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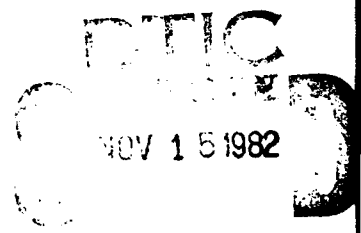
EVALUATION OF THE C<sup>2</sup> CAI CONSOLE OPERATOR  
TRAINING PROGRAM FOR MOS 16H10 OSUT STUDENTS  
AT THE US ARMY AIR DEFENSE SCHOOL

FINAL REPORT

30 SEPTEMBER 1982

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In 81, a contractor started work to provide an evaluation on the CAI of the Command/Control System, AN/TSQ-73 System, US Army Air Defense School, TX. The evaluation concentrates on: 1) Comparing performance of CAI System with current system, 2) compare training time between CAI System and current system, 3) students, instructors, and course managers acceptance/nonacceptance of the CAI presentation methods.		

## EXECUTIVE SUMMARY

### Introduction:

The U.S. Army Air Defense School (USAADS) at Fort Bliss, Texas, made a decision during the first quarter of 1981, to revise the content of the Military Occupational Specialist (MOS) 16H10 One Station Unit Training (OSUT) Program. Students enrolled in the MOS 16H10 OSUT Program were now to receive instruction on the AN/TSQ-73 Command/Control System. Previously, instruction on the AN/TSQ-73 System had been limited to those students enrolled in a MOS 25L10 Command and Control System-Operator and Repair Course.

In conjunction with introducing new content to the MOS 16H10 OSUT programs, it was decided that computer assisted instruction (CAI) materials would be developed and examined in order to determine what feasibility they might have for serving as an appropriate interactive instructional delivery system.

### Purpose of Evaluation:

The evaluation concentrated on documenting outcomes and, to some extent, activities in several basic areas of inquiry. The original evaluation request specifically sought to examine the following questions.

1. Will the CAI delivery system allow the students using CAI to obtain a statistically comparative performance rating as those learning in the current system?
2. Will the CAI delivery system allow students using CAI to complete the training in a time statistically comparative to those learning in the current system?
3. Will the students in the CAI delivery system indicate an acceptance/non-acceptance of the CAI presentation methods?
4. Will instructors/course managers of the CAI delivery system indicate an acceptance/non-acceptance of the CAI presentation methods?

An important aspect, to the evaluator, was that the new course for the MOS 16H10 OSUT students included a mixed media delivery system in a individually paced format, not just CAI materials. However, the evaluation questions were focused only on the CAI component. In developing the evaluation plan, consideration was also given to collecting some data on the overall effectiveness of the course.

### Evaluation Design:

An evaluation of a program such as the MOS 16H10 OSUT AN/TSQ-73 System Command/Control course tends to also be complex in its range of activities. Much careful planning went into the design and conduct of the evaluation so

### Evaluation Design Continued:

that it would both probe critical issues in depth and cover the breadth of probable effects.

The evaluation rests on a major assumption: that the overall system represents a curricular program. In this case the CAI and other individually paced media are not merely an alternative delivery mechanism for the same instruction. This evaluation treats sections taught by an instructor in a classroom format and those conducted on the CAI/mixed media individually-paced with instructor support as alternative curricula. While consistent in content coverage (tasks identified in MOS 16H10 OSUT course related to the AN/TSQ-73) the new course obviously differs in strategy and delivery.

The paradigm, for the summative evaluation, used to compare the experimental course to the control course, basically consisted of one independent variable and three dependent variables. The independent variable was the type of training method. The dependent variables were effectiveness (achievement, written/performance, and speed of skill acquisition).

Another part of the evaluation design included subjective ratings (by students, instructors and staff members using or instructing the CAI experimental course) which provided data for measuring the effectiveness variable and four other variables including: student acceptance, instructor acceptance, program implementation and reliability. Cost analysis variables were also examined in this evaluation.

### Population and Treatment Groups:

The evaluation design was somewhat restricted by the necessity of having to use non-equivalent treatment groups. The design was first hampered by the fact that the control subjects received course content that was slightly different from the experimental course. The control group was selected from a course that was being used to train 25L10 students on the AN/TSQ-73 System Console Operations. In other words, the experimental course was developed to train students on only a portion of the tasks included in the control course. However, it was believed that those tasks relevant to this evaluation plan could be isolated well enough to enable 25L10 students to serve as an appropriate control group.

The experimental and control groups for the summative evaluation were selected from available classes already assigned either to the MOS 16H10 OSUT or the MOS 25L10 courses. The intact class restriction prohibited the selection of a randomized sample. All students (27) assigned to a single control course were used as part of the control sample. It was necessary to combine two classes of experimental students to reach the needed sample size. The same considerations were given to the number of instructors and staff members in order to provide a reasonable precise estimate of their judgment toward the experimental course.

### Population and Treatment Groups Continued:

The experimental course can best be described as employing an individually paced methodology. All materials are under the control of the students as to how quickly they move ahead towards completion. An average time of 120 hours for students to finish the course was projected by the staff development team. The course includes a variety of self-paced media, exercises and exams.

The MOS 25L10 Command and Control System-Operator/Repair Course, which served as the control group for the evaluation, can best be described as a traditional course. Its instructional methodology was primarily lecture and discussion. All students naturally began and completed the course at the same time. One hundred and seventy clock hours of instruction were allocated to the control course for completing the tasks included in the MOS 16H10 course. It is important to note that the MOS 25L10 course also included instruction for the repair of the AN/TSQ-73. However, additional time was allocated for teaching these tasks.

### Data Analysis:

Data analyses for the evaluation were organized around the variables or questions of effectiveness, student acceptance, instructor acceptance, program implementation, reliability and cost factors. A statistical comparison was made of scores on the written test for the experimental and control classes. The statistical comparison employed a t-test to determine if there was a statistical significant difference between the mean scores of the two groups.

Analysis of several subjective questions was addressed through frequency distributions and statistical measures such as means, medium and standard deviations for each item.

### Findings and Conclusions:

1. Effectiveness measurements strongly supported the experimental course. Statistically significant differences were found on achievement measures for the experimental course over the control course. The amount of time required for acquisition of the skills was also found in favor of the experimental course.
2. Student and instructor acceptance of the course was found to be highly positive. Students seemed to be more receptive of CAI when it was an integrated part of a course, rather than when it was the only medium.
3. Program implementation was carried out in a rather successful manner. In fact, it was concluded that implementation procedures actually facilitated the learning process.
4. Both courseware and hardware proved to be extremely reliable. Very few problems were detected in either.

Findings and Conclusions Continued:

5. It is important to note that the basic development cost is a fixed cost, whether the project is continued for one or ten years. These costs are amortised over the ten years as a uniform unit cost. The operational costs, on the other hand, are repeated for each group of students regardless of the number of groups trained. In other words, it costs as much to operate the training course for the 15th group, for example, as it does to operate the course for the first group, provided the operational costs are not changed. It should be noted that the operational costs have been calculated at a set dollar amount throughout the ten-year period. In reality, one probably can expect the operational costs to increase over the years. However, it would be mere speculation to estimate these increases. Assuming that the cost will increase proportionally with other increases, one can conclude that the CAI portion of this course is an extremely worthwhile venture.

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## INTRODUCTION

The U.S. Army Air Defense School (USAADS) at Fort Bliss, Texas, made a decision, during the first quarter of 1981, to revise the content of the Military Occupational Specialist (MOS) 16H10 One Station Unit Training (OSUT) Program. Students enrolled in the MOS 16H10 OSUT Program were now to receive instruction on the AN/TSQ-73 Command/Control System. Previously, instruction on the AN/TSQ-73 System had been limited to those students enrolled in a MOS 25L10 Command and Control System-Operator and Repair Course.

In conjunction with introducing new content to the MOS 16H10 programs, it was decided that the computer assisted instruction (CAI) materials would be examined in order to determine what feasibility they might have for serving as an appropriate instructional delivery system.

### BACKGROUND:

The AN/TSQ-73 System is considered to be the state of the art in air defense command and control systems. It includes many technological advancements which were not part of earlier generations. The application of medium-scale integrated circuitry has provided further reliability increases comparable to those attained by use of integrated circuits in place of discrete components. The application of the state-of-the-art circuiting advancement has permitted added capability and capacity to be packaged in even smaller, still more reliable units. The AN/TSQ-73 System is organized on the basis of four functional subsystems of equipment: display, radar interface, automatic data processing, and communications. The widespread use of micro-electronic digital circuiting to replace discrete component digital and a number of analogy elements has resulted in size, weight and power reductions that enables the entire system to be housed in a single, highly mobile shelter. The revised training program for the MOS 16H10 OSUT student would now need to provide instruction on tasks specifically related to the AN/TSQ-73 System Command/Control console operation.

Staff personnel immediately conducted an analysis of the revised MOS 16H10 OSUT task list to determine which task would be good candidates for developing into a CAI methodology. The following criteria were established to determine the appropriateness of each task:

1. The learning process for the task would require the student to repeat the procedure until minimal proficiency was attained.
2. Prior to repeating the task (or element of a task) remediation was often required.

These two criteria produced a large list of potential tasks which could be developed into CAI materials. Further analysis of the task list led the staff members to separate the tasks into two categories.

1. Mental Skills - Those tasks that required the student to be cognizant of the elements/procedures required to perform the task.
2. Motor Skills - Tasks requiring psychomotor memory, i.e., installing the magnetic tape cartridge and changing paper in

the keyboard printing unit. The resultant list of potential CAI tasks included tasks that required:

- a. Remediation
- b. Drill & Practice
- c. Repetition
- d. Mental Skills

Initially the staff members estimated that approximately 40+ hours of CAI materials could be incorporated into the portion of the MOS 16H10 OSUT Program which pertained to the AN/TSQ-73. The staff also decided that the entire AN/TSQ-73 course should be developed around an individually paced concept. Since CAI materials were to deliver only a portion of the total course, other media forms needed to be considered. In addition to CAI materials the course eventually was designed to include programmed text, synchronized tape/slide and practical exercises. Written examinations and practical examinations were also to become an integral part of the course. A goal that the staff members attempted to use as a guiding principle in developing the course was to produce stand alone learning elements of approximately 45 minutes which avoided the structuring of contiguous lessons using the same media.

The application of the above principle resulted in the following media-mix for the course:

1. CAI - 23 hours (estimated time required for completion);
2. Sync-Tape/Slides - 23 hours (estimated time required for completion);
3. Practical Exercises\* - 30 hours (estimated time required for completion);
4. Programmed Text - 30 hours (estimated time required for completion);
5. Written Examinations - 11 hours (estimated time required for completion);
6. Practical Exam - 3 hours (estimated time required for completion);

Staff members, in the initial stage of their work designed, developed and completed a representative lesson. The representative lesson was then submitted to the Training Development Institute (TDI) of the Training and Doctrine Command (TRADOC). The result of submitting the representative lesson to TRADOC was:

1. The endorsement of the CAI training strategy.
2. Funding of an equipment lease/buy contract enabling the staff members to evaluate other technology applications.

The cost of developing the course received serious consideration. Initially the manpower required to develop an academic hour (50 minutes) of CAI ran approximately 200 manhours/lesson. This was expected by the staff but deemed unacceptable. To reduce the cost, efforts were made to streamline the entire production procedure. One of the more significant gains was through the use of a word processor for lesson authoring. Another time saver was the decision to not to include high resolution graphics directly through the CAI materials. Instead, the CAI materials would refer the students to specific pages in technical

\*Each practical exercise is concluded with a test of learning requiring the student to either demonstrate a procedure, answer questions, or both. In this regard a portion of each practical exercise is dedicated to practical testing.

manuals (TM) which depicted the required graphic. Since these documents were what the students would use when they left the school environment it was decided to simply issue the students the TM and refer them to the appropriate place. The resultant lesson authoring system and the graphics decision coupled with other developed short-cuts enabled the production of one academic hour of CAI courseware with approximately 40 manhours of labor. This level of production was deemed satisfactory and enabled the timely implementation of independent trials as various lessons were completed.

In developing the CAI lessons the staff members used the following procedures:

1. First, a subject matter expert would develop the materials for selected tasks that were appropriate for a one period lesson. Then another staff member with a background in CAI would layout, on an ADP coding sheet, the text and graphics required to adapt the material to CAI.
2. Second, a typist would enter the lesson from the coding sheets using the lesson authoring system designed by the courseware developers (the course authoring system was/is continuously being refined).
3. Next, each lesson was edited and corrected. A determination was then made as to whether or not the lesson, as currently developed, met task standards and also satisfied the training objective. If not, lesson revision was required.
4. Student trials began with both internal and external conscripts. While many of the people who participated in these trial tests were not from the targeted audience, many mistakes were caught and corrected. The people who participated in the trial test of the CAI materials came from various backgrounds and included:
  - a. Officers - Either waiting for their advanced course to begin or waiting for an assignment subsequent to attending the advanced course.
  - b. Reservists - Reserve officers on active duty for a short time.
  - c. Noncommissioned Officers and Privates - This group's background was similar to the target population.
5. The course was implemented on January 11, 1982, with 11 students. These students, who were from the target population, were used to continue the validation process. Feedback information from this group resulted in several changes. Revisions, suggested from this feedback, were made in the course prior to the collection of data for the summative evaluation.

The MOS 16H10 OSUT instruction on the AN/TSQ-73 System Command/Control Console Operations used 14 Apple II microcomputers w/48K, single disk drive and Leedex black and white monitors. All the microcomputers were located in a single room which was adjacent to three other rooms used along with the course. The other three rooms were used in conjunction with the sync-tape/slide lesson, the programmed text materials, the written examinations and the course administration and management functions. The practical exercises were conducted with equipment located in an adjacent building.

A decision was made, in September 1981, to evaluate the new course to determine its effectiveness. It was decided that an outside evaluator would be brought in to conduct the evaluation. The first task to be performed by the evaluator was to examine the intended evaluation purposes and to develop an evaluation plan that would serve these purposes. The next section of this report will discuss the purposes of the evaluation.

#### PURPOSE OF THIS EVALUATION:

What is a goal for a developer is often a question for an evaluator. This evaluation of training impact covers the breadth of this specific CAI system's potential and goes into detail on key issues. The questions which the evaluation addresses, however, reflect not just the program's goals but also needs for information for making future decisions about the program and similar projects. The staff members of the unit involved in the course must plan how best to use the system in the future. They need to know what's right and what's wrong with the course. Other instructional units will want sufficient data to decide about adopting CAI separately or adopting a media mix similar to that used in this course as a potential instructional resource. This evaluation by itself does not satisfy all such needs. Rather it contributes to the information available to diverse audiences in making these decisions.

The evaluation concentrated on documenting outcomes and, to some extent, activities in several basic areas of inquiry. The original evaluation request specifically sought to examine the following questions.

1. Will the CAI delivery system allow the students using CAI to obtain a statistically comparative performance rating as those learning in the current system?
2. Will the CAI delivery system allow students using CAI to complete the training in a time statistically comparative to those learning in the current system?
3. Will the students in the CAI delivery system indicate an acceptance/non-acceptance of the CAI presentation methods?
4. Will instructors/course managers of the CAI delivery system indicate an acceptance/non-acceptance of the CAI presentation methods?

An important aspect, to the evaluator, was that the new course for the MOS 16H10 OSUT students included a mixed media delivery system in a self-paced format, not just CAI materials. However, the evaluation questions were focused only on the CAI component. In developing the evaluation plan, consideration was also given to collecting some data on the overall effectiveness of the course.

It is common to judge the quality of an instructional program by its effects. This places emphasis on a demonstration of results rather than just an indication of potential. It was expected that such results would be evident among students as the group most affected by an instructional program. But instructors, too, bear the impact of curricular innovation through changes in their duties and responsibilities. These two groups, students and instructors, were the sources of data collection for the CAI delivery system.

From students, data were sought on achievement (effectiveness) and their attitudes toward the instructional system. Instructors participating in the experimental program were asked to provide data on their reactions to and their judgments on the effectiveness of the CAI program, as well as information on their professional role in the instructional setting. These data reflected the basic questions about student performance and instructor/student acceptance addressed in the statement of work.

Program implementation cannot be overlooked in any evaluation plan. An adequate summative evaluation requires that some attention be given to the quality of implementation of the courseware. Unless the implementation is carried out in accordance with project plans, and is of high quality, conclusions cannot be made about the impact of the courseware. Therefore, some emphasis was placed upon collecting data on the implementation of the program.

The reliability of the instructional system is important to the overall evaluation plan. The reliability issue was addressed with the question, "Are students able to consistently progress through the lessons without help from the program facilitators?" Another question concerning reliability focused upon the issue of "How often is downtime of the system a factor?"

The purpose of instructional cost-effectiveness analysis was to provide the decision-maker with data on the cost and probable effectiveness for the alternatives, among which he must choose one course of action. It should be pointed out that cost-effectiveness analysis involved clarifying the relationships between these two factors (cost and effectiveness) so that the decision-makers can make reasonable sound choices among the various ways an objective might be met. The evaluation plan for this instructional system examined several important variables related to cost-analysis, but was unable to make recommendations as to the cost-effectiveness of the experimental course as compared to that of the control course. Too many differences existed between the courses to make any reasonable cost-effective analysis.

In summary, the purpose of the evaluation was to seek information and potential answers to the six questions that follow:

1. How effective was the instructional system?
2. Did the students accept the instructional system?

3. Did the instructors accept the instructional system?
4. Was the program implementation of the instructional system effective?
5. Was the instructional system reliable?
6. What cost analysis can be made for the instructional system?

The next section of this report details the evaluation design that was used in evaluating this program. Specifically, the operational plans used in collecting and analyzing the data are detailed.

#### EVALUATION DESIGN

An evaluation of a program such as the MOS 16H10 OSUT AN/TSQ-73 Command/Control System course tends to also be complex in its range of activities. Much careful planning went into the design and conduct of the evaluation so that it would both probe critical issues in depth and cover the breadth of probable effects.

The evaluation rests on a major assumption: that the overall instructional system represents a curricular program. In this case the CAI and other individually paced media are not merely an alternative delivery mechanism for the same instruction. This evaluation treats sections taught by an instructor in a classroom format and those conducted on the CAI/mixed media individually paced with instructor support as alternative curricula. While consistent in content coverage (tasks identified in MOS 16H10 OSUT course related to the AN/TSQ-73) the new course obviously differs in strategy and delivery.

It should be clear that this is a curriculum evaluation as well as an evaluation of any specific delivery system. The alternative curriculum happens to differ along several major dimensions, including their strategy for teaching and mode of instruction. But the students learning that takes place within a course should satisfy the same minimal criteria. Comparisons of the course with similar delivery mechanisms or contrasts across different instructional strategies for courseware would most certainly be helpful in selecting among such alternatives. Still, a potential consumer might view such studies as limited in their value if none of the alternatives matched or exceeded the results obtained through traditional, proven practices. Thus, this evaluation concentrated on documenting the course's effects relative to the outcomes of usual lecture-discussion classes.

The paradigm, for the summative evaluation, used to compare the experimental course to the control course, basically consisted of one independent variable and three dependent variables. The independent variable was the type of training method. The dependent variables were effectiveness (achievement, written/performance, and speed of skill acquisition). The performance test which was included in the evaluation plan had to be dropped due to time constraints which interfered with the control group. This aspect of the evaluation will be addressed later in the report.

Another part of the evaluation design included subjective ratings (by students, instructors and staff members using or instructing the CAI experimental course) which provided data for measuring the effectiveness variable and four other variables including: student acceptance, instructor acceptance, program implementation and reliability. Cost analysis variables were also examined in this evaluation. These six variables are now discussed in this report. In addition, a matrix is provided indicating the form of measurement and the data source used for each variable.

#### EFFECTIVENESS:

Perhaps the single, most important criteria in judging a program's success is its effect on student achievement. Educators tend to look at achievement results before other outcome, and most new curricula come with a promise to improve achievement in some manner. Certainly there was interest in whether the CAI/mix media course would result in higher test performance and a shorter period of time for completion than that associated with usual classroom practices. Its developers hoped that the course would lead to 100% mastery of the subject matter, as measured by a series of examinations, for all students who completed the course. Achievement, therefore, received a high degree of attention in the evaluation.

Nine written examinations were used to evaluate student achievement for various segments of the course. In addition, scores from these nine written tests were summed to gain a composite score for the entire course.

The evaluation also examined the experimental (CAI/mix-media) group's scores on written test items relating to course content taught by CAI and compared those scores to the scores obtained by the control group. Twenty CAI questions were randomly selected for this comparison. Another examination of achievement was made by comparing the experimental group's scores on twenty randomly selected CAI questions to their own scores on twenty randomly selected test items which were taught by other forms of media.

Achievement was also to have been examined through a practical examination. Due to a time constraint, involving insufficient equipment, this comparison had to be dropped from the evaluation.

The effectiveness variable was also examined by comparing the speed of acquisition of learning for the experimental group to the speed of the control group. Since the experimental group was individually paced, an average time for completion was derived and compared to the designated time for the control group which used an instructor controlled method with a designated time for completion.

