A PERSONNEL TEST OF FIREFINDER RADAR TRAINING, TRAINER, AND SYSTEM

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Analysis of earlier automated training development needs appeared constrained. Certain training design limitations were imposed by a rapid system development schedule for the Field Artillery's AN/TPQ-37 Firefinder Radar and its A17E11 training device. A training device was proposed to reduce costs that would accrue if soldiers were trained only on an operational system, where numbers trained would be limited and length of time to train hard to control. Such a training device can concentrate attention and effort to accomplish a better integrated instructional process with attainment of individual and crew task objectives.

With the accelerated acquisition program, early training design documents could not fully accompany the radar and device. Development of test and evaluation acceptance programs was seriously curtailed. These programs could furnish training design guidelines if planned with greater detail in human factors and personnel support for the actual equipment and device design products. An inventory form for Firefinder training requirements was constructed to alleviate part of the information constraint. The form was oriented on the system training device to evaluate the utility of the commitment to simulated training and transfer to the AN/TPQ-37 Radar. This form was also the primary instrument for a personnel test of training and the Firefinder systems by verifying training design specifications and prior results from concept evaluation and user test phases.

A convergence of Firefinder course design and test requirements occurred at the earlier concept evaluation and user test phases (Lovell et al., 1980) indicating two apparent conditional training constraints. First, there were limited data available about what should constitute testable training on the A17E11 device and AN/TPQ-37 Radar. Secondly, the user test was compelled to base evaluation of training and system suitability on part of the first conditional constraint findings, while extracting training measures of effectiveness subject to continuing revisions in content and performance standards. Under these conditions there were training issues and measures that were not tested at a desired level of precision. Student, instructor, training device and equipment system relationships were not identified sufficiently to evaluate which tasks, operations or system features defined the best test of training system capability.

Other information-gathering alternatives were not proposed due to the pressure of pending training development and system test schedules. Neither an analysis approach nor model could concurrently evolve which would more economically "test" a small number of operators or mechanics in a manner similar to a

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structured "test pilot" evaluation (Kratochwill, 1978). Naturally, design of performance criteria should begin with the system creation. Later evaluation of personnel test requirements and training can proceed directly from those documented design guidelines which specify human factors and personnel requirements for system engineering and functional operations. One proposed acquisition, test and evaluation, and training development system has already been demonstrated. It would design each performance requirement with simulator specifications and man-machine interface controls (Hritz & Purifoy, Jr., 1980).

Thus a few carefully selected test-players could reliably exercise a system's operational capabilities and automated training requirements in a completely instrumented scenario, when guidelines specify human factors and personnel requirements. Group test evaluation procedures are now relatively anachronistic if measuring only operational task behaviors. A training device such as the A17E11 can test a limited number of personnel for both learning and operational tasks. But it must also display a high degree of fidelity, satisfy rigorous design parameters, and have full performance evaluation guidelines for personnel test and training procedures.

Personnel training effectiveness of the training program for the A17E11 Firefinder radar trainer and AN/TPQ equipment was evaluated by an interview-survey form developed to examine training policy needs. This 81 item form was given to 53 personnel selected as test-player subjects. To augment information limited by the accelerated systems acquisition, the form was analyzed as a system "personnel test" by group, background, and question (item) variables for learning task effects on trainer A17E11 or AN/TPQ-37 Radar training. Test subject responses were used to suggest training policy revisions using expected operator tasks and observed deficiencies.

METHOD

A questionnaire approach to analyze training development needs and personnel consequences is not unique. A comprehensive review format, however, was newly formulated to recover performance objectives rather implicitly expected in the systems' design. There is an innovative procedure, additionally, in gathering and synthesizing information for course design which was not previously referenced nor based on immediately observed training conditions. Moreover, the methodology application has pointed to finding a further clarification and coherent integration of system design procedures. Such procedures should project specified training guidelines and personnel test requirements so that an economical and accurate strategy will guide the parallel activities of Artillery system acquisition, test evaluation, and training development.

