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MARTIN MARIETTA

DESIGN SPECIFICATIONS FOR NALDA CAI

PHASE II INTERIM REPORT

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CONTENTS

LIST OF ACRONYMS

ASO	Aviation Supply Office
CAI	computer aided instruction
DBMS	Database Management System
DD	Data Dictionary
DFD	Data Flow Diagram
DSEO	Data Systems Engineering Organization
ERD	Entity-Relationship Diagram
FOJ	Fleet Originated Job
IEF	Information Engineering Facility
NALDA	Naval Aviation Logistics Data Analysis
NAMO	Naval Aviation Maintenance Office
ORNL	Oak Ridge National Laboratory
PC	personal computer
S2K	System 2000

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ABSTRACT

Data Systems Engineering Organization (DSEO) personnel are developing a prototype computer aided instruction (CAI) system for the Naval Aviation Logistics Data Analysis (NALDA) system. The objective of this project is to provide a prototype for implementing CAI as an enhancement to existing NALDA training.

The CAI prototype project is being performed in phases. The task undertaken in Phase I was to analyze the problem and the alternative solutions and to develop a set of recommendations on how best to proceed. In Phase II a structured design and specification document was completed that will provide the basis for development and implementation of the desired CAI system. Phase III will consist of designing, developing, and testing a user interface which will extend the features of the Phase II prototype.

The design of the CAI prototype has followed a rigorous structured analysis based on Yourdon/DeMarco methodology and Information Engineering tools. This document includes data flow diagrams, a data dictionary, process specifications, an entity-relationship diagram, a curriculum description, special function key definitions, and a set of standards developed for the NALDA CAI Prototype.

1. BACKGROUND

The Naval Aviation Logistics Data Analysis (NALDA) system serves Navy activities as an information management tool in the analysis of aviation logistics data and decision support activities. The Naval Aviation Maintenance Office (NAMO) is responsible for collecting and substantiating requirements for enhancements to NALDA.

NALDA incorporates many databases with information being supplied by various activities. The system is very complex and continues to expand through the incorporation of additional databases and applications. Such expansion will also lead to an increased number of users and an increased need for user training.

1.1 PROJECT HISTORY

The Data Systems Engineering Organization (DSEO) has been tasked by NAMO to design and develop a computer aided instruction (CAI) prototype for the NALDA system. The project was divided into three phases and is currently in Phase II.

Phase I included an analysis of the problem, alternative solutions, and recommendations for the development of the NALDA CAI. The study was performed by DSEO staff and culminated in the publication of the report, *Recommended CAI Approach for the NALDA System.*[a]

Phase II includes production of the structured design and specifications for the NALDA CAI system and provides the basis for its development and implementation. A structured design and specification document is required in order to design a software system that is easy to understand and implement. Through structured analysis, potential problem areas are identified, relationships between components are established, and system behavior becomes more predictable. The design effort occurs before any programming takes place and is used as a guide for coding and implementing the system. Even though a rigorous system analysis and design was completed, the prototype is intended to identify system flaws as well as serve as a "proof of principle." The intermediate results of Phase II are reported in this document. Phase II will continue with the development, testing, and implementation of the CAI prototype.

Phase III will enhance the CAI prototype by creating a design and specification for a User Interface that will increase the functionality of the prototype. With this interface, the user will be able to initially access either the NALDA system or the CAI and switch back and forth between the two without losing context in either. The interface will allow the CAI to run concurrently with the NALDA system and appear to the user as though the CAI were actually a part of the NALDA system. Additionally, a technology transfer will be performed to enable another organization to assume responsibility for building and maintaining a complete CAI system based on the methods and tools established while developing the CAI prototype.

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[a]L. D. Duncan et al., *Recommended CAI Approach for the NALDA System,* ORNL-6340, Oak Ridge National Laboratory, Oak Ridge, Tenn., April 1987.

1.2 INTRODUCTION

Formal NALDA system training is currently scheduled three times each year: in April at Norfolk, Virginia; in July at Washington, D.C.; and in November at San Diego, California. Approximately 40 people are allowed to participate in each class, which consists of two one-week sessions with a two-week break in between. This schedule can provide training for approximately 120 people each year and is costly in terms of instructor time, student time away from work, travel and subsistence expense, training facilities and equipment, and course management, registration and administration. Additionally, each scheduled class consists of the same educational material, which covers a general introduction to the NALDA system. During Phase I of this project, users requested that a shorter refresher course and an advanced course be offered and that a more flexible training schedule be implemented.

1.3 PURPOSE

The purpose of this project is to design a CAI system and develop a prototype for the NALDA system. The prototype will provide concurrent links between the instructional software and the actual NALDA applications whether the user/student is operating a remote terminal or personal computer.

The CAI prototype will enhance user productivity, efficiency, and skill in using the NALDA system by providing a readily available training package with optional degrees of training, no time restraints, and on-line help similar to that received in a regular classroom. From the student's viewpoint, the CAI system will consist of numerous courses that are subdivided into units and lessons. It will also provide on-line services for a training administrator to manage student enrollment, course maintenance, and reporting functions. The prototype will consist of a general introduction applicable to all courses, one course, a complete set of administrator functions, and guidelines for the addition of future courses.

1.4 AUDIENCE

The target audience for the NALDA CAI consists of current and future users of the multiple database NALDA system. Many of the existing databases were developed utilizing the System 2000 (S2K) Database Management System (DBMS). The CAI prototype is being designed to teach some phases of S2K and is aimed at training personnel with varying degrees of knowledge of a DBMS. Users will be allowed to proceed at their own speed, omit areas that do not pertain to their needs, take abbreviated sessions for a refresher, and take additional lessons as the need arises. The training is intended to be ongoing.

1.5 COMPUTER ENVIRONMENT

The NALDA system currently resides on the Aviation Supply Office (ASO) computer, an IBM 3081KX. IBM PC/AT personal computers (PCs) and Zenith IBM-compatible PCs (Z-248s) are being installed at local user sites. The sites with the largest concentration of users also have, or will receive, IBM System 36 minicomputers.

Recent equipment changes allow greater capacity on the mainframe for NALDA data and programs, enable more new users to gain access to the NALDA system, and are expected to improve the productivity of all NALDA users. The NALDA CAI Prototype is being designed to execute on this equipment.

2. METHODOLOGY USED IN NALDA CAI

The major working tools used in the design stages of the NALDA CAI were Data Flow Diagrams, Process Specifications, a Data Dictionary, and an Entity-Relationship Diagram.

A CAI system that functions properly must be well planned and the internal processes thoroughly analyzed before actual implementation takes place. This structured analysis serves to identify potential "bugs" and trouble spots in the system before any code is written. Using this type of planning, a more reliable, maintainable, and flexible system is obtained. The design tasks in Phase II of the NALDA CAI project were performed using this type of structured analysis. An overview of the processes is presented in Fig. 2.1.

The logic used in designing the NALDA CAI Prototype is similar to that used to create any training, whether it is to be delivered on a computer or in a classroom. Additional procedures used to design the computerized components of the prototype are discussed in this document.

2.1 DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) is a modeling tool designed to assist in understanding and verifying the data flows within a system. The DFD is a graphic tool that focuses on what a system needs regardless of how it is to be implemented. The system is pictured as a network of circles ("process bubbles") connected to each other by paths of data. Bubbles represent processes, arcs represent data flows with arrows showing the direction of the flow, and double lines represent data files, or where the data reside when not in use. A process action within a bubble transforms incoming data into outgoing data. For a process to exist, a data transformation must take place. All interfaces between components of a system are shown, giving a good overall picture of what takes place within the system. A well-planned DFD provides a model for a complex system and verifies model correctness. Possible problem areas and pitfalls can be identified and corrected before implementation takes place.

Fundamental activities of a system are identified along with events that bring about the planned responses. The information required to carry out system activities is identified, and the source of the information is established. The system obtains the information either from its environment when an event occurs or from a process when a response occurs.

All activities triggered by an event are represented by a single bubble. When an activity consists of many smaller activities, it is partitioned and shown in greater detail at a lower level.

The model depicts situations where data flows in, is modified (or transformed), and then flows out. The origins, destinations, and data files are also shown.

In a set of DFDs, the Context Diagram represents the people, organizations, and systems in the environment and the interactions the system needs to have regardless of its

PROCESSES FOR NALDA CAI

REGISTRATION

1. The administrator enters the student name.
2. The student name is assigned a CAI number (the last CAI number + 1) by a computer generated process.
3. A computer generated list of available courses is displayed to the administrator.
4. The administrator selects the courses that the student will be permitted to take.
5. The student name, CAI number, and selected course numbers are stored in the Student Registration file.

VALIDATION

1. The student enters name and assigned CAI number into the system.
2. The name and CAI number entered by the student are checked against those in the Student Registration file.
3. Students with valid names and CAI Numbers are granted admission into the System; those who do not have valid names and CAI Numbers are not.
4. The course numbers assigned to a valid student are released from the Student Registration file.

FIRST DISPLAY TO STUDENT

1. If this is the first entry into the system, the student is taken directly to the Introduction material.
2. If this is not the first entry into the system, a check is made to determine if the Introduction has been completed.
    a. If the Introduction has not been completed, the student is presented a menu giving the option to start the Introduction over, begin at the last exit point, or exit the CAI.
    b. If the Introduction has been completed, a check is made to see if a placemark has been set for the last exit point within a lesson. If a placemark has been set, the student is presented a menu giving options of resuming at the last exit point, starting the lesson over, or going to the Course Menu. If a placemark has not been set, the Course Menu is displayed to the student.

Fig. 2.1. Overview of the NALDA CAI.

Fig. 2.1 (continued)

MENU PRESENTATION AND PRETEST

1. When a student completes the Introduction, the Student Status file is updated; and the Course Menu containing the courses for which the student has been registered is displayed.
2. At the Course Menu, the student determines which course to pursue. Any courses that have been completed appear with an asterisk to the left of the course name indicating that the course has been successfully completed.
3. After a course selection is made, the Unit Menu for the selected course is displayed.
4. The student determines which unit to pursue.
5. The first time a student enters ANY unit of the course, an option to take the Pretest for that unit is presented. The questions for the test are randomly generated.

    A. If the student elects to take the Pretest, either of the following events could occur:

        1. The student passes the unit Pretest—the majority of the questions for each lesson are answered correctly.

            a. A "Congratulation" screen is displayed.

            b. The Student Status file is updated for each lesson passed.

            c. The Unit Menu is displayed with an asterisk appearing on the left side of the unit name, indicating that the unit has been successfully completed.

            d. If all units for the course are completed successfully, the course menu is displayed with an asterisk to the left of the name of the completed course. The student now has the option of beginning another course.

            e. If all units for the course are not completed successfully, the Unit Menu is displayed. The student has the option of beginning another unit.

        2. The student does not pass all of the lessons on the Pretest, but passes one or more lessons in the Unit.

            a. A "Notification" screen is displayed informing the student that the test was not passed. The Lesson Menu screen is displayed.

            b. The student is given credit for any lessons passed. An asterisk is placed on the Lesson Menu to the left of any lesson passed on the Pretest indicating successful completion of the lesson.

            c. The student may now select a lesson to study or exit.

            d. The Student Status file is updated for any lessons passed.

Fig. 2.1 (continued)

3. The student does not pass any lessons on the Pretest. A "Notification" screen is displayed informing the student that the test was not passed. The Lesson Menu screen is displayed.

B. If the student elects to not take the Pretest, the Lesson Menu is displayed. The Pretest option will not be offered again for this unit.

6. If the student has entered the unit previously, the Pretest option is no longer available. The Lesson Menu is displayed on this and any subsequent entries into the unit.

CRITERION QUESTIONS

1. Criterion questions are asked during the lesson presentation to determine the depth of understanding of the material being presented.

   A. The number of tries a student is allowed at obtaining the correct answer is dependent upon the type of question asked.

      1. If the question is a multiple choice, two tries at obtaining the correct answer will be given.

      2. If the question is of a true/false type, only one try will be given.

      3. A Hint option is available to the student. Entering the code for the Hint is not counted as an incorrect answer.

      4. After the number of tries allowed is exceeded, the correct answer is given.

   B. Should all attempts at answering the question fail, additional material relating to the question is displayed and a second criterion question asked. No more than two criterion questions will be asked on the material being presented.

   C. If the student gives the right answer to the criterion question, material covering the next topic is presented.

OPTION BARS

1. An option bar showing options available to the student is visible throughout the lesson. The options vary depending upon the type of information being presented.

2. During the lesson, the option bar always contains provisions for help and exiting.

3. Additional options are available when appropriate.

   A. Criterion questions contain an option for Hint, which is available should the student require it.

Fig. 2.1 (continued)

B. A Review of the lesson is not available until the student has completed the lesson. At that time and on subsequent entries into the lesson, Review is included as an option on the Option Bar of the Lesson Menu.

C. After all lessons under the unit have been successfully completed, the Posttest for the unit may be taken. This option will appear on the Option Bar on the Lesson Menu when all prerequisites for the Posttest have been met.

D. Back appears when the screen being displayed is not the first of a series. This option allows backward movement through the CAI screens.

PLACEMARKS

1. The point of exit from the last interactive session in the CAI is saved when a student leaves the system if the last screen is of screen type "T" (Text) or "C" (Criterion). If the last exit does not occur on one of these types, the last exit point is not saved. The option of resuming at this exit point will be offered to the Student the next time the CAI is entered.
2. Each time the student enters a lesson and exits, a placemark is set. From the Lesson Menu the student has the option of beginning at the last exit or beginning the lesson over. Each lesson in a Unit could conceivably have a placemark set for it.

SUMMARY, REVIEW, AND POSTTEST

1. Access to a summary of the lesson is available to the student on an option bar before, during, and, in some cases, after viewing a specific lesson. This summary is presented as either a graphic representation or an outline for the lesson selected.
2. The review of the lesson (a quick reminder of the main points within a topic) is not offered as an option during the first exposure to the lesson. When the last screen of the lesson is presented, Review becomes an option. On subsequent entries into the lesson, Review is available on the Lesson Menu.
3. The Posttest is presented on the Unit level. Only questions that pertain to lessons that were not passed on the Unit Pretest are included.

   A. A "Notification" screen is presented to the student upon completion of the testing phase. The message for this screen is based upon the results of the test. A menu screen is then presented, depending upon the student's progress to this point.

   B. If the Posttest is passed (the majority of the questions pertaining to each lesson given on this Posttest are answered correctly), the Unit menu is displayed with an asterisk beside of the Unit that was passed. The student may select another Unit to study, continue with another appropriate phase of the CAI, or exit. The Student Status file is updated for lessons passed.

Fig. 2.1 (continued)

C. If the entire Posttest is not passed but one or more lessons are, Student Status is updated for any lessons passed.

D. It is suggested that the lessons not passed on the Posttest be studied. Before the student gets credit for passing the Unit, the Posttest must be completed successfully.

E. After all lessons on the test are passed, the Student Status file is updated showing successful completion of all lessons in the unit.