Other factors used in judging the effectiveness variables included perceived speed of skill acquisition, perceived confidence in learning from CAI, perceived student attention, perceived student need and perceived transfer to task/performance. In summary, the effectiveness variable was examined in the following manner:

VARIABLES	MEASUREMENT	DATA SOURCE
1.0 Skill achievements.	1.1 Written test scores and practical exam scores.	1.2 Course records to be kept on each student.
2.0 Speed of skill acquisition of experimental group vs. control group.	2.2 Number of hours required to train student in experimental and control groups.	2.2 Course records primarily from individual student logs.
3.0 Perceived speed of skill acquisition via CAI versus skill acquisition from other media.	3.1 Subjective question on skill acquisition 5-point scale.	3.2 Student End-Of-Course Evaluation; Instructor End-Of-Course Evaluation.
4.0 Perceived confidence in learning from CAI versus learning from other media.	4.1 Subjective question on confidence of learning, 5-point scale.	4.2 Student End-Of-Course Evaluation; Instructor End-Of-Course Evaluation.
5.0 Perceived Attention to learning from CAI versus learning from other media.	5.1 Subjective question on attention to learning, 5-point scale.	5.2 Student End-Of-Course Evaluation; Instructor End-Of-Course Evaluation.
6.0 Perceived meeting of student need from CAI versus learning from other media.	6.1 Subjective question on meeting individual student needs, 5-point scale.	6.2 Student End-Of-Course Evaluation; Instructor-End-Of-Course Evaluation.
7.0 Perceived transfer learning from CAI to actual task performance versus transfer of learning from other media.	7.1 Subjective question on transfer of learning, 5-point scale.	7.2 Student End-Of-Course Evaluation; Instructor End-Of-Course Evaluation.

Figure 1. Effectiveness Variable

The following data sources were used in data collection for the effectiveness variable:

- a. Written Tests found at Appendix A.
- b. Practical Examination found at Appendix B.
- c. Student Usage Log found at Appendix C.
- d. Student End-Of-Course Questionnaire found at Appendix D.
- e. Instructor End-Of-Course Questionnaire found at Appendix E.

Each of the instruments are discussed later in this report under the area of Instrumentation.

STUDENT ACCEPTANCE:

Over the last several years it has become common, in many institutional settings, for students to rate their instructors. This practice gives implicit recognition to the role of students as judges. It also extends the criteria for teaching effectiveness beyond achievement and productivity to results in forms of student opinions. Despite the acceptance of student ratings and the study of student attitudes toward various teaching methods, curriculum evaluations seldom compare programs along this dimension. Yet comparisons of student attitudes, especially with dissimilar programs, offer us insight into how students react to teaching methods and what they value in their instruction.

The student acceptance variable was employed in an attempt to examine acceptance or non-acceptance on the part of the student user. The primary question was, "Would you choose the methodology used in this course if available to you in future courses?" Several questions, in various forms, were given to students in order to obtain information about the primary question. In summary, the student acceptance variable was examined in the following manner:

VARIABLES	MEASUREMENT	DATA SOURCE
1.0 Attitude toward the overall course.	1.1 Subjective question, 5-point scale.	1.2 Student End-Of-Course Evaluation.
2.0 Attitude toward CAI component of the course.	2.1 Subjective question, 5-point scale.	2.2 Student End-Of-Course Evaluation.
3.0 Attitude toward increasing the CAI component of the course.	3.1 Subjective question, 5-point scale.	3.2 Student-End-Of-Course Evaluation.
4.0 Willingness to take other similar courses involving CAI.	4.1 Subjective question, 5-point scale.	4.2 Student End-Of-Course Evaluation.
5.0 Likes and dislikes about the CAI components of the course.	5.1 Open-ended question.	5.2 Student End-Of-Course Evaluation.

Figure 2. Student Acceptance Variable

The source used in data collection for the student acceptance variable was the Student End-Of-Course Questionnaire found at Appendix D. This instrument is discussed later in this report under the area of instrumentation.

INSTRUCTOR ACCEPTANCE:

There was as much uncertainty about what instructors would do in the experimental classes as about student activities. If the experimental program succeeded in teaching students and enabled them to adjust their own instruction to fit individual needs, what then would be the instructor's role? The developers of the program foresaw a displacement of instructors from their positions or certainly a change in their role that they would perform. Instructors could perhaps assume new roles as master teachers or as subject matter experts on teams engaged in courseware production. The experimental course was to fulfill the usual teaching role: it would convey and explain materials as well as facilitate student learning through its advice. The instructor in the experimental class would function as a manager-advisor, helping students when required and controlling and facilitating student activities. So the instructor would become another resource available to students rather than the control figure in instruction.

The instructor acceptance variable was employed in an attempt to examine acceptance or non-acceptance of the course on the part of the instructors. The primary question was, "Would you choose to participate with future courses using an instructional methodology similar to that used in this course?"

Several questions, in various forms, were given to instructors in order to obtain information about this primary question. In summary, the instructor acceptance variable was examined in the following manner.

VARIABLES	MEASUREMENT	DATA SOURCE
1.0 Attitude toward the overall course.	1.1 Subjective question, 5-point scale.	1.2 Student End-Of-Course Evaluation.
2.0 Attitude toward CAI component of the course.	2.1 Subjective question, 5-point scale.	2.2 Instructor End-Of-Course Evaluation.
3.0 Attitude toward increasing the CAI component of the course.	3.1 Subjective question, 5-point scale.	3.2 Instructor End-Of-Course Evaluation
4.0 Willingness to teach other courses using CAI.	4.1 Subjective question, 5-point scale.	4.2 Instructor End-Of-Course Evaluation.
5.0 Likes and dislikes about the CAI components of the course.	5.1 Open-ended question.	5.2 Instructor End-Of-Course Evaluation.
6.0 Perceived change in conduct of training.	6.1 Open-ended question.	6.2 Instructor End-Of-Course Evaluation
7.0 Perceived change in job of instructor.	7.1 Open-ended question.	7.2 Instructor End-Of-Course Evaluation.

Figure 3. Instructor Acceptance Variable

The source used in data collection for the instructor acceptance variable was the Instructor End-Of-Course Questionnaire found at Appendix E. The instrument is discussed later in this report under the area of instrumentation.

PROGRAM IMPLEMENTATION:

Regardless of results the introduction of an innovative curriculum into a unit is in itself an achievement. This is especially true when the curriculum involves an application of instructional technology with the stated objective of supplanting traditional methods of instruction entirely. A particular unit's personnel may affect the extent to which an evaluation's results depict fairly what may be expected to happen elsewhere with other students or under different conditions.

The program implementation variable was used in an attempt to examine the question, "Did program implementation have any adverse affect on the overall effectiveness of the program?" This variable was examined through information obtained from several questions administered to both students and instructors. In summary, the program implementation variable was examined in the following manner:

VARIABLE	MEASUREMENT	DATA SOURCE
1.0 Perceived orientation to using CAI.	1.1 Subjective question, 5-point scale.	1.2 Student End-Of-Course Evaluation.
2.0 Perceived quality of instructor assistance.	2.1 Subjective question, 5-point scale.	2.2 Questionnaire given to students at the end of each lesson involving CAI.
3.0 Perceived quality of the environment in which CAI was used.	3.1 Subjective question, 5-point scale.	3.2 Questionnaire given to students at the end of each lesson involving CAI.
4.0 Perceived quality of CAI equipment operation.	4.1 Subjective question, 5-point scale.	4.2 Questionnaire given to students at the end of each lesson involving CAI.
5.0 Perceived quality of CAI course material.	5.1 Subjective question, 5-point scale.	5.2 Questionnaire given to students at the end of each lesson involving CAI.
6.0 Ability of students to work without instructor involvement.	6.1 Subjective question, 5-point scale.	6.2 Instructor End-Of-Course Evaluation.

Figure 4. Program Implementation Variable

The following data sources were used in data collection for the program implementation variable:

- a. Student End-Of-Course Questionnaire found in Appendix D.
- b. Instructor End-Of-Course Questionnaire found in Appendix E.
- c. Student End-Of-CAI Lesson Questionnaire found in Appendix F.

These instruments will be discussed in this report under the area of instrumentation.

RELIABILITY:

The question of reliability was used to examine the quality of both software and hardware. Data for software reliability was gathered from students logs as to how often and on which tasks the instructional facilitator needed to intercede with CAI lessons. The CAI system is designed in a way that automatically stops a student in a lesson when they are unable to respond correctly to an item on their third attempt. A log, recording student "errors" in CAI lessons, was to be kept for each student. The CAI hardware reliability factors was to be measured in both a quantitative and subjective manner. Daily terminal downtime, percent of downtime for each terminal and cause or type of failure was to be kept. Time phased analyses was to be used to detect any trend. However, in actuality the hardware and the software proved to be highly reliable, resulting in a very small amount of negative data. In summary, the reliability variable included:

VARIABLE	MEASUREMENT	DATA SOURCE
1.0 Need for instructor assistance in CAI lessons.	1.1 Number of times per student for each lesson, number of times for each task on a given lesson.	1.2 Student CAI Usage Log.
2.0 Daily terminal downtime.	2.1 Amount of time from report of failure to repair.	2.2 Problem Log for CAI terminals.
3.0 Cause or type of failure.	3.1 Description of malfunction.	3.2 Problem Log for CAI terminals.
4.0 Perceived reliability.	4.1 Subjective question, 5-point scale.	4.2 Student End-Of-Course Evaluation; Instructor End-Of-Course Evaluation.

Figure 5. Reliability Variable

The following data sources were used in data collection for the reliability variable:

- a. Student CAI Usage Log found at Appendix C.
- b. Student End-Of-Course Questionnaire found at Appendix D.
- c. Instructor End-Of-Course Questionnaire found at Appendix E.
- d. Problem Log for CAI Terminals found at Appendix G.

These instruments are discussed in this report under the area of instrumentation.

#### COST ANALYSIS:

This evaluation report includes a limited study of costs associated with the AN/TSQ-73 Console Operator Course. These costs were related only to the CAI lessons. Costs factors associated with the CAI lesson were examined in the following areas:

1. Analysis and development of the course.
2. Initial/acquisition of materials, equipment and supplies.
3. Operational costs.
4. Depreciation of equipment.
5. Future development costs.
6. Estimated repair costs.

It was assumed that the lifespan for the hardware would be approximately ten years; and for projection purposes the same period of time was estimated for the courseware. As useful background information for the whole section on costs, the evaluation gathered whatever data were available regarding the acquisition and repair cost of all CAI equipment. It was further assumed that additional development costs would be incurred as several of the non-CAI lessons are converted to CAI lessons. These costs were to be estimated along with other projections. The school instructors and staff members however, were unable to forecast these projected changes and costs.

Cost analysis for the experimental course were derived from several simple equations. This type of analysis was made to see how the effects of cost changes as more students are trained with the system. The future number of students over the next several years along with the average class size was estimated for the purpose of our analysis. The formulas considers two types of costs: basic developmental costs and operational costs. It is important to note that basic developmental costs, once the investments are made, do not contribute to the costs of training a few. In other words, basic developmental costs can be amortized over the life of the course. On the other hand, operational costs remain the same for each group of students, regardless of the number of groups trained. In other words, it costs as much to operate the training course for the 15th group, for example, as it does to operate the course for the first group (provided the operational costs are not changed).

The formulas for calculating training output-unit costs can be stated as:

Output unit as a group of students:

$$C_g = \frac{B}{N} + O$$

where:  $C_g$  = Cost per group  
 $B$  = Basic costs  
 $O$  = Operational costs  
 $N$  = Total number of students groups

Output unit as each student:

$$C_s = \frac{B}{N} + \frac{O}{n}$$

where:  $C_s$  = Cost per student  
 $B$  = Basic cost  
 $O$  = Operational costs  
 $N$  = Total number of students who have taken the course  
(including the present group)  
 $n$  = Number of students in the present group

In summary, cost analysis variables were examined in the following manner:

VARIABLE	MEASUREMENT	DATA SOURCE
1.0 Research and development of the course.	1.1 Cost in dollars.	1.2 Available records.
2.0 Initial/acquisition of hardware/software.	2.1 Cost in dollars.	2.2 Available records.
3.0 Operational costs.	3.1 Cost in dollars.	3.2 Available records; also projected increases by staff.
4.0 Equipment Depreciation.	4.1 Number of years.	4.2 Available data; staff projection.
5.0 Repair costs.	5.1 Projected dollars.	5.2 Available data; staff projection.

Figure 6. Cost Analysis Variable

POPULATION DESCRIPTION AND TREATMENT:

The evaluation design was somewhat restricted by the necessity of having to use non-equivalent treatment groups. The control group was first hampered by the fact that the subjects received course content that was slightly different from the experimental course. The control group was selected from the course that was being used to train MOS 25L10 students on the AN/TSQ-73 System Operation and Repair. The experimental course, to be implemented for the first time, was designed to train MOS 16H10 OSUT students on AN/TSQ-73 System Console Operations. In other words, the experimental course was developed to train students on only a portion of the tasks included in the control course for MOS 25L10. However, it was believed that those tasks relevant to this evaluation plan could be isolated well enough to enable MOS 25L10 students to serve as an appropriate control group.

Secondly, MOS 25L10 students and MOS 16H10 OSUT students were not equivalent. Students in the proposed control group were required to have a higher score on an aptitude measurement than students in the experimental course. Therefore, it was deemed essential that scores from an aptitude test be used to control for possible differences in ability.

The experimental and control groups for the summative evaluation were selected from available classes already assigned either to the MOS 16H10 OSUT or the MOS 25L10 courses. The intact class restriction prohibited the selection of a randomized sample. All students (27) assigned to a single control course were used as part of the control sample. It was necessary to combine two classes of experimental students to reach the needed sample size. The same considerations were given to the number of instructors and staff members in order to provide a reasonable precise estimate of their judgment toward the experimental course.

Deciding on the size of the sample is always a difficult task. However, one rule-of-thumb best applies: Make the sample best represent the whole group; the smaller it becomes, the less one can expect its outcomes to reflect accurately what you would have obtained by testing everyone. Generally, for performing statistical analyses, a sample size of 30 is considered adequate for gaining a stable measure no matter what the size of the group being represented.

Considerable writing and discussion have been spent on the issue of sample size. Formulas have been derived for calculating a minimum sample for obtaining reliable differences. If one predicts that a 10 percentage point difference in means might exist between the experimental and control groups on the achievement tests we can calculate the required sample size from:

$$N=2\sigma^2(Z_{\alpha/2} + Z_{\beta})^2/d^2$$

- N = minimum sample size.
- $\sigma^2$  = estimated population variance
- $\alpha$  = 1- the confidence level, or the probability of rejecting the null hypothesis when it is true ( $\alpha=1-.95=.05$ )
- $\beta$  = the probability of accepting the null hypothesis when it is false
- Z = fractile of the normal curve
- d = difference between independent means (10 percent)

It is estimated that the sample variance is likely to be 100 percentage points. If  $\sigma^2=100$ ,  $\alpha=.05$ , and  $\beta=10$ , then the required minimum sample size in each group is approximately 20 students.

The control group assigned to the evaluation had an enrollment of twenty-seven students, exceeding the minimum. The two intact experimental groups had a combined student enrollment of 31. All 31 students took part in the experiment, however it was decided to randomly select 27 of these students, keeping the control and experimental groups equal in number, for data analysis.

The subjective judgment questionnaires are based upon a 5-point rating scale. In calculating the sample size required, it is assumed that the desired precision of estimation is just under one-half a scale step (.49). The usual level of confidence selected is 95 percent. In other words, one would make an error only 5 times in 100 replications of the study. The following formula can be used to calculate the required sample size:

$$N = 4\sigma^2(Z_{\alpha/2})^2/W^2$$

- N = minimum sample size
- $\sigma^2$  = estimated population variance
- $\alpha$  = 1- the confidence level, or the probability of rejecting the null hypothesis when it is true ( $\alpha= 1-.05 = .05$ )
- $Z_{\alpha/2}$  = width of confidence interval ( $W = \pm .49 = .98$ )
- w = fractile of the normal curve corresponding to  $\alpha/2$  ( $Z_{\alpha/2}=1.96$ )

Generally it is considered that a 5-point scale has a sample variance between 1.00 and 1.96. If  $\sigma^2= 1.96$  then the required minimum sample size of approximately 30 students.

The evaluation used data from all 31 students for analysis of the subjective data. However, only an N of 15 was obtained for instructors and staff members.

The treatments received by the experimental and control groups have been discussed previously in this report, however, a brief description is now repeated.

The experimental course can best be described as an individualized methodology. All materials are under the control of the students as to how quickly they move ahead towards completion. An average time of 120 hours for students to finish the course was projected by the staff development team. The course includes a variety of individually paced media, exercises and exams. The actual forms of media and their estimated time for completion are:

1. CAI - 23 hours (estimated time required for completion).
2. Sync-Tape/Slides - 23 hours (estimated time required for completion).
3. Practical Exercises - 30 hours (estimated time required for completion).
4. Programmed Text - 30 hours (estimated time required for completion).
5. Written Examinations - 11 hours (estimated time required for completion).
6. Practical Exam - 3 hours (estimated time required for completion).

The main function to be served by the instructor was to help facilitate student learning. As a facilitator, they assisted the student when called upon. Their role was considered to be a very important part of the system. Naturally, this role varied tremendously from that of a traditional classroom instructor.

The MOS 25L10 Command and Control System-Operator/Repair Course, which served as the control group for the evaluation, can best be described as a traditional course. Its instructional methodology was primarily lecture and discussion. All students naturally began and completed the course at the same time. One hundred and seventy clock hours of instruction were allocated to the control course for completing the tasks included in the MOS 16H10 course. It is important to note that the MOS 25L10 course also included instruction for the repair of the AN/TSQ-73. However, additional time was allocated for teaching these tasks.

#### INSTRUMENTS:

Special instruments were used for assessing student achievement, student acceptance, and faculty acceptance. Several other instruments were also developed for the evaluation. The achievement instruments enabled the evaluation to focus on the tasks taught in the target courses. Special questionnaires met the specific need for collecting attitudinal data. Using these instruments permitted the evaluator to engage in constructive exchanges with course developers and instructors. Several revisions were made in the instruments as a direct result of comments from the developers and instructors. Other revisions were made after the pilot trials.

The process of preparing instruments was especially critical to the assessment of student performance. Not only did the evaluation need fair measures of achievement, attitudes and activities, but the staff also had to develop items, conduct pilot trials and revise the instruments prior to their use for the summative evaluation. When the evaluation began, the achievement tests, student and instructor attitude questionnaires and other instruments were ready.

The following instruments were used during data collection:

1. Achievement Tests: In order to obtain the desired specificity in the assessment of student achievements, criterion designed tests relating to the assigned instructional materials were employed. These tests included nine objective tests addressing the training tasks. The written portions of the tests were given in segments throughout the course. Scores from the combined sub-tests for each subject were used for analysis as well as sub-tests scores for each subject. The experimental course required a 100% mastery from the students before they were allowed to proceed to the next segment of instruction. Students who did not obtain 100% mastery in the experimental course were recycled for further instruction. The control group students were not expected to reach 100% mastery on the exams for progressing in their course. Therefore, the evaluation only considered scores obtained by the subjects on their first attempt. The plan also examined students' scores on test items which were taught entirely by CAI. In addition, the experimental subjects' scores on test items taught by CAI were compared to their own scores on test items taught via other media.

A Performance Test was to have been administered at the end of the course. The performance test was developed around a go, no/go approach. The student was to have up to three opportunities to successfully complete each test item. However, as indicated earlier in this report, the performance test had to be dropped from the evaluation. See Appendix B for a copy of this instrument.

2. Available Logs and Records: Measures of time to complete training were made available for the experimental subjects via the computer clocking system. Other booking procedures were used with the other media forms. The control group's speed of skill acquisition was obtained via summation of the assigned hours of training. Logs and records were also to be used to collect data on the reliability of the system.
3. Attitude Questionnaires: Attitudes toward the experimental program were solicited from three sources (students, instructors, and other staff members). The attitudes of subjects about the experimental courses were measured as appropriate via specially prepared data gathering techniques. These primarily involve the direct questionnaire approach. The attitude questionnaires consisted of both five scale items of opinion and open-ended questions which were amendable to content analysis. The Attitude questionnaires solicited data for effectiveness, student acceptance, instructor acceptance and program implementation.

#### DATA ANALYSIS:

Data analyses for the evaluation were organized around the variables or questions of effectiveness, student acceptance, instructor acceptance, program implementation, reliability and cost factors. Instruments used for collecting data about each of these variables have been discussed in a previous section.

A statistical comparison was made of scores on the written test for the experimental and control classes. The statistical comparison employed a t-test to determine if there was a statistical significant difference between the mean scores of the two groups. The t-test is most often used in conjunction with research and evaluation designs to scrutinize differences in scores, such as achievement, between experimental and control groups. In general you can use a t-test to search out statistically significant differences between any two groups you can identify on any measure you can administer - though how you interpret the results will differ from one situation to another. There is one qualification to this sweeping statement, however: the t-test is most appropriate for determining the significance of the difference between means when the number of subjects in each of the groups is about equal. Therefore, 27 subjects for the experimental group were randomly selected from the available pool of 31 subjects. Twenty-seven subjects were available for the control group, making the experimental and control group equal in size. The t-test was also used to check to see if a significant difference existed between the two groups on a pretest. The pretest used in this case was from the Aptitude Area and Subtest components (Operations and Foods). It was anticipated that there was a significant difference between the aptitude scores of the two groups, in favor of the MOS 25L10 students. A comparison of these scores, however, indicated that there was no significant difference between these groups. Data for this comparison and other comparisons are presented in the next section of this report.