If total coordination of system design, test, and training task objectives is conceptualized and implemented, simulator and equipment systems should fully demonstrate any designed operational features. Any suggested modification data are, then, still acceptable as system test, personnel and training decisions are formulated well before system installation. To support this adaptive concept requires, also, the early selection of a centralized coordinator to direct and monitor every critical aspect of acquisition, test and training requirements to deliver effective decisions for system design and training. A coordinator must possess the stated responsibility to intercede anytime to effect the required decision processing of either institutional managers, technical experts or contractual support personnel.

An alternative analysis approach was prompted by events to bring a degree of synthesis between course design objectives and test sanctions. This would better accommodate training and clarify test results for any course, device, or equipment changes. Questionnaire acceptance suggests that the personnel test instrument was effectively constructed to describe student concerns and equipment system relationships. These features were noted from technical observations later verified by the Firefinder training device item responses given by students and instructors and a critique of technical reviewers. Though a "one-time" instrument, the design review format for training analysis may suggest some type of standardized approach by which critical training issue and equipment capability measures can move toward increased utility and precision. Other alternative analysis approaches will surely evolve for training device acquisition and training development as more advanced computerized training systems are requested.

As an example of possible generic dimensions following from the questionnaire structure, some standard content features examining the A17E11/AN/TPQ-37 systems were projected. These generic dimensions developed on the given systems were then applied tentatively in an evaluation of the A17E14 Firefinder Maintenance Trainer. Where write-in or interview comments appeared very briefly because of the highly detailed survey analysis, there is no suggestion to pursue collection of observer or test player remarks during test operations, except as an analyst may wish to annotate some condition.

An interim analysis instrument as the method advocated in this report could yield significant training design information for review of course content and simulated performance criteria. When training information documents may have omitted certain simulated and prime system training and instructional guidelines during accelerated development, an auxiliary effort is justified. That effort should construct a training inventory and interview form to obtain the best personnel test data available. Developing a flexible questionnaire format to interpret user/operator transactions with an automated system (Berger & Hawkins, 1979), furnishes a viable alternative to support ISD system acquisition and training development activities under constrained conditions. This approach is illustrated in that simulated training device/equipment operations and personnel training needs were effectively augmented for the Firefinder Radar Systems.

A progressive review of system acquisition and training design testing would be conducted by applying the instrument results using interface perceptions of instructor, student and training device/equipment. Evolving content and form design questions which arose intimated a possible instrument combining eventually personnel test and task inventory capabilities.

Research questions explored completion of performance objectives, proficient trainer transfer to the AN/TPQ-37, tasks trained and deficiencies. These questions were designed to generally answer whether this personnel test of the implemented training system could better integrate trainer (A17E11) performance in the actual MOS 13R10 course. Group responses could indicate significant preferences for training policy activities, course content, proficiency needs, and augment already proven systems. Minimal background variables might affect responses on training performance standards while suggesting remedial training tasks. Though operator skills may be perceived as difficult to learn, tasks were to be identified for a revised task sequence and correct operational procedures to achieve proficient skill within critical learning times.

RESULTS AND DISCUSSION

Research questions stated for the personnel testing of the training effectiveness and transfer in the Firefinder course, resulted in a generally positive set of findings for training design activities and A17E11/AN/TPQ-37 operations. These questions were intended as goals by which to analyze progressive achievement in training development. They have suggested modifications to support continuing training competence and course improvements. Questionnaire evidence and intensive two-year observations by the researchers tentatively found that probable training effectiveness for student operators could be fully expected. Certain course insights and implied modifications can work to furnish an optimal training program. Improved training development and device requirements were being defined during the implementation phase of trainer acquisition and instruction. Questionnaire items were analyzed by percentages and the chi square test of significance (.05 level) examined for each of the item cross tabulations with associated correlations.

Performance Objectives. Questionnaire items affecting performance objectives were analyzed noting whether these items would describe learning constraints or options to choose an effective training-task solution. Operators are expected, it appeared, to attain or exceed performance objectives for the A17E11/AN/TPQ-37 systems when complementary tasks are explained, course content is made pertinent, and instructor skills are evident. Items 67, 60, and 50 were interpreted as specifically conveying the confirmed findings for the first research question. Performance objectives in course achievement could then be further attained or exceeded as given tasks and operations were exercised in the proper sequence. Operators succeeded, responses indicated, as instructors displayed necessary skills and helped students on the trainer and equipment, referring to manuals and radar experience. Students learned faster and better utilized study time to complete performance objectives, responses agreed, when the training sequence applied the best mix of trainer/equipment practice and study materials. Item 38 reflected a relatively conclusive overview with 98% of the test subjects significantly acquiring "reasonably to very sufficient skill" on the trainer to operate the actual equipment. This finding additionally reinforces the cumulative transfer evidence given below.