COMPLETED COURSE

1. All lessons under all units must be passed before a course is considered to be completed. A Certificate of Completion is printed to reflect the student's successful completion of a course.
2. The student may choose to take another course or may elect to review courses successfully completed.

EVALUATION QUESTIONS

1. After each course has been completed, course evaluation questions are presented. The answers to these questions will help in determining the student's attitude toward the presentation, content, and usefulness of the course.
2. The Evaluation questions are presented either as open-ended or with a linear rating scale that is designed to avoid "middle-of-the-road" selections (i.e., using an even number of options). These comments are available to the training administrator in report form and should be considered when revising or updating the CAI.
3. The student will not receive a Certificate of Completion until after the evaluation phase has been completed.

PRINTED INFORMATION REGARDING THE CAI

1. A Course Report, an Evaluation Report, a Utilization Report, and a Validation report are printed documents available to the administrator. The training administrator may also print certificates for students who have completed a course.
2. The Course Report is a listing of all courses available in the CAI.
3. The Evaluation Report includes the course number, the evaluation question and student answers to the evaluation question, and statistics regarding the questions. The results of this report should be considered when revising or updating the CAI.
4. The Utilization Report includes the number of students who have completed a course and the percentages of lessons passed on the Pretest and on the Posttest for those students.

Fig. 2.1 (continued)

Information needed for this report is electronically stored in a file. Calculations using this information will occur only when the Utilization Report is called for by the administrator.

5. The Validation report is used to determine the validity of individual test questions. The answers given by the student are matched with the correct answer, and statistical information concerning correct, incorrect, and unanswered questions is derived.

6. A Certificate of Completion is issued to the student, by the administrator, upon completion of a course. The course description, student name, and date of completion are given in the certificate text. This document is based on the date of completion and must be routinely generated by the administrator. (A flag is set to indicate that the certificate has been issued.)

implementation. The net inputs and outputs of the system in perspective to the rest of the world are shown. The system name appears in a circle in the center of the diagram. The terminators with which the system must interact appear in the surrounding environment.

The next level that appears in a set of DFDs is Level 0, or the top level. At Level 0, a general overview of all processes required by the system is given, including the files through which the main processes interact. Only flows to and from the files between the bubbles are shown. Flows to and from files that do not occur between at least two main processes at this level are not shown but appear at lower levels where they are accessed.

Other levels of a DFD are included depending on the requirements of the system being developed. Each process is examined to determine whether it is at its lowest level. If it is not, it is partitioned into smaller processes and diagramed at lower levels until only one process exists.

2.2 PROCESS SPECIFICATIONS

When a process can not be further decomposed, a description of that process appears in the Process Specifications. The DFD shows what takes place; the Process Specification tells how it takes place. In the Process Specifications, a process is explained through the use of preconditions and postconditions. Preconditions (which include the internal processing that causes the postconditions) specify what must be true before the process can function and include a discussion of data flows in and out of the process; postconditions specify what is true after the data have been processed.

Process Specifications are derived through structured design methods and are a valuable working tool for programmers who must write the programs to implement the system. Through the use of structured design, most problem areas are discovered and corrective action taken before the actual programming takes place. The preconditions give assumptions on the inputs, and the postconditions tell what the process does by relating outputs to inputs. It is up to the programmer to make these processes happen. The Process Specifications for the NALDA CAI appear in Appendix A.

2.3 ENTITY-RELATIONSHIP DIAGRAM

The Entity-Relationship Diagram (ERD) describes a system in terms of the stored data relationships. This network is developed by first determining the information that will be needed in order for the system to function as designed. Next, the associations, or relationships, between the data elements are determined.

The ERD for the NALDA CAI was developed using the Information Engineering Facility (IEF) software from Texas Instruments Incorporated. Information Engineering (IE) is a comprehensive, disciplined methodology that fully supports the information systems development life-cycle with an emphasis on data sharing. IE is a rigorous top-down analytical methodology that facilitates the graphical representation of models that form the basis for information systems. Models created throughout the development life-cycle are successively refined, expanded, and detailed for eventual translation to system code. Coupling the integrated, formal IE stages with automated tool support ensures uniformity and adherence to standards.

The ERD for the NALDA project appears in Appendix B. In addition to the ERD, each data relationship, such as Student, Course, Student Input, is further broken down and displayed on a separate page. This level of detail allows for a more thorough presentation of all the relationships between the data elements.

A legend that depicts the various types of relationships that exist between entities is presented along with the ERD. This legend also indicates whether the particular relationship is required or optional. The boxes represent the entity, the lines represent the relationship, and the line terminators indicate the relationship type.

The use of IEF as a supplement to the Yourdon/DeMarco methodology adds even more rigor and discipline to the structured analysis and design. Future changes or enhancements could be checked for consistency and completeness through the use of IEF. This merging of technologies provides a system of checks and balances in the design and development of an advanced product.

2.4 DATA DICTIONARY

All data elements used in the DFDs, Process Specifications, and ERDs are defined in the Data Dictionary (DD). The DD contains definitions of all data flows, data files, processes, and data elements that occur in the DFDs and in the Process Specifications. Each flow and file in the DFD is given a precise name and is defined and/or described in the DD. The DD listing for the NALDA CAI appears as Appendix C.

3. LOGIN BRANCHING

The branching options for the NALDA CAI system include a variety of paths available to the user. An Introduction to the CAI must be completed by the student before any other courses are presented for study. The Introduction is treated as a course; however, since it is required and not optional, there are some differences in the way in which it is presented. It has no Unit Menu and no Pretest. The order of presentation for the Introduction and the route the login branching follows for all other courses is described below.

3.1 INTRODUCTION NOT COMPLETED

Since the Introduction must be completed before any other courses can be selected, the first login takes the student immediately to the Introduction Lesson Menu (Fig. 3.1). The student may choose which lesson to pursue. Once the selection is made, the first screen of the selected lesson is displayed.

If a student terminates a session in the midst of an Introduction Lesson, a Placemark Menu is presented at the next logon (Fig. 3.2). The student has the option of starting the lesson over, resuming at the last exit point, or of going to the Introduction Lesson Menu.

If starting the lesson over is selected, the first screen of the selected lesson is displayed. If resuming at the last exit point is selected, the student is taken immediately to the screen from which the last exit was made. If the Introduction Lesson Menu is selected, it is displayed.

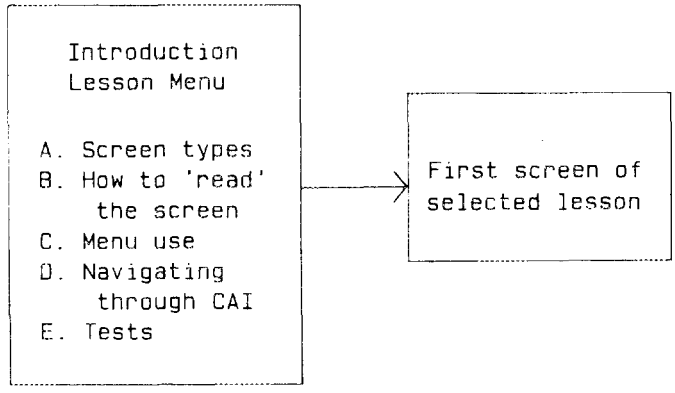


Fig. 3.1. First login to NALDA CAI.

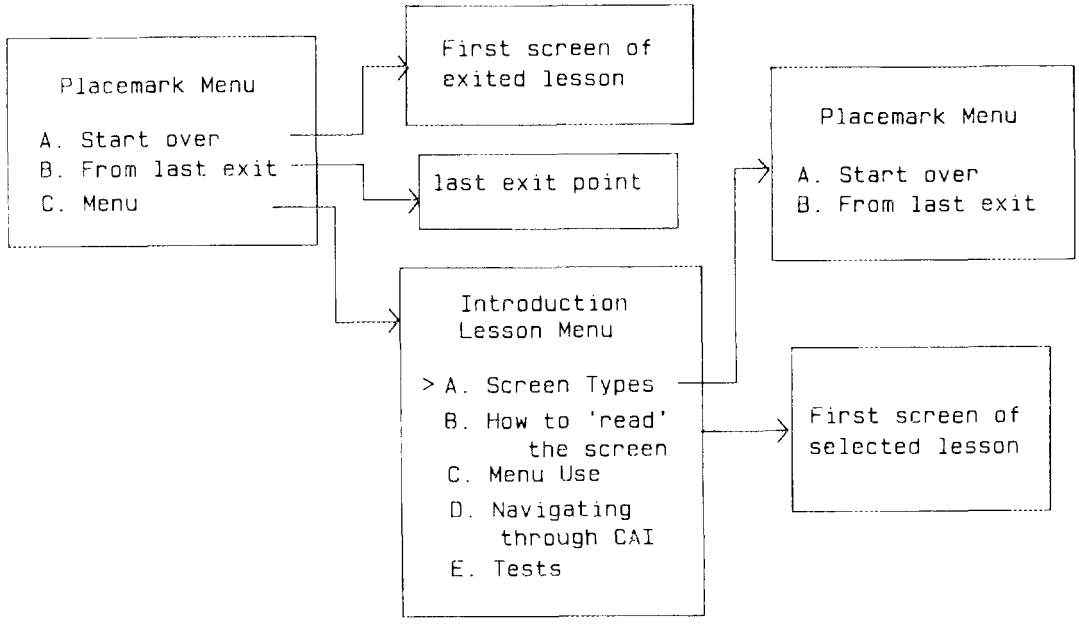


Fig. 3.2. Introduction lesson in progress.

From the Lesson Menu, the student may select another lesson to study or may decide to go back into a lesson that is already in progress. If a new lesson is selected, the first screen of that lesson is presented. If a lesson that is already in progress is selected, a Placemark Menu is displayed giving the student the option of starting the lesson over, resuming at the last exit point, or of going back to the Lesson Menu.

If the Introduction has not been completed and the last exit point was from the end of a lesson within the Introduction, the first display to the student will be the Introduction Lesson Menu. The login route is the same as the first display the student saw upon initial entry into the system, except status markers now appear on the Introduction Lesson Menu.

3.2 INTRODUCTION COMPLETED

On subsequent logins, menus are displayed to the student depending on the status information stored for that student. When the Introduction is completed, a Course Menu containing the Introduction and the courses selected by the CAI administrator for the student to take is displayed to the student (Fig. 3.3). There is an asterisk preceding the Introduction indicating that it has been successfully completed. It remains an option on the course menu and may be reentered for review. The student decides which course to pursue. The Unit Menu for the selected course is then displayed. At this point the student may select any unit within the course.

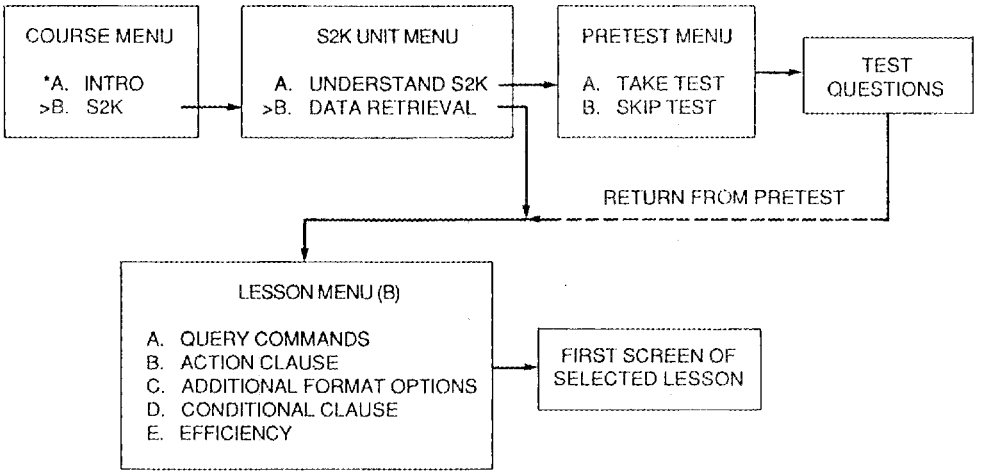


Fig. 3.3. Login with Introduction complete and no lesson in progress.

When the student enters a unit for the first time, a Pretest Menu is presented. The student has two options: (1) take the Pretest and potentially gaining credit for some or all of the lessons based on prior knowledge or (2) skip the Pretest and go directly into the instruction. Selection of the Pretest takes the student to the test and then on to the Lesson Menu. Rejection of the Pretest takes the student directly to the Lesson Menu. The Pretest Menu is presented ONLY once per unit.

If the student passes all of the lessons covered on the Pretest, a congratulatory message is displayed informing the student that the unit was passed. The Unit Menu is then displayed with an asterisk to the left of the name of the unit passed. The student may then select another unit to study. If the student passes part of the lessons covered on the Pretest, a congratulatory message is displayed. The Lesson Menu is then displayed with an asterisk to the left of any lessons passed. Only lessons not passed need to be studied; passed lessons can be reviewed. If the Pretest is taken and no lessons passed, the Lesson Menu is displayed with no asterisks.

The student has the option of pursuing any lesson from the Lesson Menu. When a selection is made, the first screen of the lesson is displayed.

When an exit is made in the middle of a lesson, the location of the exit is saved. The next time the student enters the CAI, a Placemark Menu is presented (Fig. 3.4). The student has the option of starting the lesson over, resuming at the last exit point, or going to the Course Menu.

If the student chooses to start the lesson over, the first screen of the selected lesson is displayed. If the student chooses to resume at the last exit point, the screen from which the last exit was made is presented. If the Course Menu is selected, it is displayed. From this menu the student may choose a course to pursue. All menu screens displayed contain status indicators indicating the student's progress through the CAI.

When a lesson has been interactively completed and an exit made, the last exit point is not saved. When the student logs into the system again, the Course menu is presented. The student may choose any course that appears on this menu.

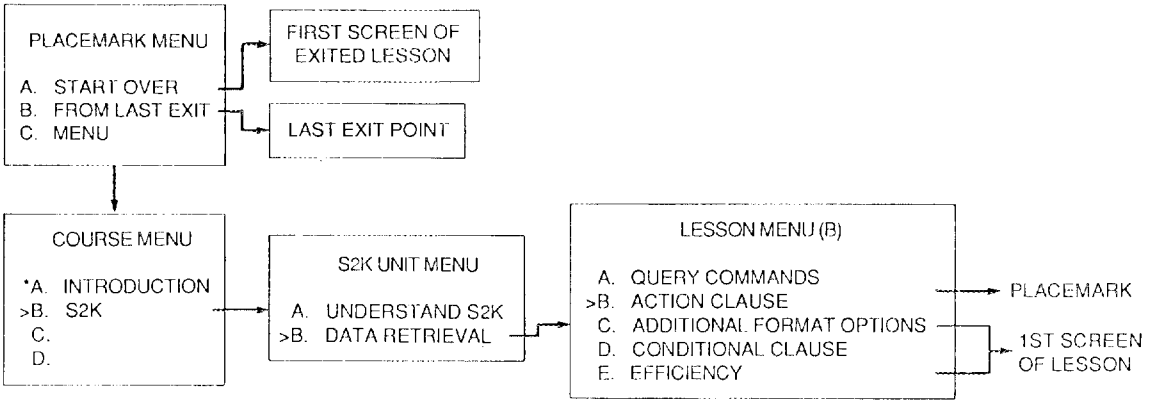


Fig. 3.4. A course lesson in progress.