Analysis of the subjective questions was addressed through frequency distributions and statistical measures such as means, medium and standard deviations for each item.

### DISCUSSION

This section of the report describes the procedures used in conducting the evaluation and reports the findings. The procedures used in conducting the evaluation are outlined in a manner that presents an overview for the reader's understanding. The findings are then repeated through standard data analysis procedures.

#### CONDUCT OF STUDY:

A person from the school personnel at USAADS was assigned to administer the data collection procedures. This person was responsible for the distribution and collection of various instruments at appropriate times and also provided the evaluator with periodic up-dates on the data collection procedures.

Before starting the summative evaluation several activities were conducted. First, the evaluator held a briefing for the participating instructors and other staff members. At the briefing, the following items were discussed.

1. Record keeping for the written exams.
2. Record keeping for the practical exams (later dropped).
3. Administration of the instructor and student questionnaires.
4. Usage log.
5. Problem log.

Secondly, each of the fourteen computer terminals were numbered and copies of the Problem Log (See Appendix G) were placed at a convenient location.

The course was then ready to be evaluated. At the appropriate designated time each written subtest (See Appendix A) was administered to both the experimental and control groups. Since the control group was instructor paced, tests were administered to all students at the same time. While in the experimental group, which was individually paced, the tests were administered as each student progressed to the appropriate test. At the end of each CAI lesson, the experimental students were asked to complete an End-Of-Lesson Questionnaire (See Appendix F).

A practical examination scheduled for the end of the course was dropped from the evaluation because of time restrictions. The main problem in this area centered on finding time for the control group to participate in the practical exam.

At the end of the course, students and instructors were required to fill out an appropriate attitudinal questionnaire. These instruments required approximately 20 to 30 minutes of time to complete. Several other data were obtained from available sources for the evaluation. The evaluator made two trips to Fort Bliss during the conduct of the evaluation. His main role was to check to see that the evaluation was progressing adequately and to interview both instructors and students.

A main concern that was addressed throughout the study was to keep the classroom procedures and activities as close to normal as possible. Evaluations in many cases have a tendency to change the environment to such an extent that the data proves to be of little valid use. It is believed, by the evaluator, that we were successful in accomplishing this aspect.

#### FINDINGS:

The purpose of the data analysis is to establish whether an apparent difference in outcome was due to the curricular program under study and, if there were treatment effects, estimate the extent of the program's impact on student performance. Here are the specific outcomes of interest centers on the following six variables: (1) Effectiveness; (2) Student Acceptance; (3) Instructor Acceptance; (4) Program Implementation; (5) Reliability; and (6) Cost Analysis. The findings for each of these variables are reported in numerical order in which they are listed above.

0. Pretest: Pretest data from an Aptitude Area Test was examined to determine if differences existed between the experimental and the control groups. It was assumed that differences might exist in the aptitude ability of the students since the experimental and control groups were selected from two different populations. Therefore, a t-test was employed to determine if any significant difference existed between the groups' entry aptitude. A summary of the subjects' scores on the Aptitude Pretest for both groups is presented in Table 1 (See Appendix H for subjects' raw scores).

TABLE 1  
Aptitude Pretest Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	110.333	8.28	.345
C-Group	27	111.148	9.09	

An analysis of the data resulted in a t value of .345 with 52 degrees of freedom. The absolute value (.345) obtained is less than the required critical value for the .05 alpha level (2.010). Therefore, no significant difference was found between the E- and C-groups on the Aptitude Pretest. Since no significant difference was found on this measure it was decided that the Aptitude Pretest would not be employed as a covariable in further analysis.

1. Effectiveness: Data pertaining to effectiveness of the program were gathered from seven different sources. The findings from these seven sources are now presented.

1a. Analyses for skill achievement have been performed from data obtained from a series of nine written tests administered throughout the course. These nine tests were used to measure student task competencies which were learned through the instructional modules of the course. First, an analysis was made for each subtest. A summary of the subjects' scores on Test 1 for both groups is presented in Table 2 (See Appendix H for subjects' raw scores).

TABLE 2  
Test 1 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	18.740	1.45	8.73*
C-Group	27	14.550	2.03	

\*Statistically significant at .001

An analysis of the data produced a t value of 8.73 with 52 degrees of freedom. The absolute value (8.73) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

A summary of the subjects' scores on Test 2 for both groups is presented in Table 3 (See Appendix H for the subjects' raw scores).

TABLE 3  
Test 2 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	50.629	3.98	6.56*
C-Group	27	43.148	4.39	

\*Statistically significant at .001

An analysis of the data resulted in a t value of 6.56 with 52 degrees of freedom. The absolute value (6.56) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

A summary of the subjects' scores on Test 3 for both groups is presented in Table 4 (See Appendix H for subjects' raw scores).

TABLE 4  
Test 3 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	13.703	1.46	9.33*
C-Group	27	9.000	2.18	

\*Statistically significant at .001

An analysis of the data resulted in a t value of 9.33 with 52 degrees of freedom. The absolute value (9.33) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

A summary of the subjects' scores on Test 4 for both groups is presented in Table 5 (See Appendix H for subjects' raw scores).

TABLE 5  
Test 4 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	38.074	3.21	6.40*
C-Group	27	31.963	3.78	

\*Statistically significant at .001

An analysis of the data resulted in a t-value of 6.40 with 52 degrees of freedom. The absolute value (6.40) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

Data from Test 5 was not collected for the control group. The proctor failed to administer the test at the appropriate time of task completion. This failure necessitated the action to drop the test entirely from the analysis.

A summary of the subjects' scores on Test 6 for both groups is presented in Table 6 (See Appendix H for subjects' raw scores).

TABLE 6  
Test 6 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	21.593	3.57	3.055*
C-Group	27	18.962	2.70	

\*Significant at .01

An analysis of the data produced a t-value of 3.055 with 52 degrees of freedom. The absolute value (3.055) obtained was greater than the required critical value for the .01 alpha level (2.680). Therefore, a significant difference was found in favor of the experimental group.

A summary of the subjects' scores on Test 7 for both groups is presented in Table 7 (See Appendix H for subjects' raw scores)

TABLE 7  
Test 7 Results for  
Experimental (E) and Control (C) Groups

Group	N	Means	SD	t-test
E-Group	27	32.444	5.06	1.99
C-Group	27	30.037	3.69	

An analysis of the data produced a t-value of 1.99 with 52 degrees of freedom. The t-value pointed in a favorable direction toward the experimental group. However, the absolute value (1.99) obtained was less than the required critical value for the .05 alpha level (2.010). Therefore, no significant difference was found between the E- and C-groups on Test 7.

A summary of the subjects' scores on Test 8 for both groups is presented in Table 8 (See Appendix H for the subjects' raw scores).

TABLE 8  
Test 8 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	25.888	2.71	3.084*
C-Group	27	23.481	3.02	

\*Statistically significant at .01

An analysis of the data produced a t-value of 3.084 with 52 degrees of freedom. The absolute value (3.084) obtained was greater than the required critical value for the .01 alpha level (2.680). Therefore, a significant difference was found in favor of the experimental group.

A summary of the subjects' scores on Test 9 for both groups is presented in Table 9 (See Appendix H for the subjects' raw scores).

TABLE 9  
Test 9 Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	27.444	2.21	8.43*
C-Group	27	20.815	3.44	

\*Statistically significant at .001

An analysis of the data resulted in a t value of 8.43 with 52 degrees of freedom. The absolute value (8.43) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

A composite score was also obtained by summing the scores on each of the eight tests. The composite score was analyzed for difference between the groups mean by applying a t-test. A summary of the subjects' score on composite test for both groups is presented in Table 10 (See Appendix H for subjects' raw scores).

TABLE 10  
Composite Test Results for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	228.519	12.76	9.21*
C-Group	27	191.962	16.21	

\*Statistically significant at .001

An analysis of the data resulted in a t value of 9.21 with 52 degrees of freedom. The absolute value (9.21) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

Twenty questions which were taught primarily by CAI in the experimental course were randomly selected for analysis. The scores for the experimental group were compared to the scores obtained by the control group. The control group had received a traditional form of instruction for those same items. A summary is presented in Table 11 (See Appendix H for subjects' raw scores).

TABLE 11  
Test Items Taught by CAI for  
Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	18.444	1.08	16.65*
C-Group	27	12.703	1.43	

\*Statistically significant at .001

An analysis of the data resulted in a t value of 16.65 with 52 degrees of freedom. The absolute value (16.65) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

Twenty questions, which were taught primarily by media forms other than CAI, in the experimental course were randomly selected for analysis. The scores for the experimental group were compared to the scores obtained by the control group. The control group had received a traditional form of instruction for these same items. A summary of the subjects' scores on these items for both groups is presented in Table 12 (See Appendix H for the subjects' raw scores).

TABLE 12  
 Test Items Taught by Non-CAI Media  
 for Experimental (E) and Control (C) Groups

Groups	N	Means	SD	t-test
E-Group	27	17.629	1.94	6.89*
C-Group	27	13.960	1.97	

\*Statistically significant at .001

An analysis of the data provided a t value of 6.89 with 52 degrees of freedom. The absolute value (6.89) obtained was greater than the required critical value for the .001 alpha level (3.505). Therefore, a significant difference was found in favor of the experimental group.

The experimental subjects' scores on the 20 CAI items were also compared to the scores that they obtained on the 20 items taught by non-CAI materials. A summary of the experimental subjects' scores for both instruction methodologies is presented in Table 13 (See Appendix H for subjects' raw scores)

TABLE 13  
 CAI Test Items Compared to Non-CAI Test Items  
 for the Experimental Group

Groups	N	Means	SD	t-test
E-Group CAI Items	27	18.444	1.08	1.90
E-Group Non-CAI Items	27	17.629	1.94	

An analysis of the data produced at t value of 1.90 with 52 degrees of freedom. The t-value pointed in a favorable direction toward the experimental group. However, the absolute value (1.90) obtained is less than the required critical value for the .05 alpha level (2.010). Therefore, no significant difference was found between the experimental groups; scores on the CAI items and the non-CAI items. It is believed that the mixed media used in the course, kept student motivation high in all media format, resulting in high achievement throughout.

1b. The actual time required for the experimental group to complete the instruction or tasks related to the AN/TSQ-73 was compared to the control groups time for completing the same tasks. This data served as another measure for the effectiveness variable. Since the experimental group used an individually paced methodology, it was necessary to obtain a separate time for each student. The control group, used an instructor-paced methodology which required an established 170 hours of instructional time. Table 14 presents the descriptive statistics for the experimental group.

TABLE 14  
Descriptive Statistics for  
Experimental Groups Actual Completion Time

Subject	Completion Time
Subject 1	66 hrs. 33 min.
Subject 2	67 hrs. 26 min.
Subject 3	79 hrs. 54 min.
Subject 4	78 hrs. 47 min.
Subject 5	78 hrs. 45 min.
Subject 6	69 hrs. 26 min.
Subject 7	86 hrs. 12 min.
Subject 8	70 hrs. 4 min.
Subject 9	73 hrs. 46 min.
Subject 10	76 hrs. 49 min.
Subject 11	67 hrs. 59 min.
Subject 12	62 hrs. 0 min.
Subject 13	69 hrs. 19 min.
Subject 14	76 hrs. 4 min.
Subject 15	73 hrs. 29 min.
Subject 16	66 hrs. 2 min.
Subject 17	73 hrs. 7 min.
Subject 18	92 hrs. 58 min.
Subject 19	74 hrs. 46 min.
Subject 20	78 hrs. 51 min.
Subject 21	62 hrs. 50 min.
Subject 22	80 hrs. 51 min.
Subject 23	77 hrs. 12 min.
Subject 24	74 hrs. 23 min.
Subject 25	83 hrs. 53 min.
Subject 26	78 hrs. 12 min.
Subject 27	74 hrs. 17 min.

$\Sigma x$  = 2013 hrs. 55 min.  
 $\bar{x}$  = 74 hrs. 3 min.  
Median = 74 hrs. 46 min.  
Range = 62 hrs. 0 min. to 92 hrs. 58 min.

The mean time required to complete the course for the experimental group was 74 hrs. 33 minutes. While, the mean time for the control group was calculated at 170 hours. Using the mean times for completion of the course, it was calculated that the experimental group required 95 hrs. and 27 minutes less time to complete instruction on the designated tasks. The experimental group in other words, took only 56.1% of the time required for the control group.

1c. Speed of acquisition from CAI lessons, as perceived by the student, was used to help analyze the effectiveness variable. The following question was used in data gathering: "How do you think your speed of learning with computer assisted instruction (CAI) compared to your speed of learning with lessons using other forms of media?" The instrument used a five item rating scale with 5 indicating a high rating and 1 indicating a low rating (See Appendix D for Student End-Of-Course Questionnaire). Descriptive statistics for this item are reported in Table 15 and the frequency distribution of scores is reported in Table 16. Seventy-seven percent of the students found the speed of acquisition to be acceptable, while sixteen percent was neutral and another six percent found it to be non-acceptable. Percentages in Table 15 will not equal 100% due to rounding off the numbers.

TABLE 15  
Descriptive Statistics for  
Experimental (E) Students' Perceived Speed

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
3.843	3.925	.737	31	77	16	6

TABLE 16  
Frequency Distribution for the  
Data in Table 15

Scores	Frequency (f)
5	4
4	20
3	5
2	2
1	0
	$\Sigma f = 31$

Speed of acquisition from CAI lessons, as perceived by the instructors was also used to help analyze the effectiveness variable. The following question was used in data gathering: "How do you think your students' speed of learning with lessons using CAI compared to their speed of learning with lessons using other forms of media?" The instrument used a five item rating scale with 5 indicating a high rating and 1 indicating a low rating (See Appendix E for Instructor-End-Of-Course Questionnaire). Descriptive statistics for this item are reported in Table 17 and the frequency distribution of scores is reported in Table 18. Note that in the case of the instructors observation with regard to the students speed of learning, 80% indicated that the students speed of learning was faster with CAI than other forms of media that students encountered in the course. This percentage is comparable to the students perception.

TABLE 17  
Descriptive Statistics for  
Experimental (E) Instructors' Perceived Speed

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
3.866	4.642	.5669	15	80	20	0

TABLE 18  
Frequency Distribution for the  
Data in Table 17

Scores	Frequency (f)
5	1
4	11
3	3
2	0
1	0
	$\Sigma f = 15$

1d. Confidence in learning from CAI, as perceived by the student was used to analyze the effectiveness variable. The following statement was used for data collection: "I felt more confident about learning from lessons using CAI than I did from lessons using other forms of media." This item is also included in the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 19 and the frequency distribution of scores is reported in Table 20. Seventy-one percent of the students indicated confidence in CAI over other forms of media, while another twenty-five percent indicated no difference and another three percent felt less confident with CAI. Percentages in Table 19 will not equal 100% due to rounding off the numbers.

TABLE 19  
Descriptive Statistics for  
Experimental (E) Students' Perceived Confidence

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.162	4.437	1.001	31	71	25	3

TABLE 20  
Frequency Distribution for the  
Data in Table 19

Scores	Frequency (f)
5	14
4	8
3	8
2	0
1	1
	$\Sigma f = 31$

Confidence in learning from CAI, as perceived by the instructor was also used to analyze the effectiveness variable. The following statement was used for data collection: "I felt more confident about my students' learning progress in CAI lessons than I did when they were in lessons that used other forms of media." This item is also included in the End-Of-Instructor Questionnaire (See Appendix E). Descriptive statistics for this item are reported in Table 21 and the frequency distribution of scores is reported in Table 22. Instructors noted that student confidence in learning from CAI almost identical with the rating by the students. Instructors' rating of confidence indicated 73% agreement of CAI over other forms of media in terms of their students' learning from CAI. Another 20% indicated no difference between CAI and other media while 6% indicated less confidence in learning from CAI. Percentages in Table 21 do not equal 100% due to rounding off the numbers.

TABLE 21  
Descriptive Statistics for  
Experimental (E) Instructors' Perceived Confidence

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.00	4.083	.9258	15	73	20	6

TABLE 22  
Frequency Distribution for the  
Data in Table 21

Scores	Frequency (F)
5	5
4	6
3	3
2	1
1	0
	$\Sigma f = 15$

1e. Attention to learning from CAI, as perceived by the student was used to analyze the effectiveness variable. The following statement was used for data collection: "The lessons using CAI kept my attention more adequately than did lessons using other forms of media." This item is also included in the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 23 and the frequency distribution of scores is reported in Table 24. Eighty-one percent of the students felt they were able to attend to CAI lessons better than other forms of media. Another 19% felt there was no difference in their attention to CAI lessons or lessons with other forms of media.

TABLE 23  
Descriptive Statistics for  
Experimental (E) Students' Perceived Attention

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.164	4.178	.7318	31	81	19	0

TABLE 24  
Frequency Distribution for the  
Data in Table 23

Scores	Frequency (f)
5	11
4	14
3	6
2	0
1	0
	$\Sigma f = 31$

Attention to learning from CAI, as perceived by the instructor was also used to analyze the effectiveness variable. The following statement was used for data collection: "The lessons using CAI kept my students' attention more adequately than did the lessons using other forms of media." This item is also included in the End-Of-Instructor Questionnaire (See Appendix E). Descriptive statistics for this item are reported in Table 25 and the frequency distribution of scores is reported in Table 26. Note that 93% of the instructors perceived that their students' attention was held better by CAI lessons than by lessons using other media forms. Another 7%, however, felt that CAI lessons did not hold their students' attention as well as other media forms. Instructors rated CAI lessons higher for holding students' attention than did the students.

TABLE 25  
Descriptive Statistics for  
Experimental (E) Instructors' Perceived Attention

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.330	4.428	.8237	15	93	0	7

TABLE 26  
Frequency Distribution for the  
Data in Table 25

Scores	Frequency (f)
5	7
4	7
3	0
2	1
1	0
	$\Sigma f = 15$

If Student perception as to whether CAI was able to meet their needs was used to analyze the effectiveness variable. The following question was used for data collection: "Do you feel you were personally able to learn more adequately with lessons using CAI as compared to lessons using other forms of media?" This item is also included in the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 27 and the frequency distribution of scores is reported in Table 28. Sixty-one percent of the students thought that they were personally able to learn more adequately from lessons using CAI lessons than lessons using other media forms. Another 29% were neutral, while 10% felt less adequate in learning from CAI lessons.

TABLE 27  
Descriptive Statistics for  
Experimental (E) Students' Perceived Need

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Adequacy	Percent Neutral	Percent of Less Adequacy
3.742	3.792	1.039	31	61	29	10

TABLE 28  
Frequency Distribution for the  
Data in Table 27

Scores	Frequency (f)
5	7
4	12
3	9
2	3
1	0
	$\Sigma f = 31$

Instructor perception as to whether CAI was able to meet their students' needs were also used to analyze the effectiveness variable. The following question was used for data collection: "How do you feel your students' learning needs were met in lessons using CAI as compared to lessons using other forms of media?" This item is also included in the End-Of-Instructor Questionnaire (See Appendix E). Descriptive statistics for this item are reported in Table 29 and the frequency distribution of scores is reported in Table 30. Instructors indicated a 47% agreement with this question, while another 47% indicated no difference and 7% indicated non-agreement. Instructors non-agreement with this question was comparable to the students reactions. However, their agreement with this question was substantially less than the students agreement. Percentages in Table 29 do not equal 100% due to rounding off the numbers.

TABLE 29  
Descriptive Statistics for  
Experimental (E) Instructors' Perceived Need

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
3.60	3.428	.8864	15	47	47	7

TABLE 30  
Frequency Distribution for the  
Data in Table 29

Scores	Frequency (F)
5	3
4	4
3	7
2	1
1	0
	$\Sigma f = 15$

1g. Transfer of learning from CAI, as perceived by the student was used to analyze the effectiveness variable. The following question was used for data collection: "How do you think you were able to perform the task learned from CAI lessons, during the practical exercise, as compared to tasks learned from other media?" This item is also included in the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 31 and the frequency distribution of scores is reported in Table 32. Sixty-five percent of the students felt they were able to perform tasks taught by CAI better during practical exercises than they were tasks taught by other forms of media. Another 32% felt there was no difference, while another 3% felt they were less able to perform the tasks taught by CAI.

TABLE 31  
Descriptive Statistics for  
Experimental (E) Students' Perceived Transfer

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Transfer	Percent Neutral	Percent of Non-Transfer
3.645	3.736	.6733	31	65	32	3

TABLE 32  
Frequency Distribution for the  
Data in Table 31

Scores	Frequency (f)
5	1
4	19
3	10
2	1
1	0
	$\Sigma f = 31$

Transfer of student learning from CAI, as perceived by the instructors' was also used to analyze the effectiveness variable. The following question was used for data collection: "How do you think your students were able to perform the tasks, which were learned from CAI lessons, during the practical exercises as compared to tasks learned from other media?" This item is also included in the End-Of-Instructor Questionnaire (See Appendix E). Descriptive statistics for this item are reported in Table 33 and the frequency distribution of scores is reported in Table 34. Instructors rated the question on the students' ability to transfer their learning to practical exercises higher than did the students. Eighty percent of the instructors rated CAI lessons higher on student transfer learning than lessons taught by other media forms. Another 20% were neutral in terms of judging any media, including CAI, better than another.

