to the availability of these two procedures training devices, each student spent about 10% of that time, or about 2 1/2 hours, learning procedures rather than learning to fly. While the flight training program has not been shortened as a result of the training now conducted in the devices, instructors report they are able to devote about 2 1/2 more actual hours to in-flight instruction.

Paper trainers also have been developed for the OV-1, and one is underway for the T-42.

While the fixed wing instrument trainers I described earlier were under development, attempts also were initiated to obtain better devices for rotary wing training. Approximately a dozen SDRs were prepared for helicopter instrument trainers and simulators for various Army helicopters. Because of its recent unfavorable experiences with the fixed wing devices, CONARC in mid-1965 pointed out the need for human factors input to device design and noted that none of the devices described in the SDRs had been adequately defined in relation to the training requirements per se. The Aviation School was directed to restudy the problem. The School, in turn, asked HumRRO to develop functional characteristics of synthetic helicopter trainers which would be responsive to the training requirements of the School and of CONARC.

Response to such a request requires familiarity with the peculiarities of the training requirement, the nature of the operational mission, and the constraints imposed by the administrative structure within which the proposed training devices must function. It is not efficient to view synthetic training as something apart from academic training and from flight training. Each of these modes of training must contribute, in integrated fashion, to the end product—the aviator. The design of training devices cannot be optimum unless there is extensive knowledge of the potential contribution of each mode of training, and the design must concentrate on—and only on—those aspects of training which are appropriate.

HumRRO had acquired the needed human factors background in Army aviation through day-to-day contact with Aviation School personnel and participation with them in discussions of aviation training problems; by attending Army-conducted aviator training courses; and by study of training practices at the Aviation School, at Army aviation field units, and at other military and civilian flight training facilities. Without this study of aviation to augment its general expertise in human factors and training technology, HumRRO would have been unprepared to respond.

The more visible part of the response consisted of the preparation of a QMR for the Synthetic Flight Training System, or SFTS, the basic design of which was planned by HumRRO researcher Dr. Paul Caro. The SFTS, or Device 2B24, is presently under construction, and the first developmental model will be delivered late this year. The Figure 12 photo was taken at the manufacturer's plant recently, and shows the developmental model under construction.