4. SYSTEM FUNCTIONS

The NALDA CAI DFD is based on Yourdon/DeMarco methodology and contains several levels: the NALDA CAI Context Diagram, Level 0: Top Level DFD for NALDA CAI System, Level 1: Manage Student Interaction, Level 1.2: Deliver Course, Level 2: Manage Administrative Function, Level 2.1: Print Information, and Level 2.2: Register Student.

4.1 NALDA CAI CONTEXT DIAGRAM

The Context Diagram for the NALDA CAI (Fig. 4.1) consists of a circle in the center bearing the name NALDA CAI System. The Student, the Author, and the Administrator appear as terminators in the environment. Interfaces in the environment between the terminators and the system are shown; that is, Author input occurs to create the CAI; screen text is presented to the Student; and Student input goes into the CAI to determine what path will be taken in the CAI; the Administrator enters the Student name to register the Student for the CAI, requests reports to be generated, and enters New Course

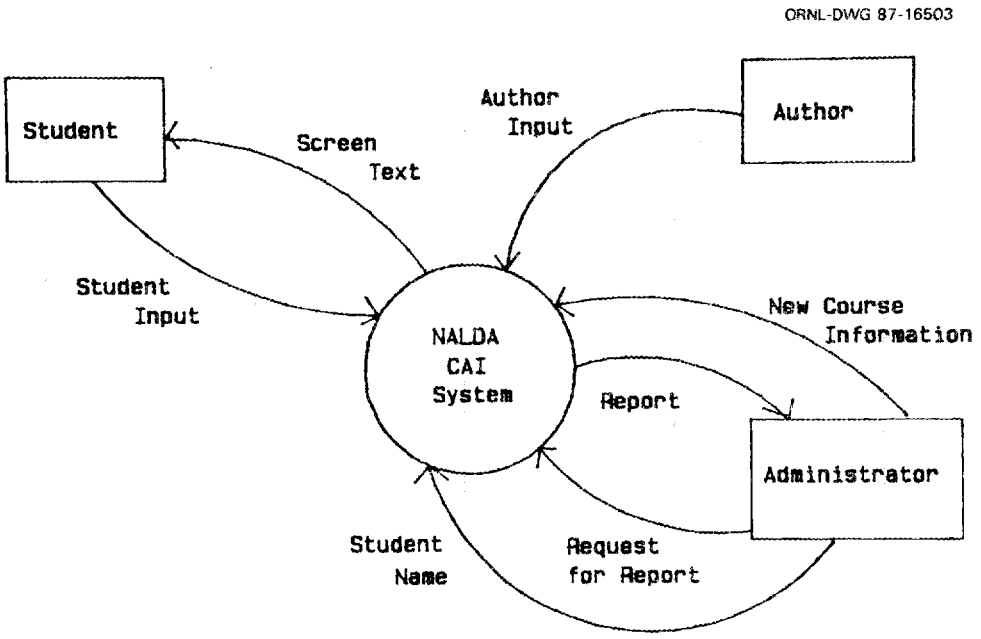


Fig. 4.1. NALDA System Context Diagram.

Information; information is returned to the Administrator in the form of Reports generated through the CAI.

4.2 TOP LEVEL DFD FOR NALDA CAI SYSTEM

Level 0, Top Level DFD for NALDA CAI System (Fig. 4.2), shows the three main processes required for the NALDA CAI System. These are: 1.0: Manage Student Interaction, 2.0: Manage Administrative Function, and 3.0: Create Course Content.

Bubbles 1.0 and 2.0 at Level 0 must be partitioned to a lower level for clarification. Bubble 3.0: Create Course Content is at its lowest level. It is within this process that the author enters the lesson text and the questions and answers that are used in the testing phases.

4.3 MANAGE STUDENT INTERACTION

Level 1.0, Manage Student Interaction (Fig. 4.3), consists of two subprocesses: Bubble 1.1: Validate Student and Bubble 1.2: Deliver Course Content. At this level, the diagram indicates that the student is either granted or denied access to the system and the material contained in the CAI is presented.

Access to the CAI is limited to those previously registered by the CAI Administrator. When a student attempts to access the CAI, a name and CAI number must be entered and checked against the name and CAI number contained in the Student Registration file. Only students with a valid name and CAI number are granted access to the system. Upon successful entry, course numbers assigned to the student are released. The student is then allowed to select the desired course of study and to proceed with the training.

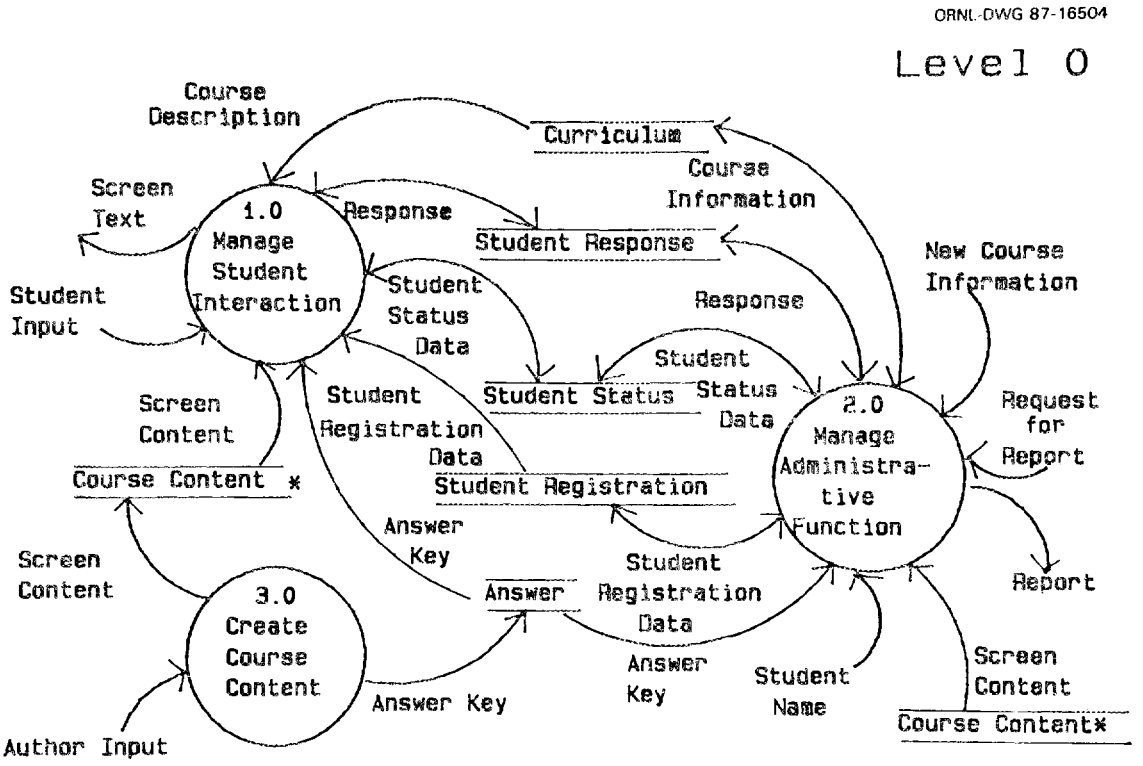


Fig. 4.2. Top Level DFD for NALDA CAI System.

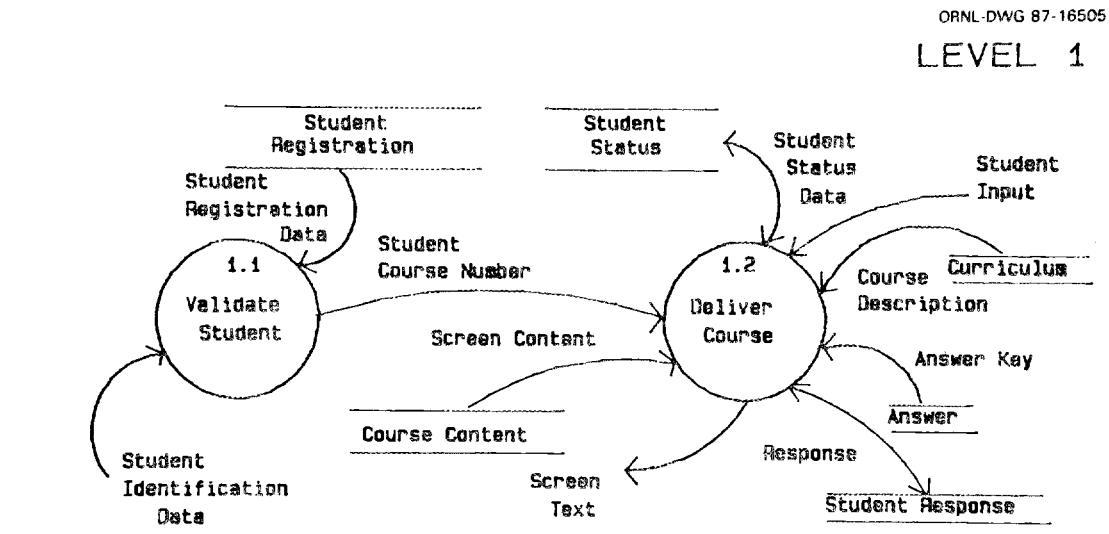


Fig. 4.3. Manage Student Interaction.

Bubble 1.1, Validate Student, indicates that the student name and CAI Number have been entered by the student. If this information agrees with the data that is contained in the Student Registration file, the student is granted access to the CAI. If it does not, the student is denied access. This process is at its lowest level and does not require a further breakdown.

4.4 DELIVER COURSE

Level 1.2, Deliver Course (Fig. 4.4), consists of two processes: Bubble 1.2.1: Process Menu, and Bubble 1.2.2: Control Course Delivery.

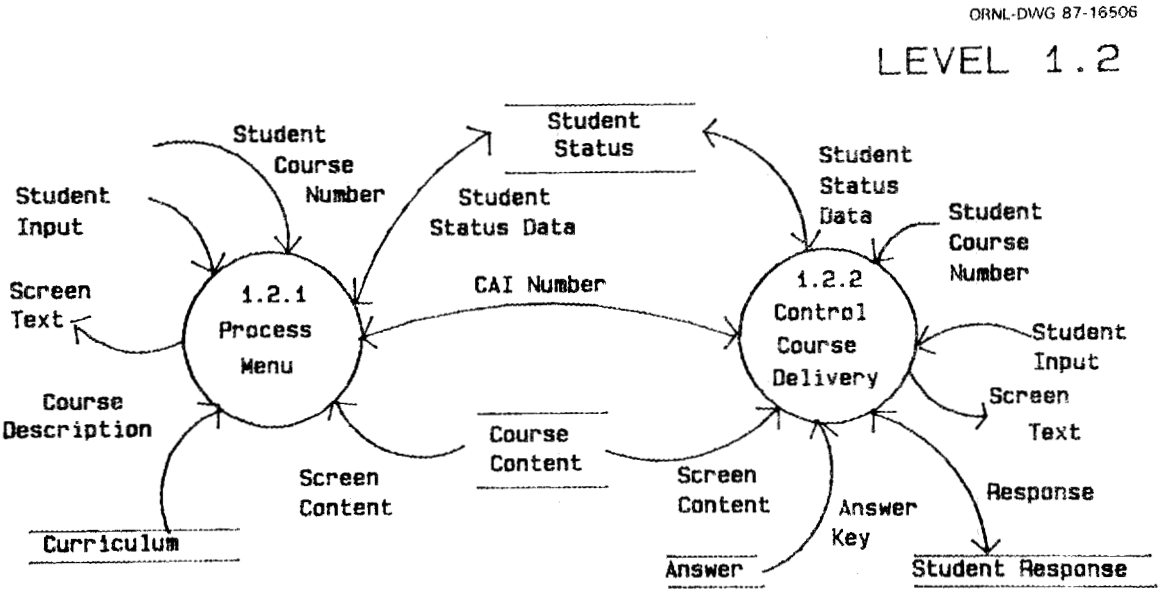


Fig. 4.4. Deliver Course.

4.4.1 Processing of Menus (Bubble 1.2.1)

Menus are displayed to the student by the processes within Bubble 1.2.1. The display of menus depends upon the course selection made available to the student, the course selected by the student, and the student's status within a course. The Course Menu presented contains only the courses the CAI Administrator selected for that particular student. The student's choice of a course to study determines which unit menu is displayed. The Student Status file is updated as the student progresses through the training. Student status data from this file supplies status indicator information for display on the menus.

If this is not the student's first entry into the CAI and if the last exit point was from within a lesson, three options are given. These are: resume at the last exit point, start over at the beginning of the current lesson, or go to a menu. If the student has not completed the Introduction material, the menu displayed is the Introduction Lesson Menu; if the Introduction has been completed, the Course Menu is displayed.

If the point of last exit was not on a text or criterion screen, the appropriate menu is displayed to the student. Any course status indicators in the student's status file will appear on the Menu.

While the Introduction is incomplete, the student sees only an Introduction Lesson Menu where a lesson selection can be made. Once the Introduction is completed, a Course Menu is displayed. After a course of study is selected, the Unit Menu for that course is displayed. The student selects a unit to study. The Unit Menu is presented containing appropriate unit status indicators.

Status indicators appear on menus when certain conditions are met. Once the student has begun a lesson, a pointer (>) appears to the left of the lesson title. This symbol also appears at the unit and course levels to indicate the direction that the student has taken. When a lesson has been studied in its entirety, a plus sign (+) replaces the > on the Lesson Menu. Lessons passed on either the Pretest or Posttest appear with an asterisk (*) preceding them. When all lessons have been passed, the unit name on the Unit Menu also receives an asterisk indicating that the unit has been completed. When all units on the Unit Menu have an asterisk beside them, the course name on the Course Menu will have an asterisk beside it to indicate that all sections of that particular course have been completed.

4.4.2 Control Course Delivery (Bubble 1.2.2)

The student's selection from the course, unit, and lesson menus determines what action will be taken in Bubble 1.2.2: Control Course Delivery. The processes within Bubble 1.2.2 control the way in which the material within the CAI prototype is delivered.

At this point the student has been registered and has entered the CAI. If this is the student's first entry into the CAI, the Introduction material is presented. Information contained in the Introduction helps facilitate navigation through the CAI. The Introduction must be completed before the student is allowed to pursue any of the available courses.

In the Introduction, the student is taught how to use the CAI. Lessons are given on how to reach a screen and "read" the data, how to use the menus and read the status indicators contained on them, and how to use the special function keys. Information about the Pretest and Posttest is also presented. When the Introduction material has been completed, the student is allowed to proceed with interactive study.