TABLE 33  
Descriptive Statistics for  
Experimental (E) Instructors' Perceived Transfer

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Transfer	Percent Neutral	Percent of Non-Transfer
4.000	3.875	.6546	15	80	20	0

TABLE 34  
Frequency Distribution for the  
Data in Table 23

Scores	Frequency (f)
5	3
4	9
3	3
2	0
1	0
	$\Sigma f = 15$

2. Student Acceptance: Data pertaining to student acceptance of the program were collected from four different sources. The findings from these four sources are now presented.

2a. Student overall attitude toward the course was of great interest to the evaluator. The following subjective question was used to collect data from students for analyzing student acceptance: "What is your opinion of the total course (all media, including CAI) that you have just completed as compared to other courses in which you have previously been enrolled?" This item, as well

as the other items in this section, is a part of the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 35 and the frequency distribution of scores is reported in Table 36. Eighty-four percent of the students rated the course higher than other courses that they have taken. Another 16% was neutral in comparing the course to other courses.

TABLE 35  
Descriptive Statistics for  
Experimental (E) Students' Acceptance of the Course

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
4.097	4.083	.6512	31	84	16	0

TABLE 36  
Frequency Distribution for the  
Data in Table 35

Scores	Frequency (f)
5	8
4	18
3	5
2	0
1	0
	$\Sigma f = 31$

2b. Student attitude toward the CAI lessons was also examined as a source of data for student acceptance. The following question was used for data collection: "What is your opinion of the lessons taught by CAI in the courseware that you have just completed as compared to other non-CAI courses in which you have previously been enrolled?" Descriptive statistics for this item are reported in Table 37 and the frequency distribution of scores is reported in Table 38. Seventy-seven percent of the students give the CAI lesson a higher level of acceptance than they did to non-CAI courses that they had previously taken. Another 19% was neutral to this issue, while 3% judged their previous courses to be better. The total percent reported in Table 37 exceeds 100% due to rounding off the numbers.

TABLE 37  
Descriptive Statistics for  
Experimental (E) Students' Acceptance of CAI

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
3.968	4.00	.7767	31	77	19	3

TABLE 38  
Frequency Distribution for the  
Data in Table 37

Scores	Frequency (f)
5	7
4	17
3	6
2	1
1	0
	$\Sigma f = 31$

2c. Another question used to assess student acceptance was: "Would you like to take further courses which use CAI?" Descriptive statistics for this item are reported in Table 39 and the frequency distribution of scores is reported in Table 40. Seventy-four percent of the students indicated that they would like to take future courses using CAI. Another 26% indicated no preference toward CAI courses. It is interesting to note that no student indicated that they would not like to take future courses using CAI.

TABLE 39  
Descriptive Statistics for  
Experimental (E) Students' Willingness to Use CAI

Mean	Median Score	Standard Deviation	Number of Scores	% of Future Usage	Percent Neutral	Percent of Future Non-Users
4.064	4.408	.7710	31	74	26	0

TABLE 40  
Frequency Distribution for the  
Data in Table 39

Scores	Frequency (f)
5	10
4	13
3	8
2	0
1	0
	$\Sigma f = 31$

2d. Two open-ended questions were used to assess student acceptance of the CAI lessons. The first question was stated: "What did you like about the CAI parts of the course?" Typical responses were as follows:

- CAI is very effective for me.
- I thought it was an easy way to learn.
- CAI kept my attention
- The question and evaluation sections of the CAI were interesting.
- They were more informative and fun to watch.
- Good way to learn but they could go faster.
- If you missed something it would make you go back.
- CAI always covered all parts in detail.
- The way the programs were set up.
- The CAI made you learn an area i.e., going back over missed questions as opposed to other forms of media.

The second question was stated: "What did you dislike about the CAI parts of the course?" Typical responses were as follows:

- Writing on the screen should be much faster.
- Took too long for words to be printed.
- Did not explain in full.
- It repeated many subjects.
- The glare on the screen.
- The computer was too slow.
- Too slow.
- Not fast enough print-out.
- Only thing is speed up but everything else is great.
- They went too slow.

3. Instructor Acceptance: Data pertaining to instructor acceptance of the program were collected from six different sources. The findings for these six sources are now presented.

3a. Instructor overall attitude toward the course was of interest just as was the students' attitude. The following subjective question was used to collect data from instructors: "What is your opinion of the total course that you have just finished teaching as compared to other courses which you have previously taught?" This item, as well as the other items in this section, is a part of the End-Of-Instructor Questionnaire (See Appendix E). Descriptive statistics for this item are reported in Table 41 and the frequency distribution of scores is reported in Table 42. Eighty-seven percent of the instructors rated the course higher than other courses that they had been associated with in the past. Another 13 percent indicated no difference and no instructor rated it lower than other courses with which they had been associated.

TABLE 41  
Descriptive Statistics for  
Experimental (E) Instructors' Acceptance of Course

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
4.266	4.285	.7046	15	87	13	0

TABLE 42  
Frequency Distribution for the  
Data in Table 41

Scores	Frequency (f)
5	6
4	7
3	2
2	0
1	0
	$\Sigma f = 15$

3b. Instructor attitude toward the CAI lessons was also examined as a source of data for instructor acceptance. The following question was used for data collection: "What is your opinion of the CAI lessons in the course that you have just finished instructing as compared to other non-CAI courses in which you have taught?" Descriptive statistics for this item are reported in Table 43 and the frequency distribution of scores is reported in Table 44. Seventy-three percent of the instructors felt the CAI portion of the course was better than other courses that they had taught in the past. Another 27% felt that there was no difference between the CAI lessons and other non-CAI courses.

TABLE 43  
Descriptive Statistics for  
Experimental (E) Instructors' Acceptance of CAI

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Acceptance	Percent Neutral	Percent of Non-Acceptance
4.066	4.083	.7791	15	73	27	0

TABLE 44  
Frequency Distribution for the  
Data in Table 43

Scores	Frequency (f)
5	5
4	6
3	4
2	0
1	0
	$\Sigma f = 15$

3c. Instructors were asked the following question: "What would you think of having some of the non-CAI lessons of this course developed into CAI lessons?" Descriptive statistics for this item are reported in Table 46. Eighty percent of the instructors' indicated that some of the non-CAI lessons should be developed into CAI lessons. Another 27% was neutral about this issue.

TABLE 45  
Descriptive Statistics for  
Experimental (E) Instructors' Attitude Toward Increasing CAI

Mean	Median Score	Standard Deviation	Number of Scores	Percent to Increase	Percent Neutral	Percent Not To Increase
4.066	4.142	.8426	15	80	20	0

TABLE 46  
Frequency Distribution for the  
Data in Table 45

Scores	Frequency (f)
5	7
4	5
3	3
2	0
1	0
	$\Sigma f = 15$

3d. Another question used to assess instructor acceptance was: "Would you like to instruct courses in the future which use CAI?" Descriptive statistics for this item are reported in Table 47 and the frequency distribution of scores is reported in Table 48. Eighty percent of the instructors indicated a desire to teach courses in the future using CAI. Another 13% was neutral on the issue, while 7% indicated that they did not care to participate in teaching future courses using CAI.

TABLE 47  
Descriptive Statistics for  
Experimental (E) Instructors' Future Participation

Mean	Median Score	Standard Deviation	Number of Scores	% of Future Participation	Percent Neutral	Percent of Non-participation
4.066	4.625	.9978	15	80	13	7

TABLE 48  
Frequency Distribution for the  
Data in Table 47

Scores	Frequency (f)
5	8
4	4
3	2
2	1
1	0
	$f = 15$

3e. Two open-ended questions concerning likes and dislikes were used to assess instructor acceptance. The first question was stated: "What do you believe are the instructional advantages of using CAI in this course?" Typical responses were as follows:

- Better feedback.
- Decreased demands for lab time.
- Students have to pay more attention.
- All students received the same instruction.
- Students can progress at their own rate.
- Computers are enjoyable for the student.
- Keeps students interested.
- Able to reiterate instruction.
- Immediate feedback if provided.
- Better learning on the part of students.

The second question was stated: "What do you believe are the instructional disadvantages of using CAI in this course?" Typical responses were as follows:

- Not sure at this time.
- None.
- Time required to field modules.
- Inability of students to review.
- Nothing.
- Materials cannot be reviewed without reviewing entire lesson.

3f. A third open-ended question was used to assess instructor acceptance of the CAI portion of the course. The question was stated as follows: "What instructional changes occurred in this course as a result of using CAI?" Typical responses were as follows:

- Major change was shift from platform instruction to individualized instruction. I liked it.
- None.
- You the instructor do not have to stand and preach for eight hours on the platform.
- Greater individualization.
- Instructors had less instruction to do; more time to facilitate individual students.

4. Program Implementation: Data pertaining to how well the program was implemented were gathered from six different sources. Each of the six sources included a question which required the respondent to choose the item that most closely represented his/her feelings. The instrument used a five item rating scale with 5 indicating a high rating and 1 indicating a low rating. The findings for these six sources are now reported.

4a. The first source was used to gather information from students about program implementation. Essentially the evaluation was interested in knowing if students felt they were adequately instructed on how to use the CAI lessons as a learning tool. The following question was used to collect that data: "What is your opinion about the introduction that you received on how to use the CAI lessons?" This item is found in the End-Of-Student Questionnaire (See Appendix D). Descriptive statistics for this item are reported in Table 49 and the frequency distribution is reported in Table 50.

TABLE 49  
Descriptive Statistics for  
Experimental (E) Students' Perceived Orientation

Mean	Median Score	Standard Deviation	Number of Scores	Percent of High Opinion	Percent Neutral	Percent of Low Opinion
4.065	4.048	.5737	31	87	13	0

TABLE 50  
Frequency Distribution for  
Data in Table 49

Scores	Frequency (f)
5	6
4	21
3	4
2	0
1	0
	$\Sigma f = 31$

The next series of data reports relating to program implementation are taken from the Student End-Of-Lesson Questionnaire (See Appendix F). These questionnaires were distributed to students after they completed each CAI lesson. Fifty questionnaires were randomly selected, from the available pool for purposes of analysis.

4b. Students were asked to rate the quality of instructor assistance though the following statement: "The course instructor was always friendly and helpful when I needed his/her assistance." Descriptive statistics for this item are reported in Table 51 and the frequency distribution is reported in Table 52. Ninety-four percent of the students' responses indicated an agreement that the instructor was always friendly and helpful when the student need assistance. Six percent of the students were neutral on the issue, while no item indicated that students felt that they received poor assistance from their instructors.

TABLE 51  
Descriptive Statistics for  
Experimental (E) Students' Perceived Quality of Assistance

Mean	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.38	4.380	.7321	50	94	6	0

TABLE 52  
Frequency Distribution for  
Data in Table 51

Scores	Frequency (f)
5	22
4	25
3	3
2	0
1	0
	$\Sigma f = 50$

4c. Another item used in collecting data focused on the perceived quality of the environment in which the CAI lessons were used. That item was stated as follows: "The environment (room, temperature, noise level, etc.), in which I used the CAI lessons, contributed to my learning." Descriptive statistics for this item are reported in Table 53 and the frequency distribution is reported in Table 54. Ninety percent of the students felt that the environment in which CAI lessons were used contributed to their learning. Another 10% indicated that the environment neither contributed nor distracted from their learning. No student indicated that the environment hindered their learning.

TABLE 53  
Descriptive Statistics for  
Experimental (E) Students' Perceived Quality of Environment

Means	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.160	4.125	.6238	50	90	10	0

TABLE 54  
Frequency Distribution for  
Data in Table 53

Scores	Frequency (f)
5	13
4	32
3	5
2	0
1	0
	$\Sigma f = 50$

4d. Program Implementation is sometimes hindered by flaws in equipment or materials. Two items were used to assess this concern. The first item was stated as follows: "I did not have any problems using the CAI materials in this lesson." Descriptive statistics for this item are presented in Table 55 and the frequency distribution is reported in Table 56. Eighty percent of the students indicated that they had few if any problems with the CAI materials. Another 16% of the students were neutral on the issue, while 4% indicated some problems with the CAI materials.

TABLE 55  
Descriptive Statistics for  
Experimental (E) Students' Reactions to CAI Material

Means	Median Score	Standard Deviation	Number of Scores	% of CAI Agreement	% Neutral	% of CAI Non-Agreement
4.100	4.152	.5637	50	80	16	4

TABLE 56  
Frequency Distribution for  
Data in Table 55

Scores	Frequency (f)
5	17
4	23
3	8
2	2
1	0
	$\Sigma f = 50$

The second item was stated as follows: "My learning was seldom interrupted by CAI equipment failure." Descriptive statistics for this item are presented in Table 57 and the frequency distribution is reported in Table 58. Students agreed at a 100% response rate that they had few if any CAI equipment failures.

TABLE 57  
Descriptive Statistics for  
Experimental (E) Students' Reactions to CAI Equipment

Means	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.640	4.718	.3224	50	100	0	0

TABLE 58  
Frequency Distribution for  
Data in Table 57

Scores	Frequency (f)
5	32
4	18
3	0
2	0
1	0
	$\Sigma f = 50$

4e. Information pertaining to program implementation was also obtained from instructors. The item used for data collection was stated as follows: "Do you feel that your students were able to use CAI lessons without too much assistance from you?" Descriptive statistics for this item are presented in Table 59 and the frequency distribution is reported in Table 60. Instructors agreed at a 100% response rate that their students were able to use the CAI lessons with little assistance.

TABLE 59  
Descriptive Statistics for  
Experimental (E) Instructors' Perception of Student Ability  
To Work With CAI Lessons

Means	Median Score	Standard Deviation	Number of Scores	Percent of Agreement	Percent Neutral	Percent of Non-Agreement
4.600	4.666	.5070	15	100	0	0

TABLE 60  
Frequency Distribution for  
Data in Table 59

Scores	Frequency (f)
5	9
4	6
3	0
2	0
1	0
	$\Sigma f = 15$

5. Reliability: The evaluator was interested in obtaining information on the reliability and quality of the CAI hardware and software. Four sources were used to collect the required data for this area. The findings for these four sources are now presented.

5a. Perceived reliability was determined by examining items from the Student End-Of-Course Evaluation Questionnaire (See Appendix D) and the Instructor End-Of-Course Evaluation Questionnaire (See Appendix E). The same item was used with both students and instructors. The descriptive statistics for the student data are reported in Table 61 and the frequency distribution of scores is reported in Table 62. Seventy-one percent of the students rated the reliability of the CAI hardware and software as highly reliable. Another 29% of the students was neutral on this issue.

TABLE 61  
Descriptive Statistics for  
Experimental (E) Students' Perception of CAI Reliability

Means	Median Score	Standard Deviation	Number of Scores	Percent of Reliability	Percent Neutral	Percent of Non-Reliability
4.097	4.150	.8311	31	71	29	0

TABLE 62  
Frequency Distribution for  
Data in Table 61

Scores	Frequency (f)
5	12
4	10
3	9
2	0
1	0
	$\Sigma f = 31$

The descriptive statistics for the instructor data are reported in Table 63 and the frequency distribution of scores is reported in Table 64. Eighty-seven percent of the instructors rated the CAI hardware and software as highly reliable. Another 13% of the instructors were neutral on this issue. Note that the instructors rated the reliability of the CAI hardware and software 16% higher than did the students.

TABLE 63  
Descriptive Statistics for  
Experimental (E) Instructors' Perception of CAI Reliability

Means	Median Score	Standard Deviation	Number of Scores	Percent of Reliability	Percent Neutral	Percent of Non-Reliability
4.066	4.286	.7530	15	87	13	0

TABLE 64  
Frequency Distribution for  
Data in Table 63

Scores	Frequency (f)
5	6
4	7
3	2
2	0
1	0
	$\Sigma f = 15$

5b. The CAI lessons were designed to have an instructor intercede when students failed to correctly respond to a CAI question on his/her third attempt. The lesson was designed to automatically stop at that point. The instructor would then brief the student and reactivate the lesson. Data for this item were collected through a special form entitled "Student CAI Usage Log" (See Appendix C). The form, however, was very seldom used. Instructors need to intercede only six times throughout the evaluation period. Each interceding time was with a different student and a different lesson.

5c. The evaluation also examined daily terminal downtime and the source or type of failure. Information concerning this area was to be collected on a form entitled, "Problem Log for CAI Terminals" (See Appendix G). For one reason or another, the form was not utilized by the staff. Fortunately, however, separate records were maintained and were made available. Only five CAI terminal related problems occurred during the evaluation period. The type of problem and date of occurrence are listed below:

- Keyboard Malfunction - 19 March 1982.
- Controller Card Malfunction - 6 April 1982.
- Disk Analog Card Malfunction - 16 April 1982
- Disk Drive (Head Mechanism) Malfunction - 29 April 1982
- Disk Drive (Align Mechanism) Malfunction - 7 April 1982

Each problem was repaired with one service call. Also, all problems were corrected within 24 hours of the repair contractor being notified. No actual training time was lost since the student was either moved to another CAI terminal or to another lesson using other forms of media.

6. Cost Analysis: The evaluation examined only those costs associated with the CAI Console Operator Training Course for MOS 16H10 OSUT Students. Cost factors considered in the analysis included:

6a. Research and development time.

<u>Item</u>		<u>Unit Cost</u>	<u>Total</u>
Supervisory Personnel	18 man-months @	1,875/mo.	\$33,750.00
Data Entry Personnel	6 man-months @	1,875/mo.	11,250.00
Clerical Personnel	2 man-months @	1,875/mo.	3,750.00
			<u>\$48,750.00</u>

6b. Acquisition of materials and equipment.

<u>No.</u>	<u>Item</u>	<u>Unit Cost</u>	<u>Total Cost</u>
14	Apple II and System*	\$2,100.00	\$29,400.00
1	Apple Graphics Table	800.00	800.00
430	Blank Diskettes	3.00	1,290.00
5	Printers	800.00	4,000.00
			<u>\$35,490.00</u>

\*Apple II and System includes 1 Apple II 48K microcomputer, 1 disk drive with controller, and 1 non-color video monitor.

6c. Operational Costs.

<u>Item</u>		<u>Unit Cost</u>	<u>Total</u>
Courseware Maintenance**	4 man-months @	1,875/mo.	\$ 7,500.00
CAI Facilitator	12 man-months @	1,875/mo.	22,500.00
<u>Estimated Supplies</u>			
Repair Contract			1,000.00
14 - Apple II 48K Microcomputers		250.00	3,500.00
16 - Disk Maintenance		102.00	1,632.00
5 - Printers		155.00	755.00
			<u>\$36,887.00</u>

\*\*Courseware revision and update.

6d. Equipment depreciation has been calculated over a ten-year period. The total cost of the equipment was \$35,490.00 which results in a cost of \$3,549.00 per year.

6e. A cost analysis projecting cost per instructional group for the next ten years is provided in Table 65. The formula for these calculations is:

$$C_g = \frac{B}{N} + O$$

Where C<sub>g</sub> = Cost Per Group  
 B = Basic Costs  
 O = Operational Costs  
 N = Total Number of Students

These calculations are based on 26 separate classes/year with an enrollment of 15 students per class.

TABLE 65  
 Cost Per Instructional Group

Year	Number of Groups	Cumulative Groups	Group Cost
1982-83	26	26	\$3,430.23
1983-84	26	52	2,492.73
1984-85	26	78	2,180.23
1985-86	26	104	2,023.98
1986-87	26	130	1,930.23
1987-88	26	156	1,867.73
1988-89	26	182	1,823.09
1989-90	26	208	1,789.61
1990-91	26	234	1,763.56
1991-92	26	260	1,742.73

Also a cost analysis projecting cost per student over the next ten years is provided in Table 66. The formula for these calculations is:

$$Cs = \frac{B}{N} + \frac{O}{n}$$

Where Cs = Cost Per Student  
B = Basic Cost  
O = Operational Costs  
N = Total Number of Students Who Have Taken the Course (Including the Present Group)  
n = Number of Students in Present Group

TABLE 66  
Cost Per Student in the  
Last Class of Each Year

Year	Number of Students	Cumulative Students	Students Cost
1982-83	390	390	\$228.68
1983-84	390	780	166.18
1984-85	390	1170	145.35
1985-86	390	1560	134.93
1986-87	390	1950	128.68
1987-88	390	2340	124.51
1988-89	390	2730	121.53
1989-90	390	3120	119.31
1990-91	390	3510	117.57
1991-92	390	3900	116.18

SUMMARY/CONCLUSION

The summative evaluation of the AN/TSQ-73 Command/Control System Training Program, for MOS 16H10 OSUT students (E-Course) was concerned with the overall effectiveness of an integral block of course material relative to several independent criteria. Also, a major effort was made, to focus on the effectiveness of the CAI portion of the Course.

In addition to effectiveness, the evaluation examined the following variables: (1) student acceptance, (2) instructor acceptance, (3) program implementation, (4) reliability, and (5) cost analysis. A summary and conclusion for each of these variables is now reported.