Trainer Equipment Transfer. Proficient trainer performance was expected from responses to transfer to the AN/TPQ-37 Radar and result in successful operation. Test subjects answered item 30 by a significant majority (76%) agreeing to the performance similarity of the systems and procedures. Where personal background of the test students showed some significant differences, this majority observation was still upheld. A contrast on item 24 was shown by the effects of group background differences. Here differences were experienced by the test personnel in that their " 'make-up' study to reach required proficiency standards" reflected some individual training preferences and course flexibility. A compressed training schedule seemed to affect the responses to item 68 regarding whether training on the actual system was more effective and useful than on the trainer. Responses tended to favor training on the actual equipment which may simply capture the preference of the test players preparing for their test site. Also the interesting conclusion is implied that test students had enough short-term training experience to compare system experiences and then prefer AN/TPQ-37 training over initial A17E11 training. The group response to item 57 showed about 74% expecting to need AN/TPQ-37 proficiency training "monthly" or more often. Researcher observations were used to analyze this relationship suggesting subjects were significantly aware of A17E11/AN/TPQ-37 transfer skills needing practice in the unit location

to complement resident training. Transfer from the A17E11 to AN/TPQ-37 was facilitated by proficient map-reading and radar skills, it was noted, and may be most handicapped if a student has low reading skill and below average mental ability (item 81).

Tasks Trained and Deficiencies. A narrative for training performance standards described in terms of items, what was trained effectively and deficiencies needing further training development according to nine content factors. Review of item responses permitted an evaluation that the course development process had succeeded in designing critical performance sequences. Guidance furnished from this process was used to adjust proficiency standards in reference to prior device acquisition and development requirements. Training of critical tasks and identifying deficiencies were predicated on relating other items (43, 46, and 54) for example, using group difference and background variable difference. The content factor results gave a unifying perspective, while a research question analysis probed other item relationships affecting control of training performance effects. If instructors explained task differences and assured availability of training materials and feedback evaluation of student errors with increasing efficiency, answers agreed, a firm basis was prepared to control critical task learning and correct deficiences. In spite of some background variable differences for item 32, a significant consensus was still obtained to report complete enough "field training to learn the required operational tasks for the AN/TPQ-37." Certain deficiencies were experienced relating to time in the primary MOS, time in the Army, and rank. Item 34 gave an overview evaluation for A17E11 task training and guidance with nearly 100% of the test students answering that "usually to completely adequate" monitoring of student errors was given to direct feedback and correction.

Trainer-Course Testing. Training effectiveness testing (Finley & Strasel, 1978) of the Firefinder course increased the understanding of trainer features and learning tasks, respondents agreed, to better integrate it in the course delivery and with the AN/TPQ-37 Radar system. The related research question was confirmed by a number of associated findings. Training requirements for the A17E11 were studied more (item 47), replies agreed, as the course was improved by on-going training design changes. It was conceded (item 73) that the instructor-student ratio of 1 to 6 should approach 1 to 3 to increase the attention level and interest. That some instructor-console tasks could require most of the instructor's time (item 69) was largely rejected by test-player answers, but less so the longer away from school radar training. The instructor-console function needed further development, it appeared, to maximize student A17E11 simulation activities. Generally test subjects significantly observed the effective A17E11 "course sequencing" with about 75% replying they were able to make suggestions improving A17E11 instruction (item 26) and instructors were more often able to answer A17E11 questions to maintain the training progress (item 40). The positive evidence presented for the other research questions above was also accepted as reasonable support for a positive answer to this last question area.

In summary findings indicated modifications acceptable to continuing training program development for the A17E11/AN/TPQ-37 systems. The personnel test more clearly described how the training program could maximize the already engineered potential for trainer/radar training effectiveness and transfer features. Training policy decisions were derived from research observations sampling performance standards. Support was provided for an improved training design and device acquisition process at generic and system specific levels.

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