The test and evaluation stages of the CAI are also handled in Bubble 1.2.2. Answers (responses) given by the student to the questions in the testing stage are compared with the correct answer contained in the Answer file. Student status records are checked and updated in this process, depending on the outcome of the test. Evaluation questions are presented to a student when a course has been completed. The student is allowed to critique the course content, delivery, test questions, examples, and special functions. This information is subsequently used to determine any changes that should be made in the course.

The first time a student enters a unit, a Pretest covering all lessons in that unit is made available on a Pretest Menu. The student has the option of taking this test or of continuing with the lessons. Students who are familiar with the material to be presented

may wish to take the test and gain credit for some or all the lessons without studying them. Those who prefer to skip the test may go directly to the lessons.

Each lesson in the unit is covered by a group of questions. Passing a majority of these questions will entitle the student to receive credit for that lesson. Should all lessons be passed, the student is given credit for passing the unit. If the Pretest is not passed in its entirety, the student will be given credit for lessons passed on the Pretest and will not have to interactively study those lessons.

If the student takes the Pretest, an information screen containing the results of the test is displayed. Menu screens will be marked according to the results of the testing. The Pretest option is offered only on the first entry into a unit. On subsequent entries, the Pretest option will not be available.

When a student initially selects a lesson for study, the first screen of the selected lesson is displayed. Selection from the Lesson Menu of a lesson that is in progress will cause a Placemark Menu for that particular lesson to be displayed. Here the student will have the option of resuming at the last exit point or of starting the lesson over. This Placemark Menu will be offered only upon selection of lessons that are in progress. The training can be completed at any pace that is comfortable to the student.

When a student exits from a lesson before completing it, the last exit point is saved. The next time that lesson is selected from the Lesson Menu, a Placemark is displayed. This menu offers the following options: resume at the last exit point, start the lesson over, or return to the Lesson Menu. A Placemark Menu is presented to the student each time a lesson that is in progress is selected from the Lesson Menu.

Throughout the initial training, the student is required to answer criterion questions. Should the student fail to answer a question correctly, the material is presented with a different approach to the subject. A second criterion question is asked to ascertain whether or not the student now understands the material.

4.4.3 Standards

Standards were written to define the layout of the various screens required by the NALDA CAI. Items of particular importance to users of a CAI package include consistent use of color, graphics, sound, reading level and sentence structure, help facilities, informative clear directions and error messages, student autonomy, and answer analysis. These standards ensure consistency of layout of the screens so that less time and attention is required on the student's part to locate needed information. Guidelines are necessary to ensure that the CAI is consistent throughout and is independent of the individual responsible for development. For a detailed description of the standards written for the NALDA CAI, see Appendix D.

It is important for the user of any computer system to have consistency in screen displays. This consistency is especially important in CAI. For example, the title of the lesson, the option keys available for the screen being displayed, and the action required of the student should appear in the same position within every basic screen design.

Research has shown the influence of characteristics such as color, sound, graphics, and feedback on the learning process; and these findings are incorporated into the standards set forth for the NALDA CAI. The chief reference for the establishment of these

standards was Robert W. Bailey, *Human Performance Engineering: A Guide for System Designers*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1982.

The use of color should be limited to three colors on a screen at one time for text items. An exception to this "rule" may be made for graphics or animation but definitely not for text items. Cueing of important words by highlighting them in color is a desirable feature of computerized learning. Using color coding frequently without regard for people with defective color vision, may cause user performance to be degraded.

Another important consideration is the use of sound as an indicator of incorrect input. Many users consider the beep annoying and prefer not to have an audible indication of their error(s). They may not want other people in the area to "hear" their mistakes. Therefore, the NALDA CAI design incorporates the user option of turning off the error beep.

A third area of concern for the designers of a CAI package is the use of graphics. Graphics can be an effective means of depicting an idea but should be used sparingly and only when appropriate. While a picture may be easier to remember than paragraphs of text, it is important that the student remember the concept being illustrated and not the "cute" picture.

The area of text standards requires careful consideration by the CAI designer who must be aware of the user population and must structure all verbal material accordingly. In general, paragraphs should be less than eight lines in length and sentences should not contain more than twenty words. The reading level of informative text should be at the eighth grade or less.

The items mentioned in the preceding paragraphs represent a sampling of areas that were considered when developing standards for producing the NALDA CAI.

4.4.3.1 Screen types

Nine screens (classified by function) that appear in the NALDA CAI are Text, Menu, Criterion, Test, Evaluation, Help, Information, Summary, and Review. All screen types have some areas that remain static throughout the training. Each screen contains an area in the upper left corner that lists the course name, unit name, lesson name, and screen identifier. This screen segment provides the students with a consistent indicator of where they are within the CAI. The message area on each screen type appears in the lower left corner. The option bar is always located on the bottom of each screen. The information contained on the option bars varies depending upon the screen type, but the location always remains the same. Generic designs for each type of screen in the NALDA CAI appear as Appendix E.

All screens that contain actual information to be learned are Text screens. These may contain introductory material to familiarize the student with the CAI or instructional material that makes up the lessons. Most of the screen is devoted to presentation of the topic material. The options available at all times on the Text screen type are Help, Summary, Exit, and Quit. The Back option is available after the first screen in a lesson has been studied. The Continue (Cont.) option is available after the last page of the lesson has been studied.

The Menu screens are used to establish individualized paths through the training and provide the mechanism for the student to select a course, unit, and lesson for study. Each

menu screen consists of a title, the options available for the menu level, and an area for the student's response. Static option bar selections include Help, Exit, and Quit. Summary, Review, and Posttest are included on the Lesson Menu only. The Review option is available after a specific lesson has been completed. The Test option is available when all lessons within the unit have been completed.

Criterion screens are presented within a lesson to test the student's understanding of concepts presented in the text. The top portion of this screen is the area where the Hint and feedback are displayed. The question itself appears in the lower two-thirds of the remaining screen area. The area for student input is located either within the text or near the bottom center and above the option bar. Option bar selections consistently available for the Criterion screen are Summary, Exit, Hint, and Quit. Back is available to review completed text, and Continue (Cont.) is available after the lesson has been completed. Using the Cont. option, the student is permitted to browse through the lesson material without being required to answer the criterion questions. If the student chooses to answer the criterion questions, the answer is entered by using the return key.

Test screens are used to present the Pretest and Posttest questions to the student. The Question text is presented in the main portion of the screen, with the area for the response located either within the text or above the option bar. Back, Cont., Exit, and Quit are the options available to the student. Using the Back and Cont. options allows the student to review answers previously entered without having to reenter the answers. Exiting during a test is considered the same as failing the test.

Evaluation screens are presented when the course is completed. The student is asked to evaluate the course just finished. The questions to be answered appear in the upper part of the screen, and the response area appears immediately below the question and above the option bar. The Back, Cont., Exit, and Quit options appear on the option bar. Back is available after the first Evaluation screen is viewed. The Cont. option allows the student to review screens previously viewed. The Exit and Quit functions appear throughout the evaluation phase. A premature exit request will result in a message asking that the evaluation be completed. A student will not receive a Certificate of Completion until the evaluation is complete.

Help screens consist of Menu screens and Text screens. A Help Menu is presented to the student when the Help option is selected. The title of the menu appears in the center of the screen with the listing of available options displayed underneath. The response area is located above the option bar. Help Text screens contain the word, phrase, or concept being defined in the top center of the screen. The definition area is located immediately below. The options available on the Help screens are Exit, Quit, and Back. Selecting the Exit option takes the student back to the screen from which the Help option was originally selected. Selecting the Quit option takes the student to the main menu where an exit out of the CAI can be made. Back is available to review previously viewed Help screens.

The Information screens contain notification or feedback messages and are presented to the student upon completion of either the Pretest or Posttest and at the end of each lesson. The upper portion of the screen contains an area where the message is given; the lower portion of the screen is devoted to text that relates to the message. The option bar is located at the bottom of the screen and contains the Help, Exit, and Quit options. Selecting Help allows the student to see the Help options available; selecting the Exit

returns the student to the Lesson Menu if all lessons under the unit are not completed or the Unit Menu if all lessons under the unit are completed. The Quit option takes the student to the main menu where an exit out of the CAI can be made.

A summary of a lesson is available from the Lesson Menu, Text, and Criterion screens. The screen that is used to display this summary information is devoted primarily to presenting either a concise textural or graphic representation of the information. The option bar is located on the bottom of the screen and always contains the Exit and Quit options and contains the Back option if there is more than one screen of information. Selecting the Exit option will return the student to the screen from which the summary option was originally selected.

After a lesson is completed, a review of the lesson material becomes available to the student. The review is a condensed interactive presentation of the information in the corresponding lesson. The screens used for the Review text and the Criterion questions contained therein have the same format and options as the Lesson Text and Lesson Criterion screens. Help, Exit, and Quit are always available on the option bar. The Back option is available when the student is not on the first screen of the Review. Cont. is available to skip a Criterion question. Quit is available to take the student to the main menu where an exit out of the CAI can be made.

4.4.3.2 Special function keys

During the training sessions, various options are available. Some of these are offered at all times; others are offered only when appropriate. Exit and Quit always appear on the option bar. Other options, such as Back, Cont., Review, Summary, Help, Hint, and Test, appear when certain conditions are met. A detailed summary of the special function keys appear in Appendix F.

Back is used to move backward through screens that have already been viewed. It is available when there is more than one screen of information being presented and when the current screen is not the first of a series.

The Help option is available on Text, Information, and Menu screens. It is not available on Criterion, Test, Review, Evaluation, and Summary screens. Help options include a glossary of terms, processes used in the training package, and other relevant aids.

The Cont. (Continue) option is not available in the text until the student has completed a lesson. This option allows the student to review the material without having to answer Criterion questions required the first time the material is presented. The Cont. option is always available during the testing and the Evaluation phases.

A Review of the material is not available until the lesson is either passed on a test or has been studied in its entirety. When the last page of the lesson is reached, the option to review the lesson will appear on the Lesson Menu. Each lesson in the unit is presented under the Review option. However, the student is permitted to review only those lessons that have been completed (have a + or a * beside the name of the lesson). Selection of a lesson that has not been studied or passed on a test is not permitted.

The Summary option is available on Text, Lesson Menu, and Criterion screens. The purpose of the Summary is to provide an overview or quick reminder of the information contained in a lesson. It is not intended to be a short cut access to the lesson material.

The Exit option appears on all screens and is used to leave the Help or Summary options or to take the student out of the current module. Selecting the Exit function in Help or Summary will return the student to the screen from which Help or Summary was entered. An exit can be made from the CAI by "backing out" through the menu screens. An exit requested while viewing a lesson screen will take the student to the Lesson Menu. Entering Exit from the Lesson Menu will display the Unit Menu. Entering Exit on the Unit Menu will display the Course Menu. Entering Exit on the Course Menu will exit the student from the system.

The Test (Posttest) option does not appear until all lessons within a unit have been completed. A lesson is considered to be completed when that lesson appears on the Lesson Menu with either an asterisk or a plus status indicator.

Hint appears on the option bar during the criterion question phase. Additional information about the material is given in a "pop-up" window when the Hint option is selected.

The Quit option appears on all screens. Its function is to take the user completely out of the CAI at the point where this option is selected. From the point where the Quit option is entered, the student is taken to the main menu where the Exit option is used to take the student out of the CAI. An exit from the system can also be made by "backing out" through the menu screens, but this is more time consuming. The student should use the Quit option when an immediate exit from the CAI is desired.

4.5 MANAGE ADMINISTRATIVE FUNCTION

The author creates the original course content. After this course content is in place, the CAI administrator must include any additional information and maintain the CAI.

The NAMO CAI Administrator is responsible for student registration, maintenance of the CAI training, and generation of reports and certificates. These duties are included in the DFD and appear as Level 2: Manage Administrative Function (Fig. 4.5). This level consists of four main processes: Bubble 2.1: Print Information, Bubble 2.2: Register Students, Bubble 2.3: Maintain Student File, and Bubble 2.4: Maintain Curriculum. It is within these processes that students are registered and/or deleted, the curriculum is updated, all reports and certificates are generated, and student activity is monitored.

4.5.1 Print Information

Level 2.1, Print Information (Fig. 4.6), consists of five processes: Bubble 2.1.1: Create Evaluation Report, Bubble 2.1.2: Create Course Report, Bubble 2.1.3: Create Utilization Report, Bubble 2.1.4: Create Validation Report, and Bubble 2.1.5: Issue Certificate.

The CAI administrator initiates the request for the generation of all reports and certificates. All printed information, with the exception of the Certificate of Completion, is designed to be used by the CAI administrator in evaluating and managing the CAI. The Certificate of Completion is presented to the student upon successful completion of a course.

The Evaluation Report generated in Bubble 2.1.1 is created from student responses to a series of questions presented at the end of each course. The printed report lists the course number, the evaluation question text, student responses to each question, and statistical summary information.

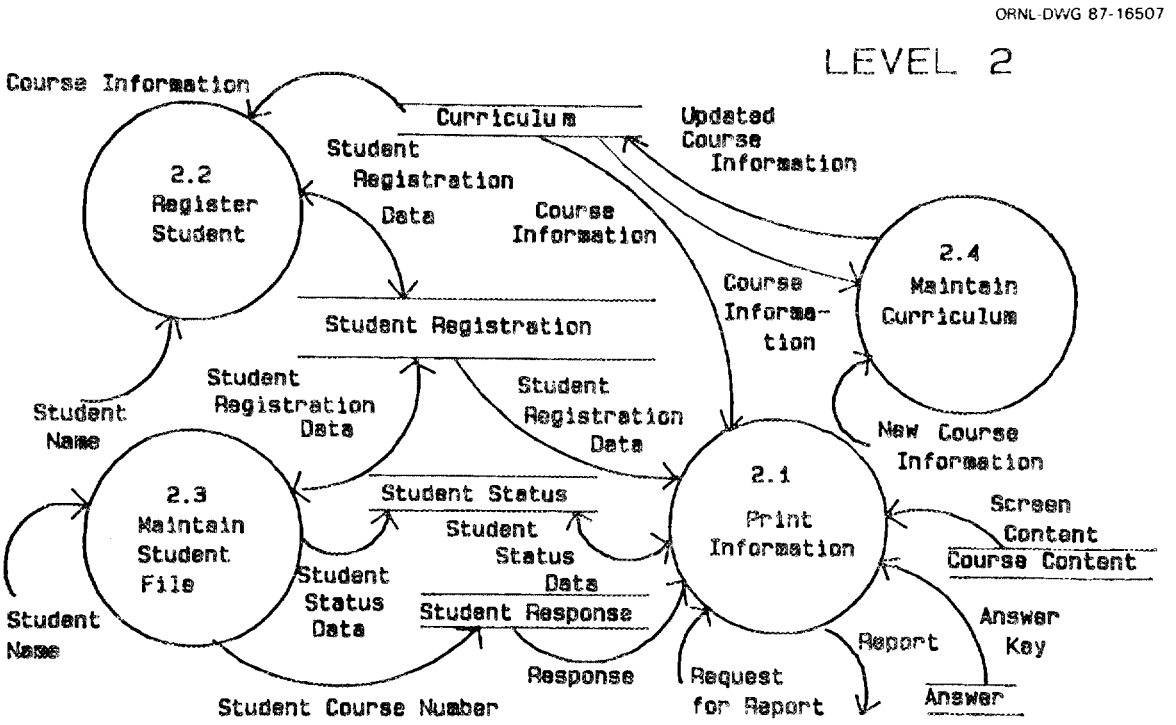


Fig. 4.5. Manage Administrative Function.