### EFFECTIVENESS:

The E-Course did indeed have a positive impact on student achievement. Analysis of the data indicated a significant difference for the E-Course over the control course (C-Course) on all achievement sub-tests, with the exception of Test 7. It is interesting to note that Test 7, with 40 items, included only four questions assessing content taught via CAI materials. These results support the developers' objective to increase student achievement. It must be remembered that the design of the materials incorporated provisions for individually pacing, appropriate practice, feedback and repetition for all tasks to be learned. It can be concluded from the evaluation finding that these provisions were highly successful.

All media forms, including CAI, utilized in the E-Course, produced statistically significant results in student achievement for the E-Course when compared to the C-Course, which used the more traditional lecture/discussion method. However, the data indicated no significant difference between the E-Course scores on task items taught via CAI materials when compared to their own scores on task items taught via other media forms. It is believed that these results suggest that the course was successfully designed with an appropriate mix of media. Students were constantly motivated by the change of pace that the course provided, as they moved from one medium to another. In other words, one medium tended to embellish each of the other media forms.

The E-Course enabled students to master the required tasks in a time period that was substantially less than that required for the C-group. In fact, the E-Course required less than one-half the time required for the C-Course. This finding is an important factor to use in judging course effectiveness. Reducing the required time for training is certainly an indication of effectiveness. However, the finding may also suggest that the C-Course should be re-examined to determine whether 170 hours of instructional time is actually necessary.

Positive data were provided for all areas pertaining to: (1) perceived speed of skill acquisition from CAI, (2) perceived confidence in learning from CAI, (3) perceived attention in learning from CAI, (4) perceived meeting of student need from CAI and (5) perceived transfer of learning from CAI to actual task performance. The only negative data in these areas tended to be associated with the speed of acquisition from CAI. A number of students and instructors felt that the CAI scrolling procedures was too slow. They would have preferred to have the text material presented on the monitors at a faster rate. These comments, however, do not in reality relate to the speed of skill acquisition. It is evident, from the achievement scores and the actual time required for completing the course, that speed of skill acquisition was very good. It does though, point to the need for increasing the present scrolling speed of the CAI lessons.

In summary, it can be concluded that the E-Course proved to be extremely effective in reaching its intended objectives. All measures of effectiveness lends support to this conclusion.

STUDENT ACCEPTANCE:

The pattern of results in the analysis of student attitude toward the total E-Course demonstrates a favorable affective reaction. This pattern is also true for the CAI component of the course. When students were asked, "What is your opinion of the lessons taught by CAI . . . ." they responded favorably. However, their response for this item was somewhat less favorable than for other items. It is interesting to note that several students had indicated in their responses to open-ended questions that they would prefer to use media forms other than CAI. Generally, students making these statements mentioned that they felt that the CAI materials needed to be paced at a faster rate of speed. Student acceptance is also indicated by their willingness to take future courses employing CAI materials. This response however, would generally be tied to the caveat that they would not want to take a course designed entirely around CAI.

In summary, students readily accepted the total course and also its CAI components. It might be suggested, however, that computer-assisted instruction by itself neither guarantees favorable student attitudes nor meets all student needs for learning all types of tasks. Students generally tend to be more receptive of CAI when it is an integrated part of a course, rather than when it represents the only medium of a course.

INSTRUCTOR ACCEPTANCE:

There has been considerable speculation about what the role of the instructor would be when technology became commonplace in instructional settings. Often it is said that technology will relieve teachers of routine duties and thus make better and fuller use of their capabilities. Other projections involve radical changes in instructors' responsibilities.

Its developers had anticipated that the E-Course would change the nature of an instructor's duties and responsibilities. It is well known that instructor attitude can make a difference in the teaching learning process. The outcome obtained with a program may be attributed, at least in part, to instructor attitudes toward that program. Strong instructor resistance could sabotage an otherwise effective project or high instructor enthusiasm might be the real explanation for observed positive outcomes. Therefore, the evaluation was interested in how well the instructors accepted the new course. It should be noted that several of the instructors were involved, to some degree, in the course development process. This involvement might have contributed toward a sense of "ownership" on the part of those instructors.

On the whole, instructors responses to the total E-Course and to its CAI component indicated attitudes supportive of the premise inherent to the design. In fact, instructors tended to have slightly more favorable response to similar questions than did students. The clearest and most prominent dimension behind instructor attitude toward the course was a focus on the interest of the student. Instructors seemed to base their responses on what they considered best for the student. Most of the staff agreed that discussion among students and informal interaction between students and instructors contributed to the training process.

Instructors were also supportive of the CAI component. Any negative response on their part, tend to be similar to the negative comments given by students. That is, the CAI programs needed to present materials at a faster rate of speed. When the evaluator interviewed the instructors, they all indicated that they would like to work with future courses which used CAI materials as part of the instructional strategy. One instructor, who held a favorable attitude toward the course, indicated however, that he sometimes missed the role of presenting lectures. At the same time, several other instructors cited that they enjoyed the E-Course strategy because, they no longer were required to give lectures.

In summary, instructors readily accepted the overall E-Course strategy. They also readily accepted the CAI component of the course. It can be concluded that the instructors are looking favorably toward the prospects of working with future courses using individually paced instruction, and CAI materials.

#### PROGRAM IMPLEMENTATION:

Program implementation appears to have been carried out in a successful manner. Analysis of the data suggested that students' perceived the instructors to be extremely helpful during the orientation session and throughout the duration of the course. Their attitudes toward the environment in which the CAI lessons were used were also good. In addition, they perceived both CAI equipment and courseware to be of high quality. It can be concluded that students were not negatively affected by the program implementation procedures. In fact, just the opposite may be the case. In conversations that the evaluator had with students, many related to him their appreciation for having concerned instructors, a good learning environment and also interesting and enjoyable courseware. It is concluded that these factors actually facilitated the learning process.

Instructors also thought that the program implementation went fairly smooth. Negative comments by instructors centered on course record keeping and with other training requirements in which their students were simultaneously involved. Student progress with CAI lessons was to have been managed through a computer management system. However, this program was not available for use during the evaluation. Several instructors perceived this to be a deterrent to the overall success of implementing the program. Also, they suggested that the course should not be run simultaneously with basic training. It was their opinion, that the basic training requirements detracted from the overall learning environment of their course.

#### RELIABILITY:

The reliability factor for both the CAI hardware and courseware proved to be extremely high. Students and instructors found little fault in the performance of the equipment. This finding should be expected, in light of the few minor repairs that were made during the period in which the evaluation was conducted. In the future, one might expect this finding to change slightly. Naturally, more hardware technical problems will occur as time passes. Any hardware has a certain amount of downtime; and downtime increases as the equipment

ages. CAI equipment certainly is not exempt from this hazard. Most of the problems that instructors or students might have with the reliability factor can more or less be alleviated by having reliable and expedient repair service. It should be stated that the instructors were quite pleased with the prompt service rendered by the present service contractor.

The courseware seemed to also be judged similarly high, as was the hardware, in terms of its reliability. Instructors were seldom required to intercede with students as they were using the CAI materials. This would indicate that the materials were able to stand alone with little or no outside assistance from instructors.

A small number of students complained that the materials in several situations repeated information more often than was needed. This complaint may or may not be valid. However, the course developers should continuously review the materials and remove any unnecessary repetitions.

#### COST ANALYSIS:

It is important to note that the basic development cost is a fixed cost, whether the project is continued for one or ten years. These costs are amortised over the ten years as a uniform unit cost. The operational costs, on the other hand, are repeated for each group of students regardless of the number of groups trained. In other words, it costs as much to operate the training course for the 15th group, for example, as it does to operate the course for the first group, provided the operational costs are not changed. It should be noted that the operational costs have been calculated at a set dollar amount throughout the ten-year period. In reality, one probably can expect the operational costs to increase over the years. However, it would be mere speculation to estimate these increases. Assuming that the cost will increase proportionally with other increases, one can conclude that the CAI portion of this course is an extremely worthwhile venture.

It is clear that the CAI Console Operator Training Course for MOS 16H10 OSUT Students did indeed meet its objectives. It can be concluded that the course is a valuable application of instructional technology and should be viewed as a legitimate and useful improvement of the training process.

### RECOMMENDATIONS

It is clear that the course did meet its objectives. The basic aim was to permit the developer to design an individually paced course which incorporated a CAI component. The course was implemented and the evaluation indicates that the staff was successful with their endeavors. Several recommendations are now presented for the staff's future consideration:

1. The staff should consider increasing the scrolling speed which is used in presenting text material on the monitor. There seemed to be a common consensus which suggested that the scrolling speed was too slow for most students. A faster rate of speed could increase student motivation toward learning from CAI materials.
2. CAI materials should be continuously examined to determine if too many repetitions are included as indicated in the conclusion section of this report, students comments on too many repetitions may or may not be valid. One must remember that the courseware produced highly successful achievement results. Changing the number of repetitions for some of the task areas may result in negative effects on achievement scores. However, removing unnecessary repetitions could perhaps increase learner motivation. It is recommended that the staff should continue to review the CAI materials and revise any repetitions that are obviously unnecessary.
3. The media mix employed in the course seemed to be a positive attribute. It is recommended that the staff should continue using a similar balance of media in the future. The present media combination provided an appropriate change of pace which kept student motivation rather high throughout the course. Any attempt to disproportionately increase the CAI component could result in lower student acceptance in the course.
4. A computer management program to monitor student progress should be developed. This program was to have been in place at the start of the evaluation. However, for one reason or another, the program has yet to be implemented. The program, when implemented, will greatly reduce the paper and pencil work that is presently required of the staff.
5. It is recommended that the staff explore approaches using computer simulated activities in the practical exercises. Most practical exercises are currently conducted with the actual console control equipment. The limited number of available consoles caused a backlog of students, waiting their turns to complete the exercises. Computer simulation could perhaps be an appropriate alternative to the present approach.

6. Consideration should be given to separating the course from the basic training requirements. Students who are too tired to stay awake can hardly be the most successful learners.
7. CAI has proven to be quite successful in this instructional/training situation. Therefore, it is recommended that the strategy be considered as an alternative for other similar courses.

APPENDIX A

WRITTEN TESTS

F6.1 E-3

EXAMINATION HPO.20114-9

INTRODUCTION TO THE AN/TSQ-73 SYSTEM

TIME ALLOWED: 75 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 20 questions. Circle the correct answers. There is only one correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Immediately contact the facilitator when you complete the examination.

1. Which of the following is not a function of the battalion AN/TSQ-73?
  - a. Assign fire unit (FU).
  - b. Determine if track is hostile.
  - c. Launch a missile.
  - d. Detect tracks.
  
2. Which subsystem within the battalion AN/TSQ-73 processes radar information?
  - a. ADPE
  - b. RIE
  - c. ADL
  - d. MTU
  
3. What subsystem within the AN/TSQ-73 is used to convert incoming power to system power?
  - a. MTU
  - b. ADPE
  - c. Power cabinet
  - d. RIE
  
4. What part of the following publication code refers to the type of publication TM 9-1430-652-10-3.
  - a. TM
  - b. 9
  - c. 1430
  - d. 652
  
5. A diagram consisting of symbols and connecting lines that show step by step progression through a usually complicated procedure or system is?
  - a. Flow chart
  - b. Grid
  - c. Loop Test

6. The abbreviation for the word PARAMETER is?
  - a. PARAM
  - b. PAR
  - c. PA
  
7. A technique or device that brings itself into a desired state through its own action is called?
  - a. Configuration
  - b. Bootstrap
  - c. Byte
  
8. A numbering system which has a base of sixteen symbols and letters is called?
  - a. Hexadecimal
  - b. Binary
  - c. Bit
  
9. Which radar is used to track targets in the hercules battery?
  - a. HIPAR
  - b. TRR
  - c. TTR
  - d. LOPAR
  
10. How many batteries does an IHAWK battalion normally consist of?
  - a. 2
  - b. 3
  - c. 4
  - d. 5

11. Once the computer in the ICC has processed the target information where is the data sent?

- a. ICWAR
- b. IBCC
- c. IPAR
- d. IROR

12. A basic standard of flow charts is that they are read from \_\_\_\_\_ to \_\_\_\_\_ and \_\_\_\_\_ to \_\_\_\_\_?

- a. Right to left and top to bottom.
- b. Left to right and top to bottom.
- c. Left to right and bottom to top.
- d. Right to left and bottom to top.

13. This symbol  is called a and tells you to \_\_\_\_\_?

- a. Decision symbol, do something.
- b. Manual operational symbol, begin something.
- c. Manual operational symbol, do something.
- d. Entry point, do something.

14. Alphanumerics are made up of?

- a. Number only
- b. Letters and numbers
- c. Letters only

15. What category of publication are used for equipment operations?

- a. Operator/crew -10
- b. Organizational maintenance -20
- c. Direct support maintenance -30
- d. General maintenance -40

16. Which publication is used for the removal and replacement of AUTOMATIC DATA PROCESSING equipment subassemblies?
- a. TM 9-1430-655-20-4
  - b. TM 9-1430-655-20-5
  - c. TM 9-1430-655-20-6
  - d. All of the above
17. The abbreviation of the words AUTOMATIC DATA PROCESSING EQUIPMENT is?
- a. ADPE
  - b. ADL
  - c. ADP
18. The abbreviation for the memory unit is?
- a. MU
  - b. MTU
  - c. MV
19. Using numbers between 0 and 9 to represent all variables involved is called?
- a. degree
  - b. decimal
  - c. digital
20. The abbreviation for the word RAID ADDED manually INITIATED TRACKING is?
- a. R
  - b. RADAR
  - c. RAMIT

Examination HPO.20217-13

Initialize the System

Time allowed: 140 minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME STARTED \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

**DIRECTIONS:** This examination consists of 55 questions. Circle the correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Contact the facilitator when you complete the examination.

1. Initial set-up:
  - a. Facilitator: Energized lab configured AN/TSQ-73 System and a site-adapted system tape.
  - b. Student: Have TM 10-3 and TM 10-4 in possession.
  
2. During Examination:
  - a. Facilitator: Monitor student progress thru test objectives.
  - b. Student: Perform each test objective in sequence.
  
3. After Examination:
  - a. Facilitator: Purge System and remove system tape.
  - b. Student: Return all reference material to progress desk.

1. Which technical manual should be used as a reference when performing Initialization and Operating Procedures?
  - a. TM 9-1430-652-10-3
  - b. TM 9-1430-652-10-1
  - c. TM 9-1430-652-10-2
  
2. Which technical manual should be used as a reference for Command Code format and contents?
  - a. TM 9-1430-652-10-1
  - b. TM 9-1430-652-10-2
  - c. TM 9-1430-652-10-6
  
3. Select the answer that list the following tasks in the sequence required to perform Hardware Initialization.
  1. Turn on equipment power.
  2. Turn on external power.
  3. Establish shelter lights.
  4. Set controls to operating positions.
  5. Establish shelter environment.
  6. Establish preliminary switch settings.

a. 2	b. 2	c. 4	d. 6
3	3	1	5
6	5	5	4
5	6	6	1
1	4	3	3
4	1	2	2
  
4. Select the answer that list the following tasks in the sequence required to perform Software Initialization.
  1. Update other data.
  2. Perform site initialization.
  3. Record new tape (if needed).
  4. Bootstrap load.
  5. Update other site data.

a. 4	b. 4	c. 1	d. 4
5	2	3	2
3	1	5	5
1	3	2	3
2	5	4	1
  
5. What is the last step required to complete System Initialization for a Battalion AN/TSQ-73 System?
  - a. ADPE checkout
  - b. RIE alignment
  - c. Hardware Initialization
  - d. Preliminary Switch Settings

6. During Hardware Initialization the LIGHTING BLACKOUT OVERRIDE switch is set to which position?
  - a. DIM
  - b. OFF
  - c. BRIGHT
  - d. ON
  
7. Following Hardware Initialization, which ADP panel switch will remain OFF?
  - a. IOX1
  - b. IOX2
  - c. IOX3
  - d. IOM
  - e. Keyboard Printer
  
8. Refer to table 3-4 in TM 9-1430-652-10-3. What position will be the AC/DC CONVERSION switches be in after power turn-on? (No remote displays are connected.)
  - a. Both on
  - b. Both off
  - c. No. 2 on and No. 1 off
  - d. No. 1 on and No. 2 off
  
9. Which switch is set ON during Preliminary Switch Settings?
  - a. Air conditioner circuit breaker
  - b. Radar Simulator Antenna Direction
  - c. ADP Power switch
  - d. Voice Comm Central Power switch
  
10. Which of the following software function makes AIR DEFENSE tactical decisions?
  - a. BOCF
  - b. M&D
  - c. SIM
  - d. SSP
  
11. To generate simulated raids for operator training, which of the following software functions is used?
  - a. BOCF
  - b. M&D
  - c. SIM
  - d. SSP
  
12. Which of the following software functions is used to detect faults?
  - a. BOCF
  - b. M&D
  - c. SIM
  - d. SSP

13. Which of the following software functions is used to generate a Site Adapted tape?
  - a. BOCF
  - b. M&D
  - c. SIM
  - d. SSP
  
14. The AN/TSQ-73 System
  - a. must be bootloaded from the upper Magnetic Tape Unit (MTU).
  - b. must be bootloaded from the lower Magnetic Tape Unit (MTU).
  - c. can be bootloaded from either the upper or the lower Magnetic Tape Unit (MTU).
  
15. During ADP operational checkout the cartridge protect switch should be set to PROT to avoid accidental erasure.
  - a. true
  - b. false
  
16. Control Commands can be entered from
  - a. the KPU only.
  - b. the ADP control panel only.
  - c. either the KPU, ADP panel, or Display Console.
  - d. The Display Console only.
  
17. Fault Isolation programs are CC \_\_\_ through CC \_\_\_.
  - a. CC34 - CC40
  - b. CC50 - CC56
  - c. CC30 - CC33
  
18. Which Battalion Configuration is suitable to perform CC50?
  - a. CC24
  - b. CC25
  - c. CC26
  - d. CC27
  
19. Which of the following Group Configurations provides reduced track capacity with two memory banks down?
  - a. CC23
  - b. CC22
  - c. CC21
  - d. CC20
  
20. Which group configurations are used with one memory bank down?
  - a. CC21 and CC22
  - b. CC23 and CC27
  - c. CC25 and CC26

21. CC24 thru CC27 are valid when the AN/TSQ-73 is operating in the \_\_\_\_\_ Configuration.
- a. Battalion
  - b. Battery
  - c. Group
  - d. Brigade
22. If using roll paper, which method of paper feed is used in the KPU?
- a. Spring
  - b. Sprocket
  - c. Cam-Action
  - d. Friction
23. What indications are present when paper in KPU nears the end of the paper roll?
- a. Alarm sounds; message "paper out" is printed at KPU.
  - b. Paper out lamp comes on; alarm sounds, red stripe appears on paper.
  - c. Paper out lamp comes on; computer stops.
  - d. Paper out lamp lights and motor stops running.
24. Which Battalion configuration is used for maximum tracks capacity?
- a. CC20
  - b. CC27
  - c. CC24
  - d. CC25
25. Which command code is used to run fault isolation on the keyboard printer unit (KPU)?
- a. CC50
  - b. CC51
  - c. CC52
  - d. CC53
  - e. CC54
26. Which of the following configurations will allow use of field utilities?
- a. CC24
  - b. CC25
  - c. CC26
  - d. CC27
27. Which program configurations are used for BOCP?
- a. CC20-27
  - b. CC54 - CC57
  - c. CC24 thru CC27
  - d. CC50-57

28. The function of a modem is to
- control power supply to DC/DC converters.
  - convert digital data into audio tones for radio transmission.
  - convert audio tones into digital data for ADPE.
  - Both b and c.
29. To select the type of signal, strength, and speed of data communications which device would be used?
- Modem Control Panel
  - Communications Demarkation
  - Data Comm Panel
30. Which of the following is used to control power to the modems?
- Comm Demarkation Panel
  - Modem Control Panel
  - Data Comm Panel
31. To bypass a failed modem, which device would be used?
- Communications Patch Panel
  - Communications Demarkation Panel
  - Data Comm Panel
32. Which of the following devices provides the capability to communicate with many subscribers simultaneously?
- Voice Comm Central
  - Voice Comm Station
  - Comm Patch Panel
33. To set a modem for MBDL, which switch(es) on the modem would be used?
- FORMAT switch
  - Power and ATTN-DB switches
  - Bit rate - BPS switch
  - both a and c
34. To how many modems does one modem power supply provide power?
- 4
  - 8
  - 20
  - 32
35. To bypass a faulty voice comm circuit, which jacks would you use?
- ADL
  - Opnl Net
  - Cmd Admin
  - Maint Net
  - b, c, and d

36. To determine if a subscriber is on line, which voice comm station switch would be used?
- a. REL ALL
  - b. KBD CLEAR
  - c. ENQUIRY
  - d. RING
37. To deactivate a data link, which command code would be used?
- a. CC100
  - b. CC50
  - c. CC100 50
  - d. CC101
38. Which command code is used to assign a data link to a modem?
- a. CC102
  - b. CC112
  - c. CC111
39. Which device processes voice communications going through the shelter?
- a. Voice Comm Central
  - b. Voice Comm Station
  - c. Comm Patch Panel
40. To speak directly with a subscriber, which of the following do you use?
- a. Comm Demarkation Panel
  - b. Voice Comm Station w/headset
  - c. Voice Comm Station with telephone
  - d. either b or c
41. What is the purpose of a modem?
- a. Acts as language translator (modulator/demodulator) that changes analog inputs into digital words.
  - b. Acts as a language translator (modulator/demodulator) that changes digital signals to audio signals and audio signals to digital signals.
  - c. All of the above.
42. How are Data Links numbered?
- a. Decimal (0 thru 9)
  - b. Octal (0 thru 37)
  - c. Binary (0 and 1)
43. The following CC102 Command CC102 01
- a. Assigns ATMS to modem 3
  - b. Assigns Group to modem 4
  - c. Other services to modem 1

44. The CC Command that assigns a data link to a modem is
- a. CC102
  - b. CC24
  - c. CC100
  - d. CC101
45. The AN/TSQ-73 System had the capability to expand to \_\_\_\_\_ modems.
- a. 32
  - b. 46
  - c. 36
46. How many modems does the current Battalion AN/TSQ-73 System have?
- a. 21
  - b. 32
  - c. 20

Modem Assignments HPO.20217-10 CAI

47. How many modems are powered by each one of the modem power supplies?
- a. 32 modems
  - b. 4 modems
  - c. 20 modems
48. What position would the Bit rate - BPS switch be set on a modem that is linked to an MBDL Fire Unit?
- a. 600
  - b. 1200
  - c. 750
49. The following command has been entered: CC102 15 14. Which answer describes the results of this command?
- a. Link 15 has been assigned to modem 14.
  - b. Modem 15 has been turned on.
  - c. Modem 15 identifies Fire Unit 15.
40. TADIL-B is always assigned to link \_\_\_\_\_.
- a. 32
  - b. 17
  - c. 0
51. What links are available for assignment at a Group AN/TSQ-73?
- a. Links 0 thru 20 (octal)
  - b. Links 1 thru 12 (octal)
  - c. Links 10 thru 32 (octal)

52. The modems are activated (turned on):
- a. manually, by the operator.
  - b. automatically, by the computer.
  - c. by the CC100 command.
  - d. by the CC101 command.
53. The links are turned on:
- a. by the CC101 command.
  - b. by the CC100 command.
  - c. manually, by the operator.
  - d. automatically, by the computer.
54. Which activated data link sounds like a steady (straight) tone?
- a. MBDL only.
  - b. TADIL-B and ATDL-1.
  - c. MBDL and TADIL-B.
  - d. ATDL-1 and MBDL
55. When bypassing a failed modem, what action is required if the patch panel is not to be used?
- a. faulty modem must remain ON.
  - b. link number must be changed.
  - c. outside cable must be moved.
  - d. link must remain off.