Artist's Concept of SFTS Device 2-B-24

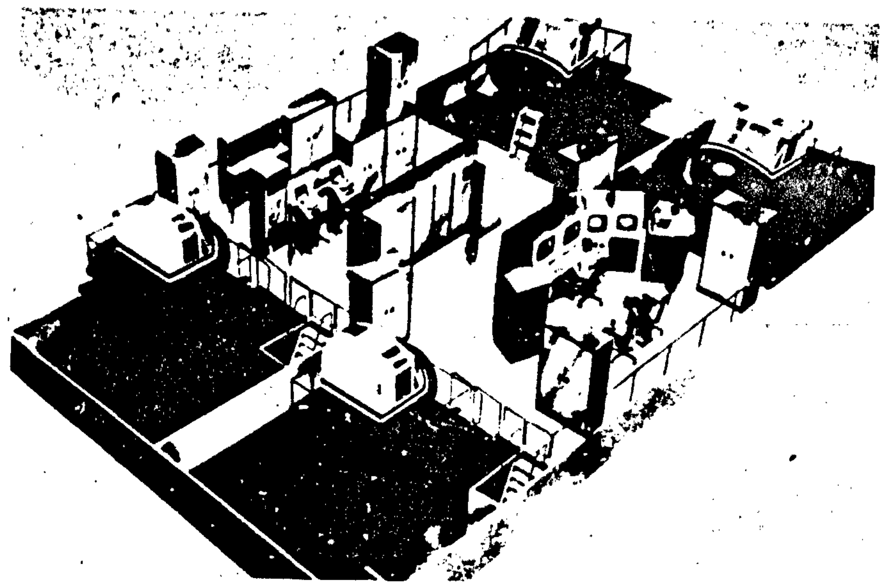

Figure 11

SFTS Under Construction

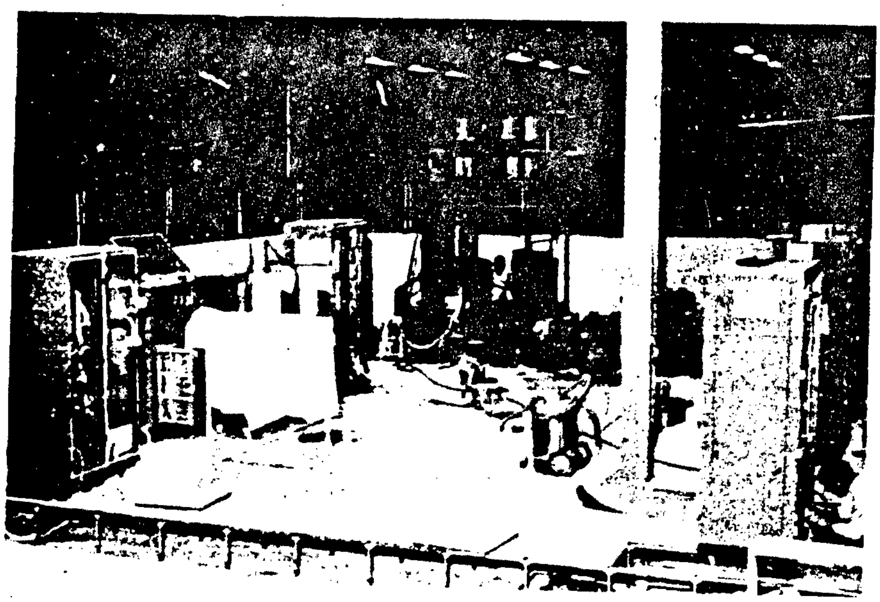

Figure 12

A design goal for the SFTS was to develop a synthetic training system which would put Army aviation at the forefront of aviation training technology. It would not be appropriate merely to take a step forward, or merely to catch up with the practices of other services. Instead, the new system must take advantage of advances in engineering, computer and training technologies, and also must be responsive to major Army flight training requirements. Subsequent action by the Department of the Army restricted the scope of the SFTS to rotary wing training, but the training technology advances inherent in its design have been preserved and broadened to keep pace with technical advances in training since 1965.

One area of SFTS design will illustrate some of the device's training features. The Army periodically faces problems related to surges in training. When large numbers of aviators must be trained, the requirement for flight instructors is overwhelming. It becomes impossible to standardize the training, and training quality control and standards suffer.

Therefore, one design goal of the SFTS was to reduce reliance on the instructor. His routine functions and the evaluation of student performance have been largely automated. It will be possible, for example, for a student to fly an instrument checkride in the SFTS, from take-off to touch-down, while the instructor does nothing more than provide simulated radio communication from the ground stations involved in the problem.

SFTS Instructor Functions and Aids

Major flight instructor functions which have been completely or partially automated in the SFTS include determining what the trainee can do and selecting an appropriate problem and difficulty level; briefing on relevant aspects of the training exercise; demonstrating desired or ideal performance independent of instructor eccentricities; objectively evaluating trainee performance against the Army's standard rather than against the variable standard of the individual instructor; providing cues to help modify or shape trainee behavior; and debriefing, or providing meaningful and timely feedback to the trainee concerning his performance.

A number of instructor aids are provided which also will contribute to the effectiveness of SFTS training. Recordings will be available of trainee performance—both video tape recordings and recordings of the flight of the simulated aircraft. These recordings can be replayed to the trainee in real time or in slow motion so that the instructor can more effectively communicate with him about deficiencies in his flying. Graphs of his ground track, airspeed, and altitude also will be available for the instructor to display to the trainee without leaving the cockpit. When any aircraft control parameter gets out of tolerance, such as altitude, the instructor will be alerted automatically, a record of the accompanying circumstances will be displayed, and, in some cases, the trainee also will be alerted.

These and other automated features and innovative aids to the instructor make the SFTS a qualitatively different kind of trainer from anything currently available. In fact, it has been referred to as a new generation of flight trainers. The Aviation School has estimated that its annual operating cost reductions in aircraft training attributable to the SFTS will be approximately $7,000,000.