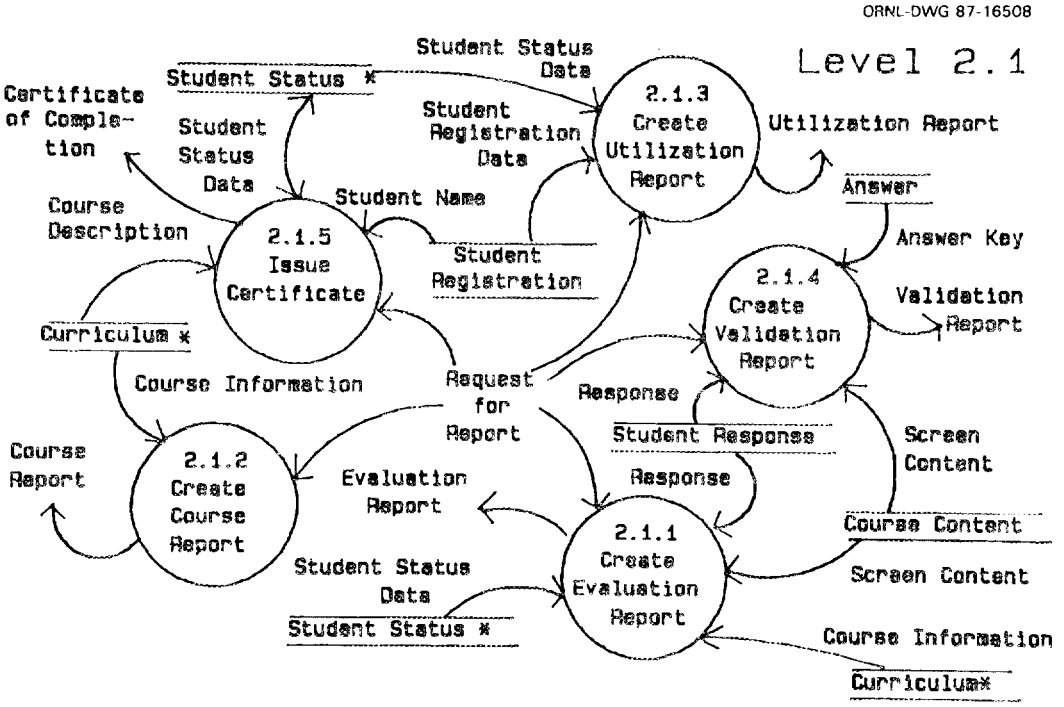


Fig. 4.6. Print Information.

The Course Report (Bubble 2.1.2) consists of a listing of course numbers, descriptions, and prerequisites. It is simply a catalog of available courses.

The Utilization Report (Bubble 2.1.3) is a compilation of the status of the students enrolled in the CAI. Statistical information is given for the number of students who have completed a course, the number of students in progress within a course, and the percent of lessons passed on the Pretest/Posttest by students who have completed the course. This report may be used to determine the level of utilization of each course within the CAI system. It also indicates usage by students who knew the information prior to taking the course.

A Validation Report (Bubble 2.1.3) is prepared for each course and is used to determine the validity of individual test questions. A listing is generated that contains questions presented on the Pretest and Posttest, student responses to each question, the correct answer, and relevant statistical information. This report should be created and reviewed regularly to identify any questions that result in an unusually high number of errors.

A Certificate is presented to the student for each successfully completed course. The certificate contains the student's name, the course name, and the date the student completed the course. Certificates of Completion (Bubble 2.1.5) are requested periodically based on a time schedule preselected by the CAI administrator. At the specified time, a certificate is prepared for each student who has completed a course since the last date certificates were prepared.

4.5.2 Register Student

The NAMO CAI Administrator is responsible for registering the students and assigning them to the appropriate courses. Level 2.2: Register Student depicts this process (Fig. 4.7). The student name is entered into the system. The name is assigned a computer-generated CAI number. This student name and CAI number become the Student Identification Data and are required each time a student logs into the system. The courses that are available in the CAI are displayed to the CAI administrator, who selects the courses that the student will be permitted to take. These courses and the Student Identification Data (student name and CAI number) are then stored in the Student Registration file where they can be referenced when needed.

The maintenance of student files consists of any modifications and/or deletions to these files. This function is performed by the CAI administrator. Students are registered in additional courses or removed from courses in Bubble 2.3. The student name is submitted and compared with the student name in the Student Registration file. If a course is to be added, the new course information is placed under the student's name in the Student Registration file. If a student is to be removed from a course, the course is deleted under the student's name in the Student Registration file. The Student Course Number is then used to delete the Student Status Data matching this number and any related information in the Student Response file.

From time to time the curriculum needs modification. The CAI administrator is responsible for updating course information and adding new information when necessary. This information is entered and existing information contained in the Curriculum file is modified in Bubble 2.4. The CAI administrator determines changes/additions to be made and updates or modifies the information accordingly.

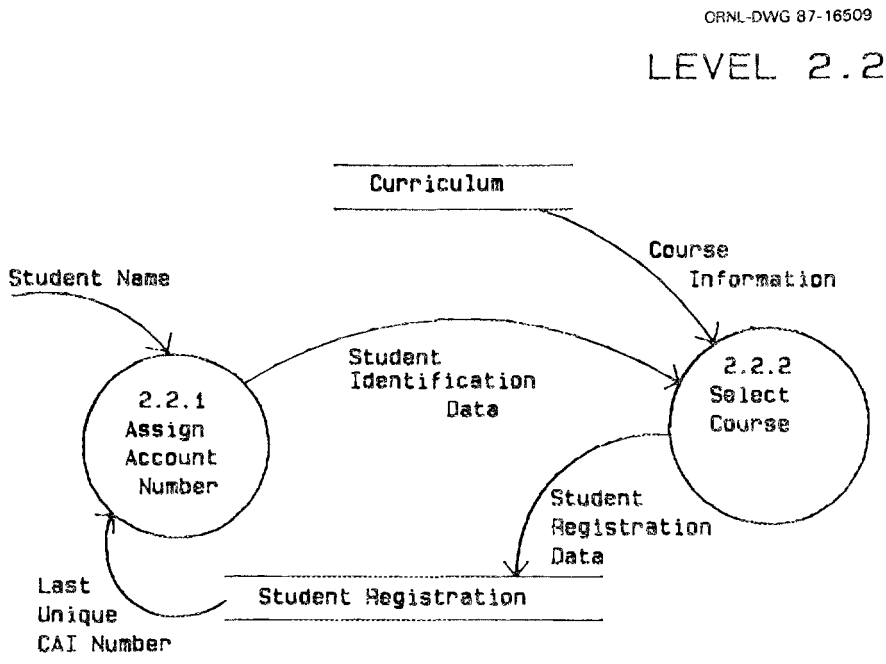


Fig. 4.7. Register Student.

5. CURRICULUM FOR THE NALDA CAI

The NALDA CAI is a completely self-contained teaching unit. All instructions, testing, and teaching are performed within the CAI system. The only outside instruction required for a student is a sheet of paper containing information on how to login/out of the CAI and the CAI Number assigned to the student.

It is expected that the student of the CAI prototype will have met the following prerequisites: knowledge of procedure for logging in/out of NALDA and the CAI, a valid ASO userid, a valid ASO password, and access to an IBM-AT compatible personal computer with an 80-column monitor.

An Introduction to the CAI is presented to the student upon first entry into the system. Material covered includes how to read the screen, use the menus, and navigate between the CAI and NALDA databases, special function keys used with the CAI, and information on the Pretest/Posttest. The student must complete the Introduction before any other course can be studied. This material is also available to the student throughout the training.

The only course being offered in the NALDA CAI Prototype is an introductory course on S2K. The prototype, however, is being designed to allow the addition of other courses in the future. The prototype S2K course consists of two units: (1) the Structure of System 2000 and (2) Basic S2K Data Retrieval.

The logical organization of S2K is presented with an explanation of terms that are used to describe the databases, schema relationships, and data types. Basic S2K data retrieval is taught, including logic, commands, and query edit. The curriculum for the NALDA CAI appears as Appendix G.

The development of the curriculum is ongoing and is being designed to give the student a solid background in information retrieval using S2K.

6. NEW FINDINGS AND CHANGES TO RECOMMENDATIONS

In the document, *Recommended CAI Approach for the NALDA System* (ORNL-6340), numerous recommendations were made on the content of the NALDA CAI system, features that should be included, and how they should be implemented. As work progressed with the detail system design and the implementation of the prototype, we determined that certain deviations from those original recommendations were in order. Those deviations are described below.

6.1 CONTENT OF NALDA CAI PROTOTYPE

Due to problems related to the existing user community, we recommended that the prototype be a refresher course for the experienced, but rusty, NALDA users. Later, NAMO staff suggested, and we agreed, that the greatest benefit could be achieved if the prototype were to address the needs of new users. The content and organization of the S2K Basic Data Retrieval lesson has been modified to emphasize the key components of query formulation and to provide the new S2K user with the greatest opportunity to customize output. The minimum features needed to get started with S2K comprise the NALDA CAI Prototype. Additional lessons and units will be required to provide full coverage of features and more advanced retrieval capabilities. This introductory course can also be made available to experienced users who desire to refresh their S2K skills.

6.2 SELECTION OF TRAINING DATABASE

In the interviews conducted during Phase I of this project, users indicated they preferred to have training on a database they would actually use rather than, or in addition to, the existing Fleet Originated Job (FOJ) training base or the EMPLOYEE database. Accordingly, we suggested that the advanced course be tailorable so that the student could select a familiar database to be used in examples and practice. While this recommendation was based on educationally sound principles, we now believe that the effort required to program the CAI in such a manner would be excessive. To implement such a choice would require the inclusion of a large case structure controlling the display of each screen and a second, more complex, case structure to evaluate student responses to the displayed information. We determined that use of the EMPLOYEE database was preferable for introductory S2K training because it isolated the information to be learned and did not assume or require an understanding of specific aviation logistics functions. Since we selected the standard EMPLOYEE database for the S2K introductory instruction, we now believe the advanced instruction should also use examples and practice on the same database. Although the EMPLOYEE database is being used within the prototype, we still recommend that additional courses be developed that will address the specific features of each database that comprises NALDA.

6.3 FEATURES

Menu status markers (*,+,>) were suggested as a means of keeping the student constantly apprised of progress through the course. Our research now indicates that students desire more informative messages, which reinforce success, in addition to the menu markers. The additional positive feedback also contributes to the students' readiness to learn and overall satisfaction with the course. Menu markers will be used in the NALDA CAI but will be supplemented with informational messages after key events such as the completion of a lesson or a test.

We recommended that, as soon as a student answered enough questions incorrectly to prevent passing, the test should be terminated. However, in the detail design of the prototype, we have included the capability for the student to skip questions and to page backward and forward to check or change answers. The added capability of reviewing answers has made it impossible to terminate a test before all questions have been presented. Answers are not "graded" until the student completes the test.

7. FUTURE PLANS

Work is continuing toward finalizing the CAI prototype for testing at user sites. Major programming routines have been written and implemented. These routines will form a skeleton of reusable code, which may be used for all future CAI development. Additionally, concrete screen design standards have been developed that will make future development easier and will provide consistency between courses. Screen design is in its final stages and text is being written. The development of this prototype is ongoing and is subject to change. Standards and specifications in this document are preliminary. After the testing is complete, any revisions will be made and the CAI prototype implemented. A final report will follow the completion of this phase.

8. SUMMARY

Much time was spent in the structured design phase of the NALDA CAI project. However, members of the NALDA CAI team are confident that the findings of this phase have been well worth the time spent. Each aspect of the system being designed has been studied and potential deficiencies in the design have been remedied. This paves the way for the development of code for the system that is reliable, flexible, and maintainable. Most systems written without the use of structured design are costly in terms of the time that must be spent repairing problems that have been created by faulty design—not bad programming.

The design of the NALDA CAI has been through rigid tests, and the final results are considered to be the best possible for the system being designed. The final programming of the system should be much faster, smoother, and more effective due to the disciplined analysis.

Appendix A

PROCESS SPECIFICATIONS

A. PROCESS SPECIFICATIONS

The Process Specifications for the NALDA CAI Prototype were derived through structured design methods and are intended to provide a valuable working tool for programmers who must write the programs to implement the system.