EXAMINATION HPO.20304-3  
ESTABLISH VOICE COMMUNICATION

TIME ALLOWED: 90 Minutes

RANK/NAME \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISH \_\_\_\_\_

DIRECTIONS: This examination consists of 15 questions. Circle the correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Immediately contact the facilitator when you complete the examination.

EXAM 20304

1. How many sections are there to the voice communication directory?
  - A. 5
  - B. 4
  - C. 6
  - D. 3
  
2. Battery subscribers will usually be listed beginning at ADDR5 No. \_\_\_\_\_.
  - A. 01
  - B. 06
  - C. 32
  - D. 09
  
3. How many names can be listed on the VCA local communications directory?
  - A. 4
  - B. 3
  - C. 5
  - D. 2
  
4. How many lines of the directory are reserved for each voice comm station?
  - A. 8
  - B. 4
  - C. 5
  - D. 1
  
5. How many assignments can be listed on the directory for all VCS?
  - A. Total of 5.
  - B. Total of 10.
  - C. Total of 15.
  - D. Total of 20.
  
6. The NET COMMUNICATIONS DIRECTORY is divided into five columns. Column 2 provides space for \_\_\_\_\_.
  - A. Addresses.
  - B. Maintenance net check marks.
  - C. Subscriber names.
  - D. CMD-AS net check marks.
  
7. The NET COMMUNICATIONS DIRECTORY has 32 lines for subscriber information. Lines 09 through 32 are usually reserved for \_\_\_\_\_.
  - A. battery subnets.
  - B. external subnets.
  - C. internal subnets.
  - D. administration subnets.

8. Columns 3, 4 and 5 of the NET COMMUNICATIONS DIRECTORY provides space for net designators. Each subscriber may be designated for \_\_\_\_\_.
- A. only 1 net.
  - B. only 2 nets.
  - C. any combination of 3 nets.
  - D. any combination of 4 nets.
9. The Local Communications Directory has space for five entries. Subscribers listed on the LCD may be \_\_\_\_\_.
- A. switchboard, messhall, command post.
  - B. orderly room, USAF, Battery Ø21.
  - C. supply room, HQDA, USAF.
  - D. Battery A, Battery B, Battery C.
10. The voice communications address directory provides space to list \_\_\_\_\_.
- A. battery grid coordinates.
  - B. subscribers' addresses.
  - C. subscribers' locations.
  - D. subscribers numbers.
11. How many digits are entered on the VCS keyboard when connecting a subscriber?
- A. 5
  - B. 4
  - C. 3
  - D. 2
12. What is the procedure used to release all subscribers from the OPNL NET?
- A. press OPNL NET and REL ALL.
  - B. press REL ALL.
  - C. press OPNL NET, REL, and REL ALL.
  - D. press REL ALL and KBD CLEAR.
13. The HOT MC/PTT switch is normally set to:
- A. PTT (push-to-talk) position.
  - B. HOT MC (hot microphone) position.
  - C. both positions - ON.
  - D. both positions - OFF.
14. The VOLUME control switch on the VCS is used to:
- A. adjust the sound level leaving the VCS.
  - B. adjust the microphone sound level.
  - C. adjust the sound level coming to the VCS.
  - D. adjust the sound level of the alarm.
15. Where is the push-to-talk switch located for the headset?
- A. There is no push-to-talk switch.
  - B. The switch is near the microphone.
  - C. The switch is a pedal on the floor.
  - D. The switch is on the VCS panel.

EXAMINATION HPO.20420-13  
INTERPRET SYSTEM DISPLAYS

TIME ALLOWED: 100 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

**DIRECTIONS:** This examination consists of 43 questions. Circle the correct answers. There is only one correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Immediately contact the facilitator when you have finished with the examination.

1. What is the main function of the AN/TSQ-73 Display Equipment?
  - A. Provide an interface between the AN/TSQ-73 and the operator.
  - B. Provide a machine to machine interface.
  - C. Provide a man to man interface.
2. What is the main function of the Data Display Group (DDG)?
  - A. Display radar and simulated video.
  - B. Display system status and fire unit data.
  - C. Display hostile and friendly tracks.
3. Which of the following is displayed on the console PPI?
  - A. Hooked Item Data.
  - B. System Status Data.
  - C. Summary Data ARO.
  - D. Radar Video.
4. Which group of controls is used to adjust the brightness of a symbol or video display?
  - A. Background Data Controls.
  - B. Brightness Controls.
  - C. Track Data Controls.
  - D. Video and ARO Controls.
5. Which of the following are valid console modes?
  - A. Track
  - B. Tac
  - C. Mon
  - D. Test
  - E. All of the above
6. Which of the following Display Console operations can be performed during the monitor mode?
  - A. Display Tracks.
  - B. Display Background Data.
  - C. Order Cease Fire.
  - D. Display Fire Unit Data in the ARO.
  - E. Answer A, B, and D.
7. Which of the following is a valid switch action in the tracking mode?
  - A. Weapons Tight
  - B. Weapons Free
  - C. Initiate
  - D. Cease Engagement
8. Which of the following functions are valid in the tracking mode?
  - A. Update
  - B. SEQ Hook
  - C. Clear Alert
  - D. All of the above

9. Which of the following tasks CAN NOT be performed in the test mode?
- A. Display Alignment
  - B. Offset Display
  - C. Check Symbol Accuracy
  - D. Check Symbol Brightness
10. What does the term "remote communications" refer to?
- A. Communications received from data links.
  - B. Communications received from your own AN/TSQ-73 site.
  - C. All communications received from field telephones.
11. A data mile equals 2000 yards; therefore seven data miles equals?
- A. 14000 yards
  - B. 1400 yards
  - C. 9000 yards
  - D. 900 yards
12. ECM symbols may be used to represent
- A. the known location of the ECM source.
  - B. the theoretical location of an ECM source.
  - C. both the known and theoretical location.
13. All Air Defense System Symbols have an associated alphanumeric data block.
- A. False
  - B. True
14. What is a Jam Strobe?
- A. A line that extends outward from the center of the track symbol.
  - B. A straight line originating at the site or track being jammed that extends downward about an inch.
  - C. A straight line originating at the site or track being jammed and extending through the jamming source to the edge of the situation display.
15. How many types of information are represented in the alphanumeric block of a fire unit site?
- A. 4
  - B. 3
  - C. 5
  - D. 6
16. How may a track number be changed once it is assigned?
- A. Fire Unit Order
  - B. Group Order
  - C. Manual Intervention
17. What is the Group Address for this track number?  
BA 454
- A. A
  - B. B
  - C. 454

18. What does the letter "Q" indicate in the alphanumeric example below?  
QC124

- A. The track is a group track.
- B. The track is from a remote source.
- C. The track is from Battalion Q.

19. Which of the following represents a TADIL-B track number?

- A. 2093
- B. AC21
- C. 2477
- D. 2497

NOTE: For the following three questions refer to Figure 2-28 of TM 10-2.

20. What position should the Memory 1 and Memory 2 switches on RIE Panel II be in prior to turning the power switch to the ON switch?

- A. Off-Line
- B. On-Line
- C. Off

21. What position should the Radar J-Box Switch be set to during preliminary control settings?

- A. FI ON
- B. FI INHIBIT

22. What position should the RDR/CPU On-Line/Off-Line switch be set to during preliminary control settings?

- A. Off-Line
- B. On-Line
- C. On

23. On which RIE Panel is the power control located?

- A. RIE Panel I
- B. RIE Panel II

24. What is the highest priority that can be assigned to a defended point?

- A. 3
- B. 2
- C. 5
- D. 1

25. If a Fire Unit is also designated as a defended point, will the defended point symbol be displayed?

- A. Yes
- B. No

26. During Control Command Entry Procedures, the console will display the keyword entries \_\_\_\_\_.
- A. in the ARO, top line.
  - B. in the ARO, bottom line.
  - C. in the ARO, Hooked Item Data Field.
  - D. on the DDG, bottom section.
27. When entering fixed point sites, the Control Command Entry switch must be pressed to?
- A. ON
  - B. OFF
28. The shift key on the console AN keyboard is \_\_\_\_\_.
- A. A momentary press switch.
  - B. a two-position switch.
  - C. pressed IN for letters.
  - D. used to "send" the command code.
29. The ARO displays a total of 512 alphanumeric characters comprised of
- A. 64 rows and 8 columns.
  - B. 8 rows and 8 columns.
  - C. 8 rows and 64 columns.
30. The data separation fields of the ARO display are identified by
- A. field separation mark "//".
  - B. data separation mark "=".
  - C. field data mark "X".
31. The contents of the Summary Data field is selected by
- A. Operator Switch Action
  - B. Computer Commands
  - C. the RIE Panel I controls
32. What does the alert status code of RL mean?
- A. responsible
  - B. reliability
  - C. released
33. The Hooked Item Data Field is displayed on the ARO between columns:
- A. 25-52.
  - B. 25-26.
  - C. 27-49.

34. Which of the track numbers in the example below is a TADIL-B track number?

Hooked Track Data ARO  
27-----49  
AB146,5246,AG234 R

- A. AB 146  
B. 5246  
C. AG234
35. The setting of the SPI bit is indicated by the letter \_\_\_\_\_?
- A. S in row 1, column 49.  
B. A in row 8, column 1.  
C. R in row 4, column 11.  
D. H in row 1, column 49.
36. To display the results of IFF Interrogations when the AN/TSQ-73 System is in the Beacon tracking Mode, the operator must select?
- A. ARO Data Selections - ALL FU.  
B. Video Selections - IFF-SIF.  
C. ARO Data Selections - Filter Data.  
D. Task Selections - Track Data.
37. To display information for all reported jam strobes by reporting source, the operator must select
- A. ARO Data Selections - ALL FU.  
B. Video Selections - IFF-SIF.  
C. ARO Data Selections - Jam by Report Source.  
D. Task Selections - Track Data.
38. To display Automatic Clutter Maps on the Display Console PPI the operator must
- A. select B SECT video.  
B. select NORMAL video.  
C. select A SECT video.  
D. select PROC video.
39. Into how many main areas is the Data Display Group (DDG) divided?
- A. 5  
B. 3  
C. 2
40. The DDG is capable of displaying summary information on how many assigned FU?
- A. 12  
B. 20  
C. 24  
D. 32

41. Which DDG indicator function is described below?

"Lights when defense conditions status is white alert, and may be changed by ADL message or control command entry."

- A. Series Regulator
- B. Operational Status - Wpns tight
- C. State of Alert - White

42. When the console alert "track limit" is on, it means that \_\_\_\_\_ percent of storage capacity has been reached.

- A. 70
- B. 80
- C. 90
- D. 100

43. Which one of the following TMs described the Console Alert Index?

- A. TM 9-1430-652-12
- B. TM 9-1430-652-10-1
- C. TM 9-1430-652-10-2
- D. TM 9-1430-652-10-3

EXAMINATION HPO. 20512-10  
PERFORM MONITOR OPERATION

TIME ALLOWED: 65 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 35 questions. Circle the correct answers. There is only one correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Immediately contact the facilitator when you have finished with the examination.

1. Which Console Mode is the Display Consoles in as a result of System Initialization?
  - A. Monitor
  - B. Test
  - C. Cease Fire
  - D. Trac/Tac
  
2. Which Background Data Display switch is activated as a result of System Initialization?
  - A. Safe Corrod
  - B. Jam Strobe
  - C. Angle Mark
  - D. Fixed Point Sites
  
3. Each angle mark is separated by \_\_\_\_\_ degrees.
  - A. 20
  - B. 15
  - C. 25
  
4. Which switch group is used to allow display of the local radar "picture"?
  - A. Video Brightness
  - B. Video Selections
  - C. ARO Data Selections
  - D. A/N Keyboard
  
5. To display NORMAL video on the PPI area of the AN/TSQ-73 CRT, the console operator must
  - A. adjust the NORMAL video brightness thumbwheel for a display brightness of 9.
  - B. press the video selection NORMAL video.
  - C. disable the video selection PROC (processed).
  
6. When the CONTROL CMD ENTRY ARO Selection is enabled on any console \_\_\_\_\_
  - A. the KPU is inhibited from entering control commands.
  - B. the ADP Control Panel is inhibited from entering control commands.
  - C. all remaining consoles are inhibited from entering control commands.
  - D. data for each data link is displayed in the ARO Summary Data Field.
  
7. To display data for all fire units of a designated status the AN/TSQ-73 operator must?
  - A. Enter the status designator on AN keyboard and press ARO Data Selections FU by STAT.
  - B. Enter the Battalion designator on AN keyboard and press ARO Data Selections FU by BN.
  - C. Press ARO Data Selections all FU.

8. When displaying background data showing 10-mile range marks, every \_\_\_\_\_ ring is intensified in brightness.
- A. second
  - B. third
  - C. fourth
  - D. fifth

NOTE: Use TM 9-1430-652-10-2 and 10-3 for the following 4 questions.

9. If located at a Battalion AN/TSQ-73, the \_\_\_\_\_ switch is pressed to display tracks originating at the DAR (defense acquisition radar).
- A. Local Manual - Unknown
  - B. Local Auto - Unknown
  - C. Q-73 RR - Unknown
  - D. Other Serv - Unknown
  - E. ATMS-TDS - Unknown
10. The use of VELOCITY VECTORS will indicate the speed and heading of a track. A vector length of one inch represents \_\_\_\_\_.
- A. 1,800 data miles per hour.
  - B. 180 data miles per hour.
  - C. 18,000 data miles per hour.
  - D. 18 data miles per hour.
11. SIM-TEST TRACKS switch is used to display which of the following?
- A. Local manual Sim Test tracks.
  - B. Local Auto Sim Test tracks.
  - C. Raid generated tracks.
  - D. All of the above.
12. The time-to-go vectors can be displayed for all FRIEND, UNKNOWN, and HOSTILE tracks at the same time.
- A. False
  - B. True
13. An individual fire unit can be designated for display with all fire units NOT displayed.
- A. True
  - B. False
14. In order to perform the Task Function of designating an individual EM (engagement marker) for display, which task selection must be pressed?
- A. Target Proc Param
  - B. Video Switch
  - C. PPI Data Entry
  - D. Track Data
  - E. ADL Data

AD-A121 416

EVALUATION OF THE C2 CAI CONSOLE OPERATOR TRAINING  
PROGRAM FOR MOS 16H10. (U) BATTELLE MEMORIAL INST  
COLUMBUS OH G L HULL 86 AUG 82 TDI-TR-82-6

2/2

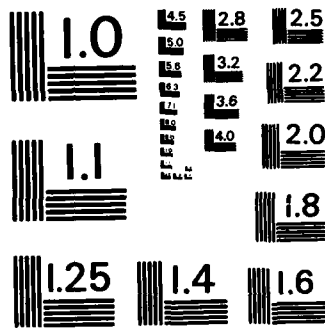
UNCLASSIFIED

F/G 5/9

NL


END

FORMED  
- -  
DTIC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

15. The CPLD FU switch under Fire Unit Data Display will allow which of the following?
- A. Display of site symbols for FU coupled to DDG.
  - B. Display of site symbols for FU coupled to console.
  - C. Display of Common Plane Directed Fire Units.
  - D. Display of Common-Purpose Label - Designator Fire Units.
16. The UNK/HOST switch for time-to-go vectors is a \_\_\_\_\_ position switch.
- A. Two
  - B. Three
  - C. Four
17. Which task selection switch allows entry of console filters?
- A. Ident IFF
  - B. Track Data
  - C. ADL Data
  - D. Status Board Data
  - E. PPI Data Entry.
18. When ALTITUDE filter is selected, all tracks outside the set limit are filtered out except \_\_\_\_\_.
- A. hostile and hooked tracks.
  - B. hooked, hostile, and priority tracks.
  - C. all hostile tracks.
  - D. hooked, special, and priority tracks.
  - E. hostile, true friend, and priority tracks.
19. To designate display of fire units by battalion, the battalion designator must be entered. Which of the following is a VALID battalion designator?
- A. PH
  - B. AT
  - C. BJ
  - D. AJ
  - E. BS
20. Which of the following is a correct entry for SPEED LIMITS filter setting for 610 data miles per hour to 990 data miles per hour?
- A. 6199
  - B. 061099
  - C. 061 099
  - D. 610990
  - E. 610 990
  - F. 99 0 61 0

21. Which Q-73 RR Links can be SELECTED or INHIBITED from DISPLAY at a BATTALION AN/TSQ-73 System. (Use TM 9-1430-652-10-2).
- A. 1, 2, 3, 4, 5, 6, and 7.
  - B. 3, 4, 5, 6, 7, 10, 11, 12, and 13.
  - C. 3, 4, 5, 6, and 7.
  - D. 1, 2, 3, 4, and 5.
  - E. 10, 11, 12, and 13.
22. Under the TASK SELECTION option of Q-73 REMOTE RADAR, the SUBORD FUS task function switch will be
- A. used by a group Q-73.
  - B. used by a battalion Q-73.
23. While using the VIDEO SWITCH task selection, the MAP 1 is designated from the console keyboard. What is the range of map designators allowed for a valid entry?
- A. 1-10.
  - B. 0-9.
  - C. A-K.
  - D. A-J.
24. Map 1 and Map 2 has been designated, yet no map is displayed (Select best description).
- A. That's not possible!
  - B. That's very possible!
  - C. System definitely has a fault!
25. What is the maximum number of maps that can be stored on one system tape?
- A. 2
  - B. 10
  - C. 1
  - D. 12
  - E. 20
  - F. 32
26. What is the FIRST step in building a Clutter Map?
- A. Press Target Proc Param.
  - B. Check the RIE switch settings.
  - C. Turn on video switches.
27. To erase a clutter map which is the last switch you press?
- A. Proc normal.
  - B. Proc MTI
  - C. Censor
  - D. Return to auto

28. What is the system G-sensitivity default value?
- A. 1
  - B. 3
  - C. 2
  - D. 5
29. To complete building a clutter map, which switch do you press last?
- A. Start AZ
  - B. Stop AZ
  - C. Gate complete
  - D. Return to Auto
30. What is the first step in changing the system G-sensitivity?
- A. Press G-sensitivity task functions.
  - B. Enter G-sensitivity on keyboard.
  - C. Press target proc param.
31. When entering Target Processing Parameters, the manual clutter map is built by \_\_\_\_\_.
- A. Battalion and group TSQ-73 System.
  - B. Group TSQ-73 Systems only.
  - C. Battalion TSQ-73 Systems only.
32. What is the limit for a manual clutter sector?
- A. 15 degrees
  - B. 45 degrees
  - C. 90 degrees
  - D. 180 degrees
  - E. 360 degrees
33. What is the effect of completing a PROC MTJ clutter gate?
- A. Only MTI video is designated to be processed in the gate.
  - B. All video except MTI will be processed in the gate.
  - C. No video will be processed in the gate.
  - D. Only hostile video will be processed in the gate.
34. To "erase" a manual clutter gate, the \_\_\_\_\_ switch is used.
- A. Censor
  - B. Gate complete
  - C. Return to Auto
  - D. Clear
  - E. De-hook
35. The INTERROGATE MODE switch under TGT PROC PARAM is used to set an IFF mode to be used by
- A. the BEACON tracking mode.
  - B. the RADAR tracking mode.
  - C. the SPECIAL VIDEO tracking mode.