Other Training Device Activity

One other training device activity I wish to discuss concerns current research related to use of another fixed wing trainer. Several years ago, the Aviation School asked HumRRO to review all fixed wing training and recommend action related to the requirements for new devices. One

Exterior View of Link GAT-II Trainer

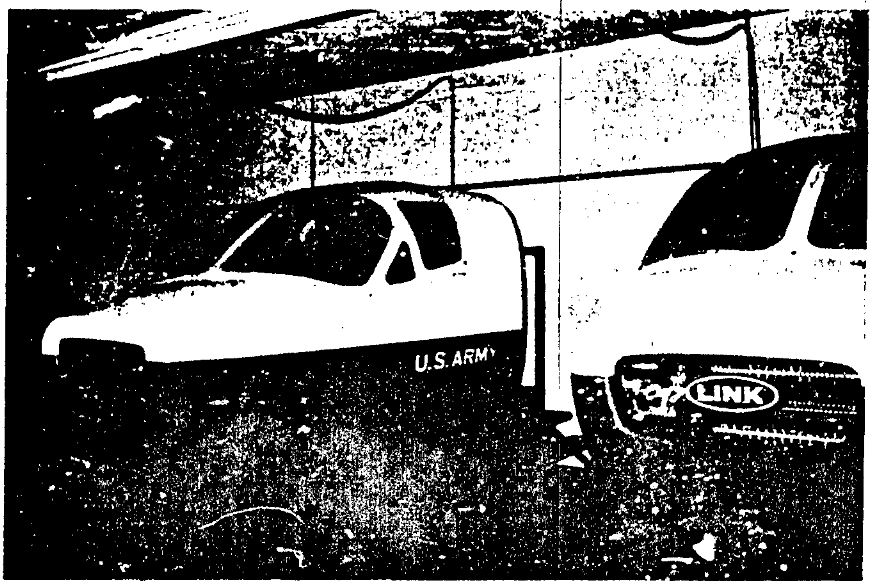

Figure 13

outcome of our study was the purchase by the School of a commercially available twin-engine instrument trainer for evaluation. The device incorporates training features that have been developed during the past several decades but are not available in other Army synthetic trainers. While it in no way compares with the technological sophistication of the SFTS, it would, if found suitable for the Aviation School's specific requirement, be an improvement over devices presently in use.

HumRRO conducted a transfer of training study in which it was determined that training in the twin-engine instrument trainer could contribute to the efficiency of fixed wing, twin-engine transition and instrument training. Although our study did not address the question specifically, it is believed that the device also is suitable for use in fixed wing instrument proficiency training programs throughout the Army.