A.1 VALIDATE STUDENT (Bubble 1.1)

Precondition	1	STUDENT IDENTIFICATION DATA occurs and is matched with CAI NUMBER and STUDENT NAME located within STUDENT REGISTRATION DATA called from STUDENT REGISTRATION
Postcondition	1	STUDENT COURSE NUMBER released set to CAI NUMBER and one or more of COURSE NUMBER
Precondition	2	STUDENT IDENTIFICATION DATA occurs and is not matched with CAI NUMBER and STUDENT NAME located within STUDENT REGISTRATION DATA called from STUDENT REGISTRATION
Postcondition	2	Error Message

A.2 PROCESS MENU (Bubble 1.2.1)

Precondition	1	STUDENT COURSE NUMBER occurs set to CAI NUMBER and COURSE NUMBER and is matched with CAI NUMBER in STUDENT STATUS DATA from STUDENT STATUS and SCREEN IDENTIFIER has SCREEN TYPE "T" or "C" and branch address is set to SCREEN IDENTIFIER of the Placemarker Menu
Postcondition	1	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	2	STUDENT INPUT (* Last Exit Point Selection *) occurs and branch address is set to SCREEN IDENTIFIER of the Last Exit Point
Postcondition	2	CAI NUMBER is released
Precondition	3	STUDENT INPUT (* Restart Lesson Selection *) occurs and branch address is set to SCREEN IDENTIFIER of the first screen of the lesson
Postcondition	3	CAI NUMBER is released
Precondition	4	STUDENT INPUT (* Menu Selection from Placemarker Menu *) occurs and INTRO FLAG is "Y" and branch address is set to SCREEN IDENTIFIER for the COURSE MENU
Postcondition	4	SCREEN TEXT accessed from COURSE CONTENT and COURSE DESCRIPTION accessed from CURRICULUM and course status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	5	STUDENT INPUT (* Menu Selection from Placemarker Menu *) occurs and INTRO FLAG is "N" and branch address is set to SCREEN IDENTIFIER for the UNIT MENU of Introduction

A.2 PROCESS MENU (Bubble 1.2.1) (continued)

Postcondition	5	SCREEN TEXT accessed from COURSE CONTENT and unit status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	6	STUDENT COURSE NUMBER occurs set to CAI NUMBER and COURSE NUMBER and is matched with CAI NUMBER in STUDENT STATUS DATA from STUDENT STATUS and SCREEN IDENTIFIER has SCREEN TYPE not "T" or "C" and INTRO FLAG is "Y" and branch address is set to SCREEN IDENTIFIER of the Course Menu
Postcondition	6	SCREEN TEXT accessed from COURSE CONTENT and COURSE DESCRIPTION accessed from CURRICULUM and course status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	7	STUDENT INPUT (* Course Menu Selection *) occurs and branch address is set to SCREEN IDENTIFIER of Unit Menu
Postcondition	7	SCREEN TEXT accessed from COURSE CONTENT and unit status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	8	STUDENT INPUT (* Unit MENU SELECTION *) occurs and is matched with COURSE NUMBER and UNIT NUMBER in STUDENT STATUS and STATUS is "0" and branch address is set to SCREEN IDENTIFIER of the Pretest Menu
Postcondition	8	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	9	STUDENT INPUT (* Unit MENU SELECTION *) occurs and matches COURSE NUMBER and UNIT NUMBER in STUDENT STATUS and STATUS is greater than "0" and branch address is set to SCREEN IDENTIFIER of the Selected Lesson Menu
Postcondition	9	SCREEN TEXT accessed from COURSE CONTENT and lesson status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	10	STUDENT INPUT (* Lesson MENU SELECTION *) occurs and STATUS within STUDENT STATUS is "0" and branch address is set to SCREEN IDENTIFIER for Selected Lesson
Postcondition	10	STATUS within STUDENT STATUS is updated to "1" and CAI NUMBER is released
Precondition	11	STUDENT INPUT (* Lesson MENU SELECTION *) occurs and STATUS within STUDENT STATUS is greater than "0" and SCREEN INDENTIFIER has SCREEN TYPE "T" or "C" and SCREEN INDENTIFER is set to Placemark Menu
Postcondition	11	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	12	STUDENT INPUT (* Lesson MENU SELECTION *) occurs and STATUS within STUDENT STATUS is greater than "0" and SCREEN INDENTIFIER has SCREEN TYPE not "T" or "C" and branch address is set to SCREEN IDENTIFIER of the first screen of lesson

A.2 PROCESS MENU (Bubble 1.2.1) (continued)

Postcondition	12	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	13	CAI NUMBER occurs and branch address is set to SCREEN IDENTIFIER for Menu
Postcondition	13	SCREEN TEXT accessed from COURSE CONTENT and lesson status indicators (*,+,>) derived from STUDENT STATUS are displayed
Precondition	14	STUDENT INPUT (* Negative Pretest Option *) occurs and branch address is set to SCREEN IDENTIFIER for Lesson Menu
Postcondition	14	STUDENT STATUS is updated set to CAI NUMBER and COURSE NUMBER and UNIT NUMBER and iterations of LESSON NUMBER and STATUS is "0" and SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	15	STUDENT INPUT (* Positive Pretest Option/Option Bar Selection=F *) occurs and screen number is randomly generated for the first question
Postcondition	15	Branch address is set to SCREEN IDENTIFIER for pretest/posttest and CAI NUMBER is released
Precondition	16	STUDENT INPUT occurs (* OPTION BAR SELECTION = E *) and branch address is set to SCREEN IDENTIFIER of previous Menu
Postcondition	16	SCREEN TEXT accessed from COURSE CONTENT is displayed or System Exit Occurs
Precondition	17	STUDENT INPUT occurs (* OPTION BAR SELECTION = H or S or R *) and current SCREEN IDENTIFIER is stored internally and branch address is set to SCREEN IDENTIFIER of Help Menu or Summary or Review
Postcondition	17	SCREEN TEXT accessed from COURSE CONTENT is displayed

A.3 CONTROL COURSE DELIVERY (Bubble 1.2.2)

Precondition	1	(* Student's first entrance into CAI *) STUDENT COURSE NUMBER occurs set to CAI NUMBER and COURSE NUMBER and is matched with CAI NUMBER in STUDENT STATUS DATA from STUDENT STATUS and branch address is set to SCREEN IDENTIFIER of the first screen of Introduction and INTRO FLAG is "X" and SCREEN IDENTIFIER is stored internally
Postcondition	1	SCREEN TEXT accessed from COURSE CONTENT is displayed and INTRO FLAG in STUDENT STATUS is updated to "N"
Precondition	2	CAI NUMBER occurs and branch address is set to SCREEN IDENTIFIER for first accessed screen of selected Lesson or Test Question and SCREEN IDENTIFIER is stored internally

A.3 CONTROL COURSE DELIVERY (Bubble 1.2.2) (continued)

Postcondition	2	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	3	STUDENT INPUT (* Carriage Return / Criterion *) occurs and branch address is set to SCREEN IDENTIFIER for next screen and SCREEN IDENTIFIER is stored internally
Postcondition	3	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	4	STUDENT INPUT (* Response to Test or Evaluation Question *) occurs set to STUDENT ANSWER or ANSWER TO EVALUATION QUESTION and branch address is set to SCREEN IDENTIFIER of the next question or Test Completion sequence is initiated and SCREEN IDENTIFIER is stored internally
Postcondition	4	RESPONSE is stored in STUDENT RESPONSE and SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	5	(* After exit from testing phase *) For stored SCREEN IDENTIFIERs SCREEN IDENTIFIER in RESPONSE is matched with SCREEN IDENTIFIER in ANSWER KEY and STUDENT ANSWER in RESPONSE is evaluated against CORRECT ANSWER in ANSWER KEY and branch address is set to SCREEN IDENTIFIER of the Information Screen
Postcondition	5	STUDENT STATUS DATA set to CAI NUMBER and COURSE NUMBER and UNIT NUMBER and iterations of LESSON NUMBER and STATUS is stored in STUDENT STATUS and SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	6	STUDENT INPUT occurs (* Carriage Return on Information Screen *) and status data accessed from STUDENT STATUS and branch address is set to SCREEN IDENTIFIER for Menu
Postcondition	6	CAI NUMBER is released
Precondition	7	STUDENT INPUT occurs (* OPTION BAR SELECTION = B *) and branch address is set to SCREEN IDENTIFIER of previous screen
Postcondition	7	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	8	(*Student is not in Help or Summary*) STUDENT INPUT occurs (* OPTION BAR SELECTION = E *) and branch address is set to SCREEN IDENTIFIER of Lesson Menu
Postcondition	8	SCREEN IDENTIFIER for current lesson is stored in STUDENT STATUS twice and CAI NUMBER is released
Precondition	9	(* Student is in Help or Summary *) STUDENT INPUT occurs (* OPTION BAR SELECTION = E *) and branch address is set to SCREEN IDENTIFIER of screen prior to entrance

A.3 CONTROL COURSE DELIVERY (Bubble 1.2.2) (continued)

Postcondition	9	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	10	STUDENT INPUT occurs (* Last Screen of Lesson *) and branch address is set to SCREEN IDENTIFIER of Lesson Menu
Postcondition	10	STATUS within STUDENT STATUS is updated with "2" and CAI NUMBER is released
Precondition	11	STUDENT INPUT occurs (* OPTION BAR SELECTION = H or S *) and current SCREEN IDENTIFIER is stored internally and branch address is set to SCREEN IDENTIFIER of the Help Menu or Summary
Postcondition	11	SCREEN TEXT accessed from COURSE CONTENT is displayed
Precondition	12	STUDENT INPUT occurs (* Last Screen of Introduction *)
Postcondition	12	SCREEN IDENTIFIER within STUDENT STATUS is set to Course Menu and INTRO FLAG is set to "Y" and STUDENT COURSE NUMBER is released

A.4 CREATE EVALUATION REPORT (Bubble 2.1.1)

Precondition	1	REQUEST FOR REPORT occurs matching "Evaluation"
Postcondition	1	EVALUATION REPORT is created from RESPONSE retrieved from STUDENT RESPONSE and matching SCREEN IDENTIFIER of type "E" in COURSE CONTENT and matching COURSE NUMBER and CAI NUMBER from RESPONSE to COURSE NUMBER and CAI NUMBER in STUDENT STATUS to get COMPLETION DATE and matching COURSE NUMBER from RESPONSE to COURSE NUMBER in CURRICULUM set to COURSE EVALUATION REPORT as defined in Data Dictionary

A.5 CREATE COURSE REPORT (Bubble 2.1.2)

Precondition	1	REQUEST FOR REPORT occurs matching "Course"
Postcondition	1	COURSE REPORT is created from COURSE INFORMATION retrieved from CURRICULUM set to iterations of COURSE NUMBER and COURSE DESCRIPTION and COURSE PREREQUISITE

A.6 CREATE UTILIZATION REPORT (Bubble 2.1.3)

Precondition	1	REQUEST FOR REPORT occurs matching "Utilization"
Postcondition	1	UTILIZATION REPORT is created from STUDENT STATUS DATA retrieved from STUDENT STATUS set to COURSE NUMBER, count of students in progress, count of students completing course, and calculations of percent of lessons passed on pretest and percent of lessons passed on posttest by students who have completed course and percent of students completed and STUDENT REGISTRATION DATA from STUDENT REGISTRATION set to Count of Registered Students by COURSE NUMBER

A.7 CREATE VALIDATION REPORT (Bubble 2.1.4)

Precondition 1 REQUEST FOR REPORT occurs matching "Validation"

Postcondition 1 VALIDATION REPORT is created from SCREEN IDENTIFIER of SCREEN TYPE "P" retrieved from STUDENT RESPONSE and matching SCREEN IDENTIFIER in ANSWER to get ANSWER KEY and matching SCREEN IDENTIFIER in COURSE CONTENT to get TEST QUESTION set to COURSE NUMBER and TEST QUESTION and ANSWER KEY and iterations of STUDENT ANSWER and count of correct and count of incorrect and count of unanswered and percent correct and percent incorrect and percent unanswered

A.8 ISSUE CERTIFICATE (Bubble 2.1.5)

Precondition 1 REQUEST FOR REPORT occurs matching "Certificate"

Postcondition 1 CERTIFICATE OF COMPLETION is created based on COMPLETION DATE accessing CAI NUMBER and COURSE NUMBER from STUDENT STATUS and matching CAI NUMBER in STUDENT REGISTRATION to get STUDENT NAME and matching COURSE NUMBER in CURRICULUM to get COURSE DESCRIPTION set to COURSE DESCRIPTION and STUDENT NAME and COMPLETION DATE and Certificate Text and PRINT FLAG is updated in STUDENT STATUS

A.9 ASSIGN ACCOUNT NUMBER (Bubble 2.2.1)

Precondition 1 STUDENT NAME occurs initiating search of STUDENT REGISTRATION for LAST UNIQUE CAI NUMBER

Postcondition 1 STUDENT IDENTIFICATION DATA set to STUDENT NAME and (LAST UNIQUE CAI NUMBER plus 1)

A.10 SELECT COURSE (Bubble 2.2.2)

Precondition 1 STUDENT IDENTIFICATION DATA occurs set to NAME and CAI NUMBER and COURSE NUMBER and COURSE DESCRIPTION in COURSE INFORMATION is retrieved from CURRICULUM

Postcondition 1 STUDENT REGISTRATION DATA within STUDENT REGISTRATION is updated and set to STUDENT NAME and CAI NUMBER and one or more COURSE NUMBER

A.11 MAINTAIN STUDENT FILE (Bubble 2.3)

Precondition 1 STUDENT NAME occurs and is matched with STUDENT NAME in STUDENT REGISTRATION DATA stored in STUDENT REGISTRATION

Postcondition 1 STUDENT REGISTRATION DATA modified and if deletion took place STUDENT STATUS DATA matching STUDENT COURSE NUMBER is deleted from STUDENT STATUS and RESPONSE matching STUDENT COURSE NUMBER is deleted from STUDENT RESPONSE

A.12 MAINTAIN CURRICULUM (Bubble 2.4)

Precondition	1	NEW COURSE INFORMATION occurs and is evaluated with COURSE INFORMATION located in CURRICULUM
Postcondition	1	UPDATED COURSE INFORMATION modifies or is added to CURRICULUM

A.13 CREATE COURSE CONTENT (Bubble 3.0)

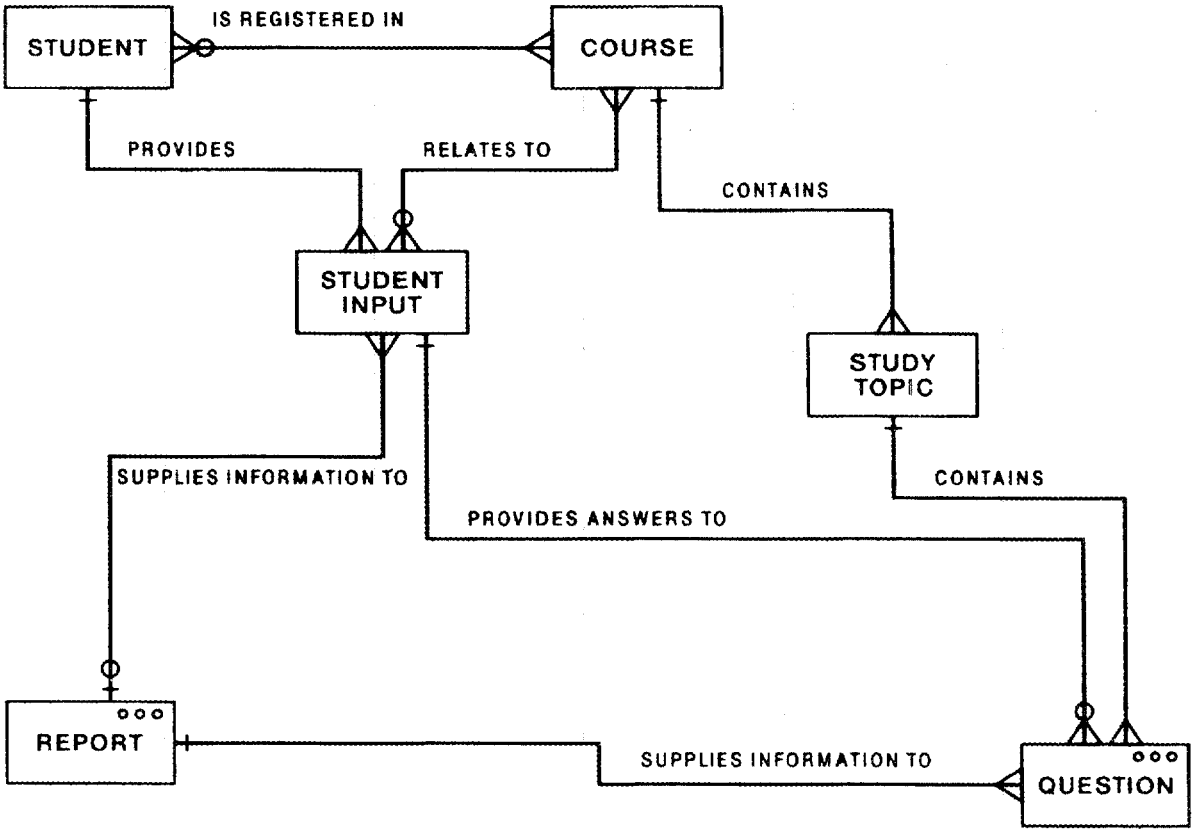
Precondition	1	AUTHOR INPUT occurs
Postcondition	1	SCREEN TEXT is assigned SCREEN IDENTIFIER and stored in COURSE CONTENT
Precondition	2	SCREEN IDENTIFIER occurs with SCREEN TYPE "P"
Postcondition	2	ANSWER KEY is stored in ANSWER