EXAMINATION HPO.20610-6  
TRACKING OPERATIONS

TIME ALLOWED: 50 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 26 questions. Circle the correct answers. There is only one correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Contact the facilitator when you have finished with the examination.

Use TM 9-1430-652-10-3 to answer the following four questions.

1. While in the TRACKING mode, which one of the following TASK SELECTIONS can be selected?
  - A. Assign
  - B. Status Board Data
  - C. ADL Data
  - D. Engage Ripple
  
2. The first step in changing or entering TRACK DATA is to \_\_\_\_\_.
  - A. change the track number.
  - B. enter a track height.
  - C. press TASK SELECTIONS - VIDEO SWITCH.
  - D. press TASK SELECTIONS - TRACK DATA.
  
3. Height finder radar #1 reports a target that is 22,000 feet above the radar site. What would be the correct keyboard entry for that track height?
  - A. R1 22,000
  - B. R1 022
  - C. RØ1 22000
  - D. RØ1 022
  
4. A local manual track symbol is flashing. What is a valid reason for this alert?
  - A. The track has to be updated.
  - B. The track is a hostile.
  - C. The track is a friend.
  - D. The track has to be dropped.
  
5. When manually initiating a track using a pre-selected ATDL-1 track number
  - A. the preassigned track numbers may be the same as a current number in the track file.
  - B. The preassigned track number may NOT be the same as a current number in the track file.
  
6. Manually updating an AUTO TRACK will cause
  - A. an illegal action alert.
  - B. the track symbol to move designated location.
  - C. the AUTO TRACK to change to RAMIT.
  - D. Both B and C.
  
7. Manual velocity and heading entries are not valid for tracks in the auto-tracking mode.
  - A. True
  - B. False

8. The last digit of a track alphanumeric block indicates
- A. tracking mode or track quality.
  - B. raid size.
  - C. track heighth.
9. When entering the fixed point site symbology for an airfield, the symbol code that would be entered on the AN keyboard is
- A. A
  - B. T
  - C. O
  - D. R

NOTE: Figure 4-29 of TM 9-1430-652-10-3 may be used as a reference in answering the next five questions.

10. What technical manual would be used as a reference to ID Amplification Code entries?
- A. TM 9-1430-652-10-4
  - B. TM 9-1430-652-10-5
  - C. TM 9-1430-652-10-6
  - D. TM 9-1430-652-10-7
11. When an auto-track is changed to a SIM-TEST track
- A. automatically initiated tracks cannot be changed to SIM-TEST.
  - B. the IFF information contained in row 7 of the hooked track data in the ARO is cleared.
  - C. the last character of the second line of the track alphanumeric block becomes a T.
12. The range for Mode 1 entries when entering IFF data on the AN keyboard is
- A. 00 - 73
  - B. 0000 - 9999
  - C. 0000 - 7777
13. Where in the hooked track data field do you look for ID information?
- A. Row 7, column 31 and 32.
  - B. Row 7, column 34 thru 37.
  - C. Row 7, column 39 thru 42.
  - D. Row 2, column 36 thru 39.
14. The Mode 4 response of NI means the target
- A. no response.
  - B. has not be interrogated.
  - C. had normal interrogation.
  - D. is a true friend.

NOTE: Figure 4-39 of TM 9-1430-652-10-3 may be used as a reference in answering the next questions.

15. Prior to Mode 4 interrogation the
  - A. track to be interrogated must be hooked.
  - B. interrogation mode must be designated.
  - C. tab marker must be positioned to the center of the sector to be interrogated.
  
16. When using the TPX-46, how many modes may be designated for interrogation?
  - A. 1
  - B. 2
  - C. 3
  
17. When using the Console Hooking Procedures - GEOREF, how many characters must be entered on the AN keyboard to enter the GEOREF?
  - A. 4
  - B. 6
  - C. 8
  
18. When task Function Dehook is pressed, the Hooked Item Message is removed from the ARO.
  - A. True
  - B. False
  
19. Manual Initiation of a track must be performed in the tracking mode only.
  - A. True
  - B. False
  
20. When manually updating a track, the update position must be within \_\_\_\_\_ data miles of the previous location.
  - A. 8
  - B. 12
  - C. 64
  - D. 100
  
21. When entering height data on the AN keyboard, the source \_\_\_\_\_ separated from the value by a space.
  - A. is
  - B. is not
  
22. When entering a fixed point site the GEOREF MUST first be entered on the AN keyboard before positioning the tab marker to the desired location on the PPI?
  - A. True
  - B. False

23. When assigning a site a non-transmittable address and name
- A. the site address must be numeric only (0000 - 9999).
  - B. the site name must be alpha characters only (AAAA - ZZZZ).
  - C. the site name and the site address can be alphanumeric (0000 - 9999, AAAA - ZZZZ).
24. Jam strobes entered from your own site
- A. require an azimuth entry on AN keyboard.
  - B. require positioning of tab marker along azimuth where jam strobe is to be located.
  - C. require either A or B.
25. To drop a Fire Unit
- A. your console must be in the MONITOR mode.
  - B. you must hook the Fire Unit and press DROP once.
  - C. two drop actions in succession are required.
26. When sequence hooking alerts, the Hook Symbol appears around the track fire unit, or jam strobe and information about the alert condition appears in row \_\_\_\_\_ of the Hooked Item Data Field of the ARO.
- A. 1
  - B. 7
  - C. 8
  - D. 9

EXAMINATION HPO.20712-9  
TACTICAL OPERATIONS W/RAID

TIME ALLOWED: 90 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 40 questions. Circle the correct answers. There is only one correct answer for each question. Make thorough erasures when necessary. This examination requires 100% accuracy. Immediately contact the facilitator when you complete the examination.

1. Which light will come on if the Track/Tac switch is pressed twice in a row?
  - A. Tac only.
  - B. Track only.
  - C. Both track and tac.
  
2. Which ONE of the following contains a correct DDG row DESIGNATION/LOCATION?
  - A. Row 10 - LEFT status.
  - B. Row 9 - RIGHT status panel.
  - C. Row 30 - RIGHT status panel.
  - D. Row 1 - LEFT status panel.
  
3. Select a switch which is used when a change in the missile count is made.
  - A. FU ALERT STATUS
  - B. Status Board Data
  - C. FU Status
  - D. Assign Row Number
  - E. Video Switch

4. The following information is displayed across one row of the DDG: (NOTE: \* Represents a blank display).

C061H0 \*\*\*\*\*00907 Which of the following is a true statement?

- A. FU C06 is at a One Hour alert status.
- B. FU C06 is 9 Hot Missiles and 0 Cold Missiles.
- C. FU C061 is Out of Action.
- D. FU C06 is at Operating status.
- E. RU C061 is at a One Hour status.

Use TM 9-1430-652-10-3 to answer the following four questions.

5. Which one of the following is first required to move fire unit A12 from one row of the DDG to another row?
  - A. The fire unit must be hooked.
  - B. "A12 CLEAR" must be entered on the keyboard.
  - C. "A12 00" must be entered on the keyboard.
  - D. "A12 01 00" must be entered on the keyboard.
  
6. The fire unit alert status is determined by which one of the following?
  - A. Data Line-Computer assignment.
  - B. Voice communication.
  - C. SOP of the unit.
  - D. Answers B and C.
  - E. Answers A, B, and C.

7. When the MSLS EXPENDED switch is pressed the missile count for HOT missiles will decrease in \_\_\_\_\_.
- A. the DDG, ARO hot missile count, and ARO weapons total count.
  - B. the DDG only.
  - C. the ARO only.
  - D. the DDG and ARO hot missile count only.
8. The maximum cold missile count is?
- A. 127
  - B. 31
  - C. 20
  - D. 999
9. What does the Intrg Auto/Manual switch control?
- A. Enables automatic IFF interrogation.
  - B. Inhibit automatic IFF interrogation.
  - C. Both of the above.
10. When the INITATE AUTO/MANUAL switch is in the auto position, does the computer use Radar returns or IFF returns to initiate tracks?
- A. Radar
  - B. IFF
  - C. Both A & B
11. What type of aircraft can you assign to a fire unit in Weapons Tight?
- A. Friend
  - B. Unknown
  - C. Hostile
12. What is the number of categories that can be entered for sequence hooking?
- A. 4
  - B. 5
  - C. 6
  - D. 7
13. After offsetting the scope, can you return to normal center by pressing the Center/Offset switch?
- A. Yes
  - B. No
14. What expansion scale will the console be in after a console reset or power-up?
- A. 1
  - B. 1/2
  - C. 1/4
  - D. 1/8

15. To cause the center of the radar sweep to be at the LOWER edge of the display screen \_\_\_\_\_.
- A. the tab ball is moved to the LOWER edge and designate offset.
  - B. the radar set needs to be re-adjusted.
  - C. the RIE in the TSQ-73 needs to be re-adjusted.
  - D. the tab ball is moved to the TOP edge and designate offset.
16. Which of the following lists contains all the correct SEQUENCE HOOK criteria keyboard entries.

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
H	H	H	H
E	E	E	E
L	L	L	L
P	P	P	P
M	R	F	D
Y	I	A	O
C	N	T	
A	G		
R			

17. To position hook a fire unit, the fire unit address must be known.
- A. True
  - B. False
18. If the Fourth Letter in the second row of the Track Alphanumerics is a "M", what does this signify?
- A. A Raid size of Many.
  - B. A Manual initiated track.
  - C. A Marginal priority track.
  - D. A Manual IFF response
19. Are low targets priority tracks given a recommended assignment?
- A. Yes.
  - B. No.
20. Data link message for a secondary assignment is sent a fire unit.
- A. True
  - B. False
21. What is required when using the CLEAR ALERT switch?
- A. The track must be hooked.
  - B. The Fire Unit must be hooked.
  - C. The track must be dropped.
  - D. The Fire Unit must be dropped.

22. Which command is used to STOP an engagement on a friendly track?
- A. Hold Fire.
  - B. Cease Fire.
  - C. Cease Engagement.
23. When assigning weapons in the automatic mode, which switch must be pressed?
- A. ADL Data
  - B. ADL Address
  - C. Engage
  - D. Cmd Code
  - E. Accept Recmd Assign
24. What is the procedure to manually assign a hostile track to a specific fire unit?
- A. Hook fire unit, hook track, and press assign.
  - B. Hook track, hook fire unit, and press assign.
  - C. Press assign, hook fire unit, press engage.
  - D. Press assign, hook track, press engage.
  - E. Press assign, press engage, hook track.
25. Following cancellation of a secondary assignment, the following visual indication can be seen.
- A. The solid pairing line disappears.
  - B. The ALERT lamp illuminates.
  - C. The CANCEL lamp illuminates.
  - D. The ARO secondary assignment starts flashing.
  - E. The dashed pairing line disappears.
26. During operations of the console, the HOLD FIRE switch was pressed which prevents further assignments to the fire unit. What is now required to resume normal operations?
- A. The clear STATUS switch must be pressed.
  - B. The clear ALERT switch must be pressed.
  - C. The clear EFFECT switch must be pressed.
  - D. The CLEAR HOLD FIRE switch must be pressed.
27. A JAM STROBE is entered FROM \_\_\_\_\_.
- A. own location only.
  - B. own location, or fixed point sites only.
  - C. own location, fixed point sites, or fire units only.
  - D. own location, hookable fixed point sites or tracks.
28. A JAM STROBE is eliminated from the display by which of the following:
- A. Erase Jam Strobe switch only.
  - B. Drop switch only.
  - C. DEHOOK switch only.
  - D. DROP or ERASE JAM STROBE switches.
  - E. DEHOOK or ERASE JAM STROBE switches.

29. How many POINTERS may be sent over ADL at one time.
- A. 1 pointer at a TIME.
  - B. 1 pointer for each Fire Unit.
  - C. 1 pointer for each Track.
  - D. 1 pointer for each Data Link.
  - E. 1 pointer for each Fixed Point Site.
30. SALVO command is not valid for local Fire Units.
- A. True
  - B. False
31. The \_\_\_\_\_ configuration is required to operate a RAID tape.
- A. CC20 or 24
  - B. CC21 or 25
  - C. CC25 or 27
  - D. CC25 or 26
32. How many simulated fire units can be entered to operate against a raid?
- A. Maximum of twelve.
  - B. Maximum of eight.
  - C. Maximum of thirty-two.
33. During RAID Tape Operation, what happens to the System Tape during the data recording option?
- A. It is put in WRITE position.
  - B. It is moved to the lower MTU.
  - C. It is used as the SCRATCH tape.
  - D. It is removed.
34. Which of the following is a "legal" name for a RAID?
- A. MAINBATTLE.
  - B. SPACEWAR.
  - C. HEROMAKER.
35. To terminate a RAID, the following command is entered:
- A. CC17
  - B. CC30
  - C. CC104 4 MLU 0
  - D. CC25 or CC26
36. While operating against a RAID, the following actions can be performed.
- A. Manual track initiate.
  - B. RAMIT track update.
  - C. Manual weapons assignment.
  - D. (All of the above)

37. (RAID Tape Operations is shown in TM 9-1430-652-10-3 as figure 7-2).  
That figure indicates that raids begin at:

- A. 00 01 00 Hours
- B. 00 00 00 Hours
- C. 00 00 01 Hours

38. A live fire unit can be used for raid tape operations if it is not on an active link.

- A. Yes, if it is dropped!
- B. Yes!
- C. No Way!

HPO.20712-3

39. If the range of the PPI is 512 data miles in the 1 scale, what is the range of the PPI display in the 1/8 range scale?

- A. 64 data miles.
- B. 4096 data miles.
- C. 496 data miles.
- D. 640 data miles.

HPO.20712-4

40. To number hook a fixed point site \_\_\_\_\_.

- A. 2 characters are entered on the keyboard.
- B. 3 characters are entered on the keyboard.
- C. 2 or 3 characters are entered on the keyboard.

EXAMINATION HPO.20809-6  
PROCESS DATA LINK MESSAGES

TIME ALLOWED: 110 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 30 questions. Circle the correct answer for each question. Make thorough erasures, when necessary. This examination requires 100% accuracy. Contact the facilitator when you complete the examination.

1. What are the two types of communication used in the AN/TSQ-73 System?
  - A. OPNL NET and CMD AD communications.
  - B. MAINT and LOCAL COMM communications.
  - C. Data and voice communications.
  
2. Which data link format is used to communicate with Fire Units ONLY?
  - A. MBDL
  - B. IA/TB
  - C. NATO
  
3. Which data link format is used to communicate with Fire Units, ATMS, TOS, and other AN/TSQ-73 Systems?
  - A. SP
  - B. IA/TB
  - C. NATO
  - D. MBDL
  
4. Which data link format is used to communicate with other services?
  - A. MBDL
  - B. NATO
  - C. SP
  - D. IA/TB
  
5. Which data link format is NOT USED?
  - A. SP
  - B. IA/TB
  - C. MBDL
  
6. As an AN/TSQ-73 console operator, what two types of information do you send to a Fire Unit in either MBDL or ATDL-1 format?
  - A. Command and Reference Data.
  - B. Command and Status Data.
  - C. Status Data only.
  
7. As an AN/TSQ-73 operator, what type of information do you receive from a Fire Unit?
  - A. Command Information
  - B. Status Data.
  - C. Reference Data.
  
8. Which of the following is a Command Message?
  - A. Cease Fire
  - B. Cover
  - C. Neither A nor B
  - D. Both A and B

9. Which of the following is/are Action Management messages?
- A. FORCE TELL
  - B. EMERGENCY TELL
  - C. INFO DIFF REPORT
  - D. All of the above.
10. What is the FIRST action required to react to the following condition?
- "Special track begins flashing on PPI and the console alert 'ACTION REQD' illuminates."
- A. Press Task Functions - ADL DATA.
  - B. Press Task Selections - CMD CODE.
  - C. Hook the track.
11. What is the first step required to send the Operational Status Command Message - Weapons tight?
- A. Enter WT on AN.
  - B. Press Task Selections - ADL DATA.
  - C. Press Task Functions - CMD CODE.
  - D. Hook the site.
12. To reference an Individual track you must hook the track before you hook the FU.
- A. True
  - B. False
  - C. Doesn't make any difference.
13. To send the Action/Management Message Emergency tell, you must first
- A. enter S on AN keyboard.
  - B. enter L on AN keyboard.
  - C. Hook track.
  - D. Hook site.
  - E. Press Task Selections - ADL DATA.
14. How many pointers is the AN/TSQ-73 capable of displaying at a time?
- A. 1
  - B. 2
  - C. 3
  - D. 4
15. Can the AN/TSQ-73 console operator at the sending site see the pointer on his PPI?
- A. Yes
  - B. No

16. What happens when ANY of the Task Functions Reference-Dereference switches are activated for the second time?
- A. Tracks become referenced.
  - B. Tracks become dereferenced.
  - C. Track will become a special.
17. What type of symbol will referenced tracks have?
- A. Flashing
  - B. Solid
  - C. Dashed
  - D. All referenced tracks become unknown.
18. Which of the following is an indication that you have received a Command message?
- A. Action Required indicator lights.
  - B. Illegal Action indicator lights.
  - C. Attn Required indicator lights.
19. The AN keyboard entry of AD when sending an Action Management Message means:
- A. Information Difference Report
  - B. Data upon Request
  - C. Cease Reporting
  - D. Change Data Order
20. What actions are required to comply with the message shown below?

Conditions:

-Action Required Alert on console.

-Special purpose air track symbology on PPI with the following alphanumeric:

AB070  
HCRF7

ROWS	HOOKED TRACK DATA ARO COL
	27 -----49
1	AC070,4326, 1 R7,
2	C: ID:H314 TRT:1F
3	SRCE: , PRJDF2
4	SP:065 HD:080 ALT:01
5	HF1:R085,A285 P:AB00
6	HF2:R126,A329 S:
7	IFF: , , NI,
8	ALERT:ER:RESPREQD,GD

- A. Press Task Functions Clear Alert, and take appropriate action IAW unit SOP.
- B. Press Task Selections ADL DATA, enter Compliance Code on AN keyboard, press Task Functions Compliance Code, press Task Functions Clear Alert, and take appropriate action IAW unit SOP.

21. What actions are required to comply with the message shown below?

Conditions:

-Attn Required Alert on console.

-Special purpose air track symbology on PPI with the following alphanumerics:

AC067  
HCF57

```
                HOOKED TRACK DATA ARO
ROWS    COL
27 -----49
  1    AC067,4326,      R7, ,
  2    C:   ID:H314 TRT:1S N
  3    SRCE:   ,      PRJDF2030
  4    SP:065 HD:080 ALT:018,E
  5    HF1:R085,A285 P:AB002,E
  6    HF2:R126,A329 S:   ,
  7    IFF:   ,   ,   ,NI,
  8    ALERT:CF:NOTREQD,GD
```

- A. Press Task Functions Clear Alert, and take appropriate action IAW unit SOP.
- B. Press Task Selections ADL DATA, enter Compliance Code on AN keyboard, press Task Functions Compliance Code, press Task Functions Clear Alert, take appropriate action IAW unit SOP.

22. Which of the following action(s) are used to comply with the change data message described below?

Conditions:

-Action Required Alert on console.

-Special purpose air track symbology on PPI with the following alphanumerics:

AB120  
FACS7

-Hooked Track Data ARO looks like this:

```
ROW    COL
27-----49
  8    ALERT:CHGID:F000,GA
```

- A. Send a Compliance Code.
- B. Press Task Function Clear Alert.
- C. Take appropriate SOP action.
- D. Both B and C.

23. In order to comply with the information difference message shown below, you must first:

- A. Press Task Function Clear Alert.
- B. Send a Compliance Code.
- C. Change ID of the track.
- D. None of the above.

Conditions:

- Action Required Alert on console.
- Special purpose air track symbology on PPI with following alphanumerics:

AC123  
UAD57

-Hooked Track Data ARO looks like this:

ROW	COL
27	-----49
8	ALERT:INFODIF:H000,GD

24. What action is required when complying with the message shown here?

Conditions:

- Special purpose priority air track symbology on PPI with the following alphanumerics:

AA069  
HE1U5

-Hooked Track Data ARO looks like this:

ROW	COL
27	-----49
1	AA069,4326, R5,E,S
2	C: ID:H314 TRT:1UO N
3	SRCE: , PRJDF2030
4	SP:065 HD:080 ALT:01 ,A
5	HF1:R085,A285 P: ,
6	HF2:R126,A329 S: ,
7	IFF: , , ,NI,
8	ALERT:

- A. No action is required.
- B. Take appropriate unit (tactical) SOP action.