Interior View of Link GAT-II Trainer

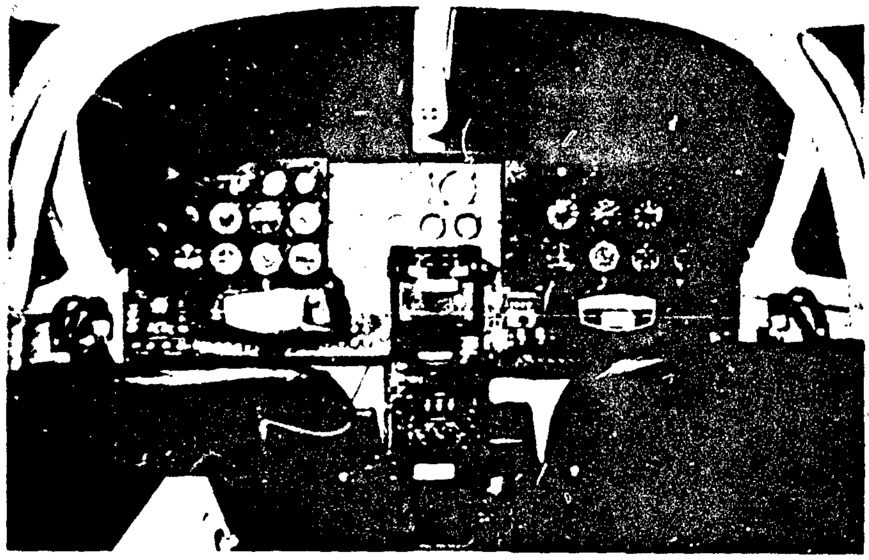

Figure 14

HumRRO also has developed a training program for use with the fixed wing device which we believe will permit a 20 flight-hour reduction in the current 60-hour fixed wing instrument training program. Such a savings could permit reduction of the initial entry fixed wing aviator course from the current average of about 215 flight hours to the 200-hour minimum permitted by Congress. The cost savings would approach $1,000 per student.

Discussions are under way with the Aviation School which we hope will lead to adoption of the new program. It incorporates several training techniques that are unfamiliar to flight instructors, and its administration will require integration of flight, synthetic, and academic training. We have offered to conduct a Methods of Instruction course for selected Army flight instructors which would include supervision of the training of a small group of students. This procedure would result in an appropriately qualified nucleus of Army instructors who then could implement the new program for the Aviation School.

Two problems related to our training device research at Fort Rucker could have an adverse effect upon research to improve the quality and efficiency of flight training. Both problems relate to the Army's flexibility where new approaches to training are concerned and to the provision of necessary resources to support the development of training programs.

First, there may be an expectation that, as soon as the various SFTS acceptance tests are completed, it will be possible to insert a raw recruit into one end and extract an accomplished aviator from the other. This will not happen. There must be an extended tune-up period in which various training and testing programs will undergo successive revisions. Each revision will increase the effectiveness and the efficiency of training. Unless the Army recognizes a need for this developmental activity and provides resources to support it, the full training potential of the SFTS will never be realized.

Provision must be made, specifically, for flexibility in scheduling the device and in the assignment of the best available personnel. If the existing administrative criteria of assignment of instructors, maintenance personnel, and students are applied, little more can be expected from the SFTS than is being realized from the present equipment. The Army should exploit this new equipment rather than replace the old devices with the new and conduct the same old training programs in the shiny new SFTS. It will not be enough if the training conducted in the SFTS is a little better—it has the potential of being a lot better.

The second problem area relates to the fact that much of the flight training at Fort Rucker is conducted under contract. These contracts tend to be written in such manner that the Army is unable to undertake test training programs aimed at improving training. This matter is of concern in connection with development of SFTS training as well as with our offer to train Army personnel to administer the programs we developed for the new fixed wing device.

It appears that the terms of the fixed wing training contract may not allow Army personnel to undergo the MOI training program we have proposed. The contractor may have an exclusive right to use of the new program with any Army trainees, even on an experimental basis. In view of the contractor's financial interest, it is undesirable that he administer the experimental program during such a test. Should the test program fail, the results might be held suspect, regardless of how conscientiously the contractor had administered the training. It is also undesirable for the Army to be unfamiliar with the new program and therefore unable to monitor the training conducted by the contractor.

The implications of this dilemma are very serious. If the Army cannot conduct training to test new equipment and techniques, there is no possible way to develop more efficient training. You either must continue whatever you are doing when the contract is initiated, or you must implement new training programs without testing them beforehand.

An alternative, of course, is to ask the training contractor himself to conduct your tests. However, it would seem more desirable that the Army conduct the tests of new programs that shorten training. This will minimize the problem of real or suspected bias in the results related to the contractor's financial interest, as previously discussed.

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13. ABSTRACT

This paper records four presentations on research and development in educational technology made by members of the HumRRO staff at a briefing sponsored by the Office of the Deputy Chief of Staff for Individual Training at Headquarters, U.S. Continental Army Command in February 1970. The presentations describe research under Work Unit IMPACT, Prototypes of Computerized Training for Army Personnel; research activities on individual training, with low aptitude personnel under Project 100,000; and research in aviation training and aviation training devices. This was the sixth in a series of briefings on training research and development programs of the U.S. Army Behavior and Systems Research Laboratory, the Center for Research in Social Systems, and HumRRO.

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