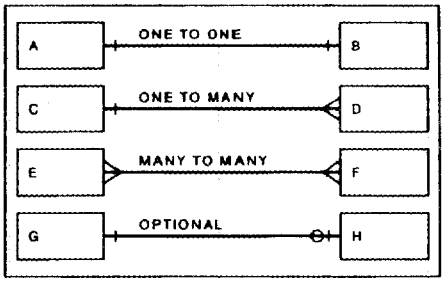
Appendix B

ENTITY-RELATIONSHIP DIAGRAM

ORNL-DWG 87C-18495

ERD FOR NALDA CAI

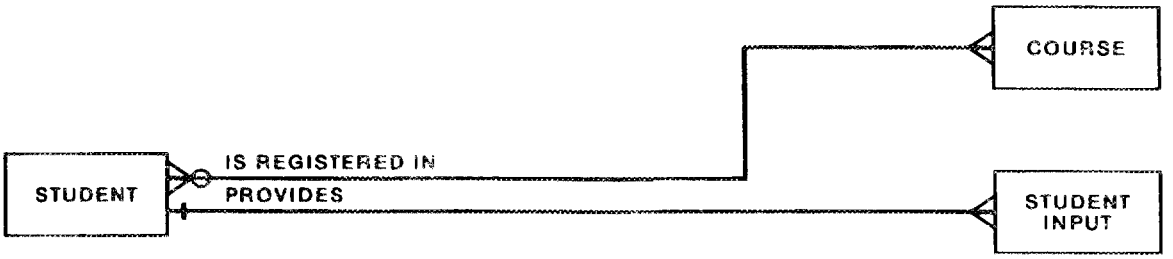


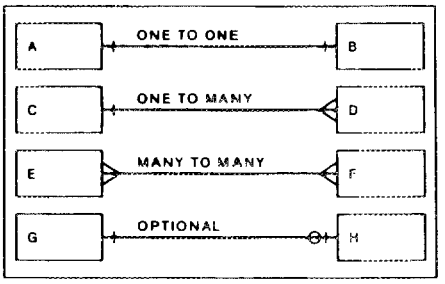


LEGEND

ORNL-DWG 87C-18499

STUDENT RELATIONSHIPS WITHIN THE ERD

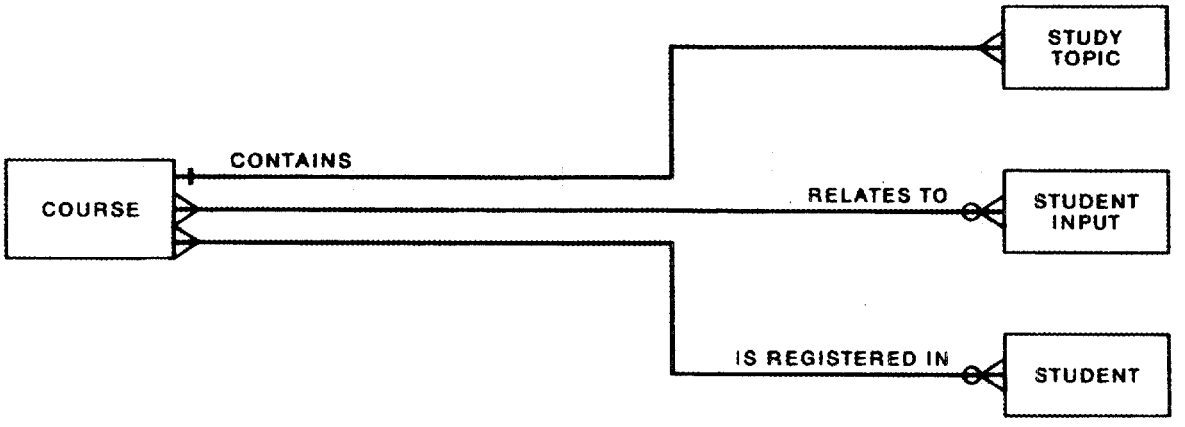


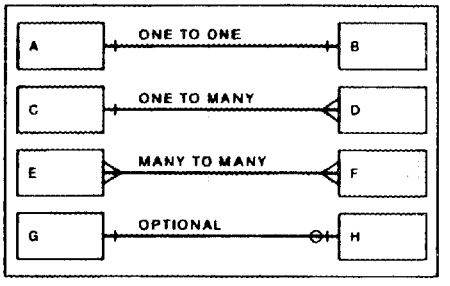


LEGEND

ORNL-DWG 87C-18500

COURSE RELATIONSHIPS WITHIN THE ERD

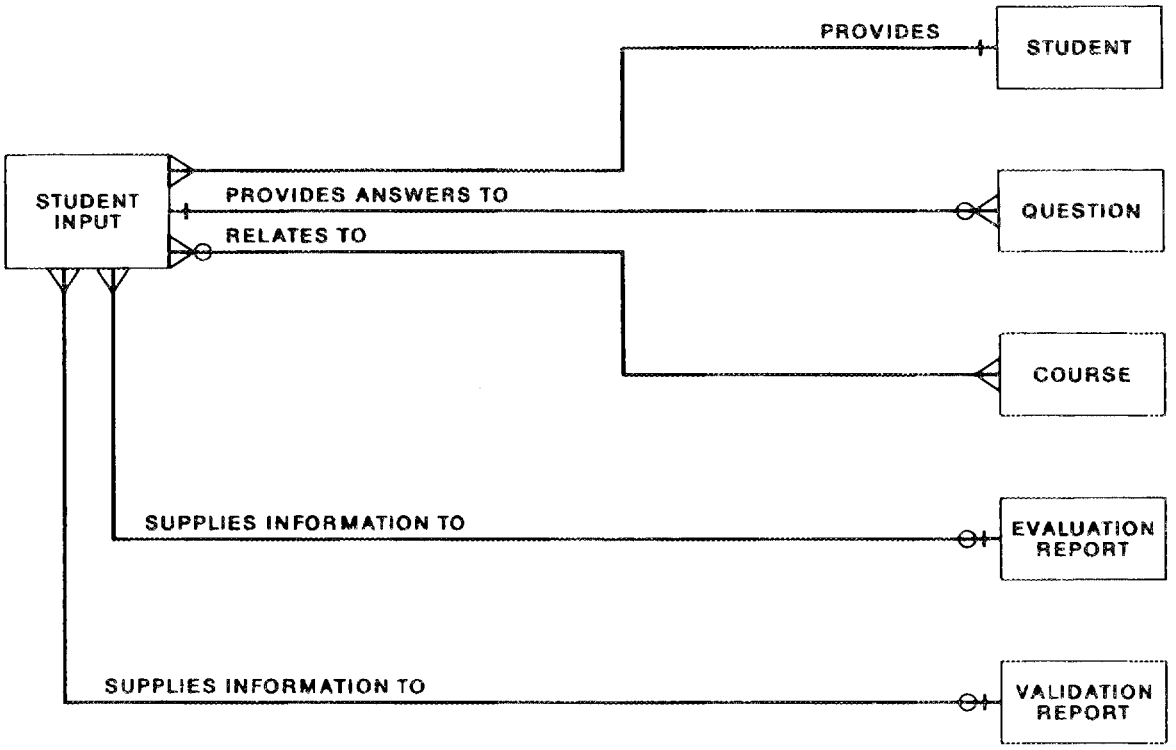


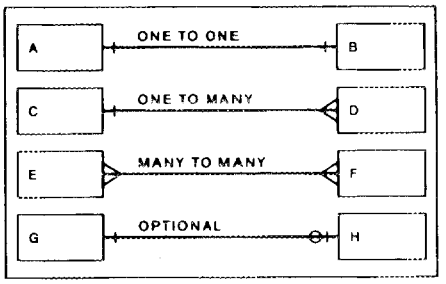


LEGEND

ORNL-DWG 87C-18502

STUDENT INPUT RELATIONSHIPS WITHIN THE ERD

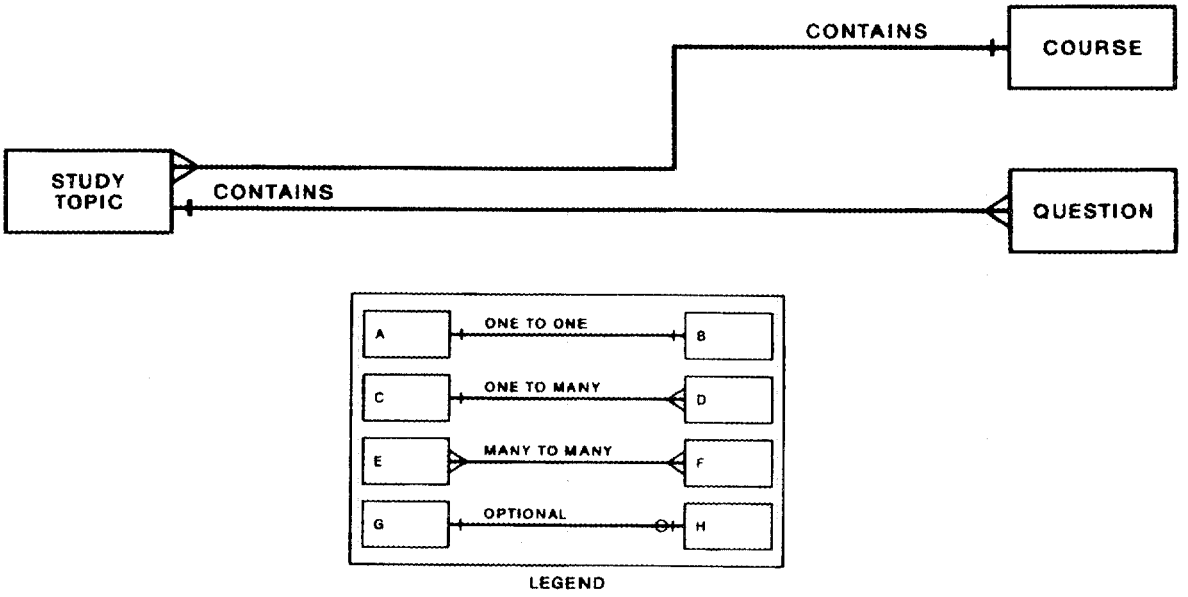




LEGEND

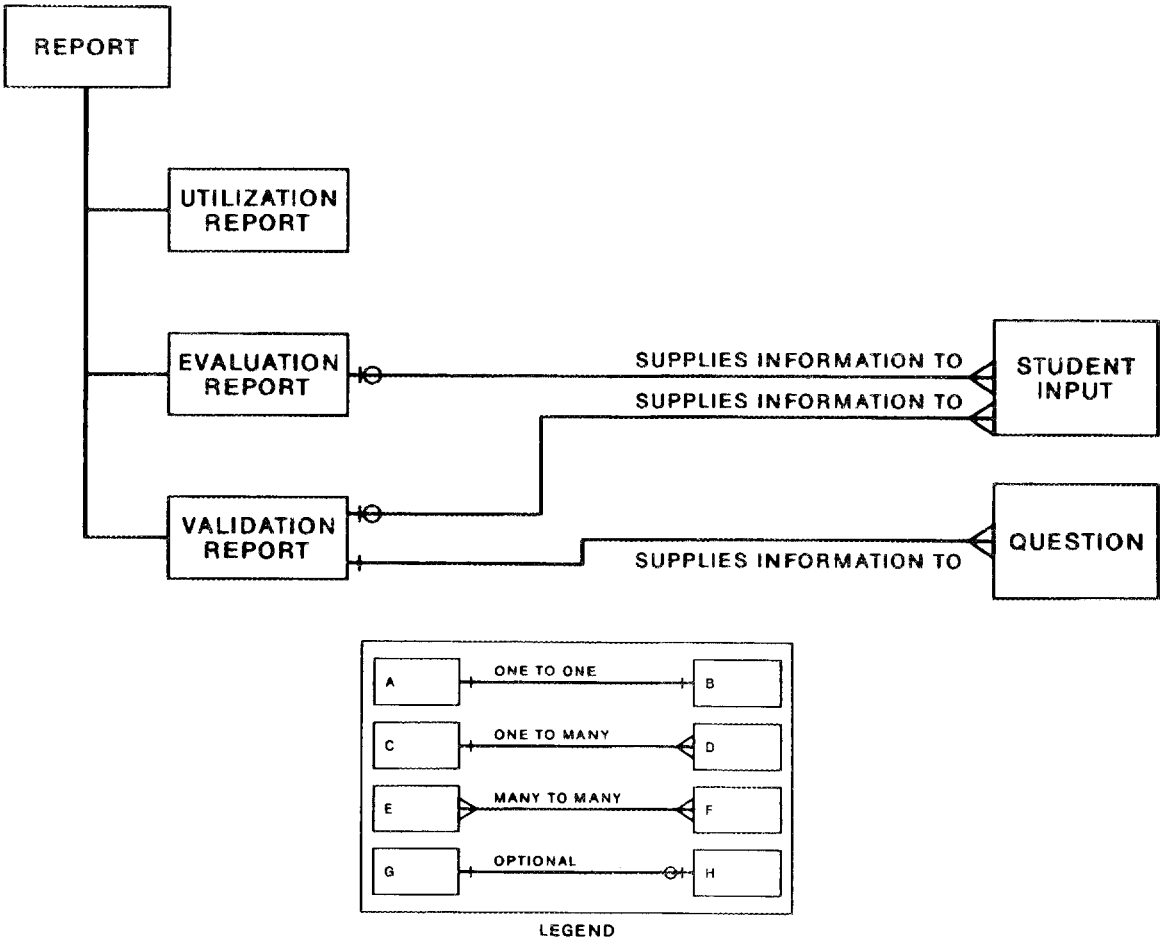
ORNL-DWG 87C-18501

STUDY TOPIC RELATIONSHIPS WITHIN THE ERD



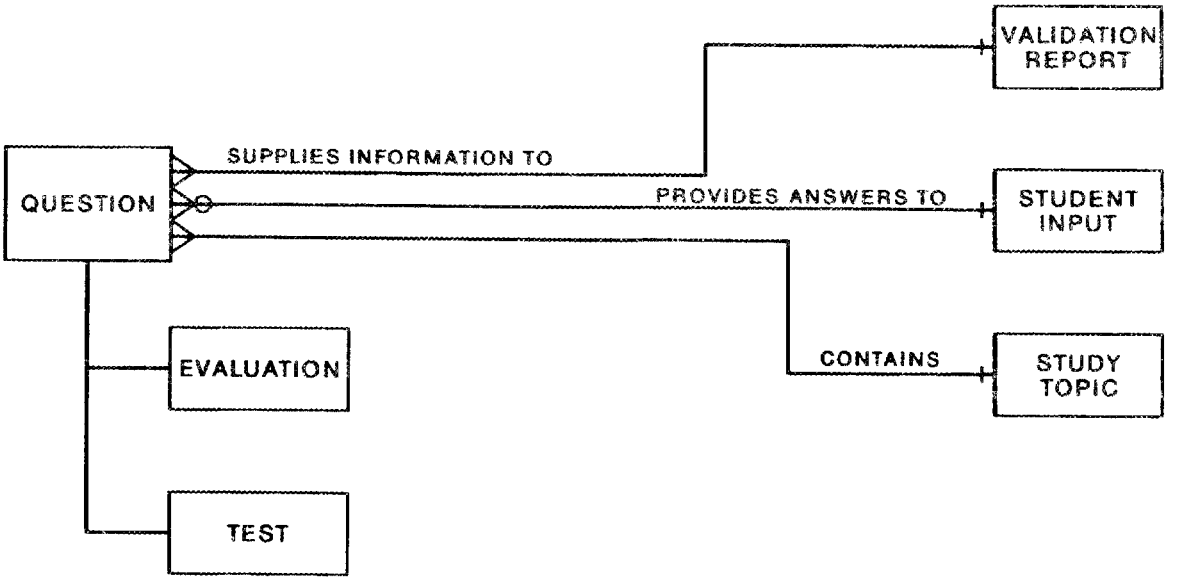
ORNL-DWG 87C-18497

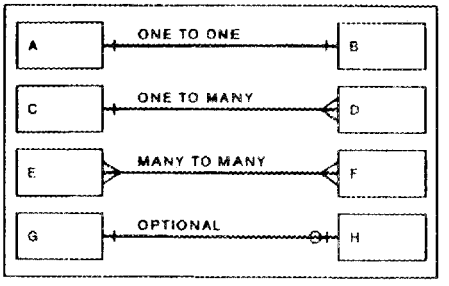
REPORT RELATIONSHIPS WITHIN THE ERD



ORNL-DWG 87C-12496

QUESTION RELATIONSHIPS WITHIN THE ERD





LEGEND

Appendix C

DATA DICTIONARY

NALDA CAI DATA DICTIONARY 18-Sep-1987

	Data Flow/Store/Element Name or Description/Decomposition Interface or Abbreviation	
1	Administrator	*The person responsible for administering the course including student and course registration, production and interpretation of reports, and direction of personnel performing course maintenance, corrections, and/or enhancements*
2	Answer	={Answer Key}
3	Answer Key	=Screen Identifier + {Correct Answer}
4	Answer to Criterion Question	*The student's direct answer to a criterion question which occurs within the teaching screens*
5	Answer to Evaluation Question	*The student's direct answer to an evaluation question which occurs at the end of each course*
6	Author	*The person(s) responsible for creating the course content, as directed by the NAMO administrator*
7	Author Input	*The instructions, screen text, and other input to the authoring system entered by a course developer (author)*
8	CAI Number	*A number that uniquely identifies each CAI student and is formed by the last unique CAI number plus 1 at time of registration*
9	Certificate of Completion	*Certificate issued to Student upon completion of course. Contains name, course description, Completion Date, and certificate text*
10	Completion Date	*Date course was completed*
11	Correct Answer	*A correct answer to a pretest or posttest question*
12	Course Content	={Screen Content}

Symbols Used in Data Dictionary

====	Is Composed of	[]	Select One of
+	And	**	Comment
()	Optional	@	Identifier for a Store (Key Field)
{}	Iteration	|	Or

13	Course Description	*Course Name*
14	Course Information	=@Course Number + Course Description + Course Prerequisite
15	Course Number	*Two alphanumeric characters corresponding to a specific course*
16	Course Report	={Course Information}
17	Course Prerequisite	*Requirement for course enrollment*
18	Criterion Question	*A question asked the student while receiving instruction to measure understanding of the lesson*
19	Curriculum	={Course Information}
20	Evaluation Data	=Course Number + Course Description + count of Students + {Evaluation Question + [{Answer to Evaluation Question + Completion Date} | {count of Answer to Evaluation Question + {percent of Answer to Evaluation Question}]}
21	Evaluation Question	*A question asked the student to assess attitudes toward the training received*
22	Evaluation Report	={Evaluation Data} + Course Number
23	Information Text	*A screen of information containing notification or feedback messages*
24	Introduction Flag	[Y *Introduction completed* | N *Introduction Not Completed* | X *Introduction never started*]
25	Last Unique CAI Number	*Highest CAI number found in Student Registration at any time*
26	Lesson Number	*A number that uniquely identifies a lesson within a course*
27	Lesson Text	*One screen of information contained in an interactive lesson*
28	Menu Information	*Options available to student*
29	Menu Selection	*The student's choice of an option from a menu*
30	New Course Information	*Any change necessary to course information as a result of an administrative report*

Symbols Used in Data Dictionary

==	Is Composed of	[]	Select One of
+	And	**	Comment
()	Optional	@	Identifier for a Store (Key Field)
{}	Iteration	|	Or

31	Option Bar Selection	=[B *Back* | E *Exit* | H *Help* | H *Hint* | F *Posttest (Final)* | R *Review* | C *Continue* | S *Summary*]
32	Print Flag	*Marker in Student Status to indicate the Certificate of Completion has been issued*
33	Report	=[Evaluation Report | Course Report | Utilization Report | Validation Report | Certificate of Completion]
34	Report Statistics	=Course Number + Unit Number + [Count of Passed Posttest | Count of Passed Pretest]
35	Request for Report	=[Request for Evaluation Report | Request for Course Report | Request for Utilization Report | Request for Validation Report | Request for Certificate]
36	Response	=Screen Identifier + CAI Number + [Student Answer + Test Phase | Answer to Evaluation Question | date | time]
37	Review Text	*One screen of information contained in a lesson review*
38	Screen Content	*Used internally* =Screen Text + Screen Identifier
39	Screen Identifier	*A unique designator assigned to each screen. These fields are electronically stored in the following order* =Course Number + Unit Number + Lesson Number + Screen Type + Screen Number
40	Screen Number	*A three-digit number indicating which screen within a lesson*
41	Screen Text	*Displayed to Student* =[Menu Information | Lesson Text | Summary Text | Review Text | Criterion Question | Test Question | Evaluation Question]
42	Screen Type	=[M *Menu* | T *Text* | C *Criterion* | P *Pretest/Posttest* | H *Help* | I *Information* | R *Review* | S *Summary* | E *Evaluation*]

Symbols Used in Data Dictionary

==	Is Composed of	[]	Select One of
+	And	**	Comment
()	Optional	@	Identifier for a Store (Key Field)
{}	Iteration	|	Or

43	Status	=[0 *Null* | 1 *Lesson has begun* | 2 *Lesson has been studied* | 3 *Passed on Pretest* | 4 *Passed on Posttest*]
44	Student	*The person interacting with the course software*
45	Student Answer	*The student's answer to a pretest or posttest question*
46	Student Course Number	=CAI Number + {Course Number}
47	Student Identification Data	=Student Name + CAI Number
48	Student Input	=[Answer to Criterion Question | Answer to Evaluation Question | Student Answer | Menu Selection | Carriage Return | Option Bar Selection | CAI Number | Student Name]
49	Student Name	*Name of the individual user*
50	Student Registration	={Student Registration Data}
51	Student Registration Data	=Student Identification Data + Course Number