25. The Reference-Dereference source code G means?

- A. Battalions
- B. Groups
- C. Other services

26. The Task Function - Engage switch is pressed during an "ASSIGN WEAPONS" command message for:
- A. Ripple fire
  - B. Cover
  - C. Assign/Investigate
27. You are sending a Terminate Command - Hold Fire by entering the command code HF on the AN keyboard. You must press the:
- A. Task Function - ADL ADRS switch.
  - B. Task Function - CMD CODE switch.
  - C. System Mode - HOLD FIRE switch.
28. The two types of Operational Status command messages are:
- A. CMD CODE and ADL ADRS
  - B. WEAPONS FREE and WEAPONS TIGHT
  - C. HOLD FIRE and CEASE FIRE
29. The Action/Management message "FORCE TELL REQUEST" is entered on the AN keyboard as code:
- A. P
  - B. R
  - C. F
30. Sending an Action/Management message Code (T) will cause:
- A. the track symbol to revert to Track ID.
  - B. special track symbol to flash.
  - C. data banks to be purged.

EXAMINATION HPO.20911-7  
RAPID RIE ALINEMENT/VERIFICATION

TIME ALLOWED: 145 Minutes

NAME/RANK \_\_\_\_\_

STUDENT NO. \_\_\_\_\_

DATE \_\_\_\_\_

TIME START \_\_\_\_\_

TIME FINISHED \_\_\_\_\_

DIRECTIONS: This examination consists of 30 questions. Circle the correct answer for each question. Make thorough erasures, when necessary. This examination requires 100% accuracy. Contact the facilitator when you complete this examination.

1. What AN/TSQ-73 Equipment enables the system to interface with a wide variety of Radars?
  - A. Radar Interface Equipment (RIE)
  - B. Automatic Data Processing Equipment (ADPE)
  - C. Console
  - D. Voice Communications Central (VCC)
  
2. Which device links the AN/TSQ-73 shelter with its associated radar and IFF equipment?
  - A. Radar Interface Equipment (RIE)
  - B. Automatic Data Processing Equipment (ADPE)
  - C. Radar Junction Box (RJB)
  - D. Console
  
3. Which subunit directs VIDEO traffic within the RIE?
  - A. Radar Interface Unit (RIU)
  - B. IFF Interface Unit (IIU)
  - C. Video Simulator Unit (VSU)
  - D. Video Distribution Unit (VDU)
  
4. Which RIE subunit provides the range and azimuth information?
  - A. Radar Interface Unit (RIU)
  - B. IFF Interface Unit (IIU)
  - C. Video Processor Unit (VPU)
  - D. Display Interface Unit (DIU)
  
5. Which subunit of the Radar Interface Equipment provides the interface for exchange of data to and from the IFF equipment?
  - A. IFF Interface Unit (IIU)
  - B. Video Distribution Unit (VDU)
  - C. Video Processor Unit (VPU)
  - D. Display Interface Unit (DIU)
  
6. Which subunit of the Radar Interface Equipment (RIE) converts raw radar video into processed video?
  - A. IFF Interface Unit (IIU)
  - B. Video Simulator Unit (VSU)
  - C. Display Interface Unit (DIU)
  - D. Video Processor Unit (VPU)
  
7. Which subunit of the Radar Interface Equipment provides simulated targets for RAID exercises?
  - A. Video Simulator Unit (VSU)
  - B. IFF Interface Unit (IIU)
  - C. Video Distribution Unit (VDU)
  - D. Video Processor Unit (VPU)

8. Where do radar signals coming from the Radar Junction Box (RJB) enter the AN/TSQ-73 shelter?
  - A. Radar Demarkation Panel
  - B. Communication Demarkation Panel
  - C. Environmental Demarkation Panel
  - D. Power Demarkation Panel
  - E. Remote Display Demarkation Panel
  
9. Which switch controls power to the RIE I and RIE II panels?
  - A. RDR/CPU ON LINE/OFF LINE switch
  - B. POWER ON/OFF switch
  - C. INTEGRATED ON/OFF switch
  - D. BITE switch
  
10. Following initialization of the system, what is the position of the MEMORY 1 switch on the RIE II panel?
  - A. OFF
  - B. OFF-LINE
  - C. ON LINE
  
11. Which two TM's are used for reference to initialize and align the RIE?
  - A. TM 9-1430-652-10-3 and 10-5
  - B. TM 9-1430-652-10-2 and 10-6
  - C. TM 9-1430-652-10-4 and 10-7
  - D. TM 9-1430-652-10-3 and 10-7
  
12. Prior to RIE power on, what is the PRELIMINARY control setting for HIPAR alignment for the MODE INTERLACE switch?
  - A. Off
  - B. 1
  - C. 2.3
  - D. 3
  
13. The guide used by you to set the RIE switches is the?
  - A. TM 9-1430-652-10-3
  - B. TM 38-750
  - C. Data Sheet
  
14. The mode interlace switch is located on the?
  - A. RIE I Panel
  - B. RIE II Panel
  - C. RJB Panel
  
15. The SIF alignment switch located on RIE Panel I is called a?
  - A. Window switch
  - B. Value switch
  - C. Thumbwheel switch

16. The MTI/NORMAL gate range adjustment is adjusted:
- A. By organizational maintenance
  - B. By operator personnel
  - C. By motor pool personnel
17. The "MISALIGNED" indicator on RIE panel I should normally be?
- A. Lit
  - B. Not Lit
  - C. Blinking
18. The system initialization and RIE alignment is performed \_\_\_\_\_.
- A. At any time.
  - B. Before Radar/IFF operation VERIFICATION.
  - C. After Radar/IFF operation VERIFICATION.
19. PPI landmarks or CLUTTER are compared to:
- A. Other AN/TSQ-73 Systems display.
  - B. Local Radar PPI display.
  - C. Military maps of the same area.
20. When checking COMP VIDEO (compressed video), what difference is acceptable?
- A. Slight shift of target position is OK.
  - B. Slight difference in intensity is OK.
  - C. Slight change of number of target is OK.
  - D. Absolutely no differences are allowed.
21. When verifying Identification-Friend or Foe operations, what type of video is selected at the console?
- A. Test
  - B. Special
  - C. Normal
  - D. IFF/SIF
  - E. A Sect
22. The video selection to check processed video is made \_\_\_\_\_.
- A. from the console.
  - B. from RIE panel II.
  - C. from the KPU.
23. Which one of the following informs the operator that a subsystem failure has occurred?
- A. An action/management message.
  - B. A command message.
  - C. The ADP alarm sounds.
  - D. The DDG alarm sounds.

24. Which of the following is a system STATUS message?
- A. TMON Fault.
  - B. INFO Difference Report.
  - C. Action/management message.
  - D. Site Adaption Report.
25. To locate a fault, which of the following is checked?
- A. Fault Location Indicator - DDG
  - B. Diagnose Status Indicators - ADP
  - C. System Status Messages - KPU
  - D. All of the above
26. What is the faulty device number for a TMON of 700240?
- A. 70
  - B. 40
  - C. 24
27. When turning off the system, the FIRST action is to move the POWER SOURCE SELECT switch to the OFF position.
- A. False
  - B. True
28. How many memory units are there in the RIE?
- A. NONE
  - B. 1
  - C. 2
  - D. 3
29. The CLUTTER MAPPER is part of:
- A. the RIE
  - B. the ADP
  - C. the KPU
  - D. the DDG
30. The BITE switch on RIE Panel II is the \_\_\_\_\_ switch.
- A. Built-In-Target-Enquiry
  - B. Basic Integrated-Target-Evaluation
  - C. Balance-Inserted-Target-Exit
  - D. Build-In-Test-Equipment

APPENDIX B

PRACTICAL EXAM

PRACTICAL EXAM

Copies of the practical Exams can be obtained from US  
Army Air Defense School, Fort Bliss, Texas.

APPENDIX C

Student CAI Usage Log

STUDENT  
CAI USAGE LOG

COURSE: Console Operator Training for MOS 16H10 OSUT

STUDENT: \_\_\_\_\_

Date	Lesson/task#	Start	End	No. of Times Instructor Intercedes*					
				1	2	3	4	5	More than 5

\*The instructor should record a check mark (✓) each time the student is halted on his/her error rate.

APPENDIX D

Student End-of-Course  
Questionnaire

STUDENT

END-OF-COURSE QUESTIONNAIRE

COURSE: Console Operation Training for MOS 16H10 OSUT

DATE: \_\_\_\_\_  
                    Day                                    Month                                    Year

DIRECTIONS: This questionnaire is designed to allow you to record your reactions to the course that you have just completed. As a user of the materials, you are in the best position to judge the value and the effectiveness of the course. Please complete this questionnaire to the best of your ability by responding to every question.

1. How do you think your speed of learning with lessons using Computer Assisted Instruction (CAI) compared to your speed of learning with lessons using other forms of media?

- \_\_\_\_\_ 1. Learned much faster when using CAI.
- \_\_\_\_\_ 2. Learned faster when using CAI.
- \_\_\_\_\_ 3. Learned about the same when using CAI.
- \_\_\_\_\_ 4. Learned slower when using CAI.
- \_\_\_\_\_ 5. Learned much slower when using CAI.

Comments:

2. I felt more confident about learning from lessons using CAI than I did from lessons using other forms of media.

- \_\_\_\_\_ 1. Agree.
- \_\_\_\_\_ 2. Somewhat Agree.
- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Somewhat Disagree.
- \_\_\_\_\_ 5. Disagree.

Comments:

3. The lessons using CAI kept my attention more adequately than did lessons using other forms of media.

- \_\_\_\_\_ 1. Agree.
- \_\_\_\_\_ 2. Somewhat Agree

- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Somewhat Disagree.
- \_\_\_\_\_ 5. Disagree.

Comments:

4. Do you feel you were personally able to learn more adequately with lessons using CAI as compared to lessons using other forms of media?

- \_\_\_\_\_ 1. Learned much more adequately with CAI.
- \_\_\_\_\_ 2. Learned more adequately with CAI.
- \_\_\_\_\_ 3. Learned about the same with CAI.
- \_\_\_\_\_ 4. Learned less adequately with CAI.
- \_\_\_\_\_ 5. Learned much less adequately with CAI.

Comments:

5. How do you think you were able to perform the tasks, learned from CAI lessons, during the practical exercise, as compared to tasks learned from other media?

- \_\_\_\_\_ 1. CAI lessons greatly increased my performance.
- \_\_\_\_\_ 2. CAI lessons increased my performance.
- \_\_\_\_\_ 3. CAI lessons did not change my performance.
- \_\_\_\_\_ 4. CAI lessons decreased my performance.
- \_\_\_\_\_ 5. CAI lessons greatly decreased my performance.

Comments:

6. What is your opinion of the lessons taught by CAI in the course that you have just completed as compared to other non-CAI courses in which you have previously been enrolled?

- \_\_\_\_\_ 1. Much better than other courses.
- \_\_\_\_\_ 2. Better than other courses.
- \_\_\_\_\_ 3. Little or no difference from other courses.

- \_\_\_\_\_ 4. Worse than other courses.
- \_\_\_\_\_ 5. Much worse than other courses.

Comments:

7. What is your opinion of the total course (all media, including CAI) that you just completed as compared to other courses in which you have previously been enrolled?

- \_\_\_\_\_ 1. Much better than other courses.
- \_\_\_\_\_ 2. Better than other courses.
- \_\_\_\_\_ 3. Little or no difference from other courses.
- \_\_\_\_\_ 4. Worse than other courses.
- \_\_\_\_\_ 5. Much worse than other courses.

Comments:

8. Would you like to take future courses which use CAI?

- \_\_\_\_\_ 1. Would very much like to use CAI.
- \_\_\_\_\_ 2. Would like to use CAI.
- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Would not like to use CAI.
- \_\_\_\_\_ 5. Would very much not like to use CAI.

Comments:

9. What is your opinion about the introduction that you received on how to use the CAI lessons?

- \_\_\_\_\_ 1. Most effective introduction.
- \_\_\_\_\_ 2. Effective introduction.
- \_\_\_\_\_ 3. Undecided about the introduction.
- \_\_\_\_\_ 4. Ineffective introduction.
- \_\_\_\_\_ 5. Most ineffective introduction.

Comments:

10. Compared with other training equipment that you have used (slide projectors, tape recorders and etc.), CAI micro-computers seemed to perform:

- \_\_\_\_\_ 1. Much better than other training equipment.
- \_\_\_\_\_ 2. Better than other training equipment.
- \_\_\_\_\_ 3. About the same as other training equipment.
- \_\_\_\_\_ 4. Worse than other training equipment.
- \_\_\_\_\_ 5. Much worse than other training equipment.

Comments:

11. What did you like about the CAI parts of the course? \_\_\_\_\_

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12. What did you dislike about the CAI parts of the course? \_\_\_\_\_

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APPENDIX E

Instructor End-of-Course  
Questionnaire



\_\_\_\_\_ 4. Somewhat Disagree.

\_\_\_\_\_ 5. Disagree.

Comments:

4. How do you feel your students' learning needs were met in lessons using CAI as compared to lessons using other forms of media?

\_\_\_\_\_ 1. Needs were met much more with CAI.

\_\_\_\_\_ 2. Needs were met more with CAI.

\_\_\_\_\_ 3. Needs were met about the same with CAI.

\_\_\_\_\_ 4. Needs were met less with CAI.

\_\_\_\_\_ 5. Needs were met much less with CAI.

Comments:

5. How do you think your students were able to perform the tasks, which were learned from CAI lessons, during the practical exercises as compared to tasks learned from other media?

\_\_\_\_\_ 1. CAI lessons greatly increased their performance.

\_\_\_\_\_ 2. CAI lessons increased their performance.

\_\_\_\_\_ 3. CAI lessons did not change their performance.

\_\_\_\_\_ 4. CAI lessons decreased their performance.

\_\_\_\_\_ 5. CAI lessons greatly decreased their performance.

Comments:

6. What is your opinion of the CAI lessons in the course that you have just finished instructing as compared to other non-CAI courses in which you have taught?

\_\_\_\_\_ 1. Much better than other courses.

\_\_\_\_\_ 2. Better than other courses.

\_\_\_\_\_ 3. Little or no difference from other courses.

- \_\_\_\_\_ 4. Worse than other courses.
- \_\_\_\_\_ 5. Much worse than other courses.

Comments:

7. What is your opinion of the total course that you have just finished teaching as compared to other courses which you have previously taught?

- \_\_\_\_\_ 1. Much better than other courses.
- \_\_\_\_\_ 2. Better than other courses.
- \_\_\_\_\_ 3. Little or no difference from other courses.
- \_\_\_\_\_ 4. Worse than other courses.
- \_\_\_\_\_ 5. Much worse than other courses.

Comments:

8. Do you feel that your students were able to use the CAI lessons without too much assistance from you?

- \_\_\_\_\_ 1. Very much able to work without assistance.
- \_\_\_\_\_ 2. Able to work without assistance.
- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Not able to work without assistance.
- \_\_\_\_\_ 5. Very much not able to work without assistance.

Comments:

9. What would you think of having some of the non-CAI lessons of this course developed into CAI lessons?

- \_\_\_\_\_ 1. Would very much like to increase CAI lessons.
- \_\_\_\_\_ 2. Would like to increase CAI lessons.
- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Would not like to increase CAI lessons.
- \_\_\_\_\_ 5. Would very much not like to increase CAI lessons.

Comments:

10. Would you like to instruct courses in the future which use CAI?

- \_\_\_\_\_ 1. Would very much like to instruct with CAI.
- \_\_\_\_\_ 2. Would like to instruct with CAI.
- \_\_\_\_\_ 3. Undecided.
- \_\_\_\_\_ 4. Would not like to instruct with CAI.
- \_\_\_\_\_ 5. Would very much not like to instruct with CAI.

Comments:

11. Compared with other training equipment that you have used in instruction (slide projectors, tape recorders and etc.), CAI micro-computers reliability was:

- \_\_\_\_\_ 1. Much better than other training equipment.
- \_\_\_\_\_ 2. Better than other training equipment.
- \_\_\_\_\_ 3. About the same as other training equipment.
- \_\_\_\_\_ 4. Worse than other training equipment.
- \_\_\_\_\_ 5. Much worse than other training equipment.

Comments:

12. What do you believe are the instruction advantages of using CAI in this course? \_\_\_\_\_

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13. What do you believe are the instructional disadvantages of using CAI in this course? \_\_\_\_\_

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14. What instructional changes occurred in this course as a result of using CAI? \_\_\_\_\_

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APPENDIX F

Student End-Of-CAI  
Lesson Questionnaire



APPENDIX G

Problem Log For  
CAI Terminals



APPENDIX H

APTITUDE AND ACHIEVEMENT TEST  
RAW SCORES FOR E-GROUP AND C-GROUP

**APPTITUDE AND ACHIEVEMENT TEST  
RAW SCORES FOR E-GROUP AND C-GROUP**

EXPERIMENTAL GROUP												CONTROL GROUP													
	Pretest	Test 1	Test 2	Test 3	Test 4	Test 6	Test 7	Test 8	Test 9	COMBINED	CAI	NON-CAI		Pretest	Test 1	Test 2	Test 3	Test 4	Test 6	Test 7	Test 8	Test 9	COMBINED	CAI	NON-CAI
Subject 1	95	20	53	15	41	24	31	25	28	237	19	16	Subject 1	107	14	47	12	35	22	31	28	26	215	14	15
Subject 2	121	20	53	14	35	19	30	28	28	227	19	19	Subject 2	102	16	45	7	32	16	28	22	18	184	11	12
Subject 3	117	20	42	11	39	14	21	20	26	293	19	11	Subject 3	125	15	47	10	36	15	20	20	15	176	13	12
Subject 4	105	19	54	13	40	25	39	27	29	247	19	17	Subject 4	103	13	41	10	25	21	37	26	22	195	12	12
Subject 5	103	19	55	15	42	21	30	26	30	238	19	18	Subject 5	114	18	48	12	38	18	30	25	21	210	15	14
Subject 6	98	19	50	15	37	26	37	23	28	234	18	19	Subject 6	122	16	48	9	34	17	25	27	25	201	10	16
Subject 7	108	20	45	12	32	21	29	28	28	215	19	18	Subject 7	103	10	45	8	26	20	27	18	18	173	13	10
Subject 8	102	18	55	15	41	25	35	21	23	233	17	18	Subject 8	98	12	42	9	30	21	28	24	21	187	13	10
Subject 9	113	16	49	14	37	23	26	29	23	217	18	17	Subject 9	131	12	43	10	29	17	28	29	27	195	12	15
Subject 10	124	19	51	14	39	24	40	27	29	243	19	19	Subject 10	110	13	31	7	32	19	30	21	20	173	12	14
Subject 11	115	18	54	14	40	26	40	24	26	243	20	19	Subject 11	100	13	44	11	28	16	31	20	18	181	14	12
Subject 12	115	20	50	13	35	21	29	23	30	221	20	17	Subject 12	100	15	44	10	30	18	26	23	18	184	12	15
Subject 13	123	20	44	14	41	17	28	25	30	219	20	17	Subject 13	111	14	44	11	30	19	27	28	27	200	12	15
Subject 14	116	17	52	14	42	24	35	30	30	244	19	20	Subject 14	116	15	46	12	38	22	36	24	21	214	14	15
Subject 15	126	19	50	15	41	25	32	27	28	227	16	19	Subject 15	114	15	43	8	31	20	30	24	23	194	13	15
Subject 16	110	15	53	15	33	23	33	26	28	226	17	14	Subject 16	121	16	43	8	35	21	33	25	22	203	15	12
Subject 17	109	19	46	15	38	23	33	24	24	222	20	18	Subject 17	119	18	47	12	35	18	35	26	21	212	11	18
Subject 18	116	19	51	14	41	21	38	29	29	242	19	19	Subject 18	118	16	43	5	26	15	27	18	16	166	12	12
Subject 19	105	20	51	15	42	18	32	25	27	230	19	15	Subject 19	114	16	42	7	35	24	31	21	25	200	12	17
Subject 20	107	18	53	11	32	22	39	26	28	229	19	18	Subject 20	116	13	31	4	29	18	28	20	16	159	9	14
Subject 21	117	20	52	13	42	26	37	27	29	246	18	20	Subject 21	115	14	38	7	34	20	32	22	16	183	13	14
Subject 22	114	20	51	14	37	20	32	26	27	227	17	19	Subject 22	104	14	42	8	33	21	30	24	20	192	13	14
Subject 23	104	19	53	15	36	20	36	30	25	234	18	19	Subject 23	101	16	44	10	27	15	31	21	18	182	13	13
Subject 24	107	16	55	14	33	26	34	25	26	229	17	18	Subject 24	105	19	50	12	35	22	35	26	25	224	13	16
Subject 25	90	17	51	9	38	14	29	21	23	202	18	18	Subject 25	97	13	42	8	29	16	28	22	20	178	14	14
Subject 26	109	19	50	14	37	17	29	29	28	223	18	18	Subject 26	114	13	40	9	33	18	34	24	21	192	15	15
Subject 27	102	20	54	14	37	18	22	28	30	223	17	17	Subject 27	121	15	45	7	38	24	33	26	22	210	16	16