52	Student Response	={Response}
53	Student Status	={Student Status Data}
54	Student Status Data	=CAI Number + Screen Identifier + Introduction Flag + {Course Number + {Unit Number + {Lesson Number + Status + Screen Type + Screen Number}} + Print Flag + Completion Date}
55	Summary Text	*One screen of information contained in a lesson summary*
56	Test Phase	*Testing phase during which question appeared [P *Pretest* | F *Final/Posttest*]*
57	Test Question	*A question asked the student as a part of a formal test*
58	Unit Number	*Number that uniquely identifies a unit within a course*
59	Updated Course Information	*New and/or modified course information*

Symbols Used in Data Dictionary

=	Is Composed of	[]	Select One of
+	And	**	Comment
()	Optional	@	Identifier for a Store (Key Field)
{}	Iteration	|	Or

60	Utilization Report	*Report consisting of the percentages of lessons passed on the pretest and lessons passed on the posttest by students who have completed a specific course* ={@Course Number + count of students registered in the course + count of students who have completed the course + % of students completing the course + count of students in progress + % of lessons completed on pretest by students who have completed the course + % of lessons completed on posttest by students who have completed the course}
61	Validation Report	*Report used by the course Administrator to determine the validity of individual test questions* ={Screen Identifier + {Student Answer} + {Correct Answer} + count of correct + count of incorrect + count of unanswered + percent correct + percent incorrect + percent unanswered}

Symbols Used in Data Dictionary

====	Is Composed of	[]	Select One of
+	And	**	Comment
()	Optional	@	Identifier for a Store (Key Field)
{}	Iteration	|	Or

Appendix D

STANDARDS

Standards for NALDA CAI

LOCATION AREA 1

(2,1),(19,1),(2,10),(19,10)	**FRAME**	Background Color	***BLACK***
		Foreground Color	***WHITE***
		Frame Color	***BLUE***

(4,2) 'DSRD Prototype'
(6,4) Course name <= 13 characters
(6,5) Unit name <= 13 characters
(6,6) Lesson name <= 13 characters
(6,7) Blank line/lesson name cont'd <= 13 characters
(7,9) Screen Identifier = 8 alphanumerics

Put ASCII character #249 in column 5 rows 4, 5, and 6

LOCATION AREA 2

(2,1),(19,1),(2,10),(19,10)	**FRAME**	Background Color	***BLACK***
		Foreground Color	***WHITE***
		Frame Color	***GREEN***

(4,2) 'DSRD Prototype'
(6,4) Course name <= 13 characters
(6,5) Unit name <= 13 characters
(6,6) Lesson name <= 13 characters
(6,7) Blank line/lesson name cont'd <= 13 characters
(7,9) Screen Identifier = 8 alphanumerics

Put ASCII character #249 in column 5 rows 4, 5, and 6

MESSAGE AREA 1

(4,12),(18,12),(4,22),(18,22)	Background Color	***BLACK***
	Foreground Color	***WHITE***

Used for key idea, module positioning, error messages, graphic

Up to 15 characters per line
11 lines available

Module position (4,22),(18,22) 'Screen ## of ##'

Error message	**BOX** 4,16,17,22	Box Color	***WHITE***
	FRAME 4,16,17,22	Frame Color	***BLUE***
		Foreground Color	***BLUE***

14 or less words
Up to 12 characters per line
5 lines available
Acts as a window

MESSAGE AREA 2

(4,12),(18,12),(4,22),(18,22)

Background Color ***BLACK***
Foreground Color ***WHITE***

Used for error messages, key idea, module positioning, graphic

Up to 15 characters per line
11 lines available

Module position (4,22),(18,22) 'Screen ## of ##'

Error message

BOX 4,16,17,22
FRAME 4,16,17,22

Box Color ***GREEN***
Frame Color ***BLACK***
Foreground Color ***BLACK***

14 or less words
Up to 12 characters per line
5 lines available
Acts as a window

MESSAGE AREA 3

(4,12),(18,12),(4,22),(18,22)

Background Color ***BLACK***
Foreground Color ***WHITE***

Used for error messages, key idea, module positioning, graphic

Up to 15 characters per line
11 lines available

Error message

BOX 4,16,17,22
FRAME 4,16,17,22

Box Color ***WHITE***
Frame Color ***BLUE***
Foreground Color ***BLUE***

14 or less words
Up to 12 characters per line
5 lines available
Acts as a window

OPTION BAR AREA 1 (Options noted in order for each screen type)

(22,24),(78,24) **BOX**

Box Color ***WHITE***
Foreground Color ***BLUE***

Blank space before the first option and after the last option
Two blanks between the options

OPTION BAR AREA 2 (Options noted in order for each screen type)

(22,24),(78,24)	**BOX**	Box Color	***GREEN***
		Foreground Color	***BLACK***

Blank space before the first option and after the last option
Two blanks between the options

CARRIAGE RETURN (almost all screens: exception noted in Summary)

(72,22),(73,22)	↵	Background Color	***BLACK***
		Foreground Color	***WHITE***

RESPONSE AREA (All menu screens and most question screens; exceptions noted)

(40,22),(59,22)		Background Color	***BLACK***
		Foreground Color	***WHITE***

20 characters available
1 line available

HINT/FEEDBACK AREA 1

(22,2),(77,2),(22,6),(77,6)	**BOX** 22,2,77,6	Box Color	***WHITE***
	FRAME 22,2,77,6	Frame Color	***BLUE***
		Foreground Color	***BLUE***

Left Justified, text begins on line 3
Up to 56 characters per line
5 lines available
Acts as a "window" on the Criterion Screen if F8 is pressed or for feedback to the responses to the review/criterion questions.

HINT/FEEDBACK AREA 2

(22,2),(77,2),(22,6),(77,6)	**BOX** 22,2,77,6	Box Color	***GREEN***
	FRAME 22,2,77,6	Frame Color	***BLACK***
		Foreground Color	***BLACK***

Left Justified, text begins on line 3
Up to 56 characters per line
5 lines available
Acts as a "window" on the Criterion Screen if F8 is pressed or for feedback to the responses to the review/criterion questions.

TEXT SCREEN

LOCATION AREA 1
MESSAGE AREA 3
OPTION BAR AREA 1
CARRIAGE RETURN

TEXT AREA:

(22,4),(72,4),(22,20),(72,20)

Background Color	***BLACK***
Foreground Color	***WHITE***

Centered vertically as much as possible
Text is left justified
Up to 51 characters per line
17 lines available
Maximum of 8 lines per paragraph (single spaced)
Single blank line between paragraphs

OPTION BAR: F1:BACK* F2:HELP F5:SUMMARY F6:EXIT F9:QUIT

MENU SCREEN

LOCATION AREA 1
MESSAGE AREA 3
OPTION BAR AREA 1
RESPONSE AREA

MENU TITLE AREA

(32,3),(64,3),(32,4),(64,4)

Background Color ***BLACK***
Foreground Color ***WHITE***

Left Justified
Underline
Up to 33 characters
2 lines available
First character of each word capitalized

MENU TEXT AREA

(23,6),(72,6),(23,20),(72,20)

Background Color ***BLACK***
Foreground Color ***WHITE***

Bulleted Menu Choices (30,8),(72,8),(30,20),(72,20)

Status indicator area — * > + — (30,8),(30,9),(30,10) (30,11),(30,12)

Alpha choice indicator — (32,8),(32,9),(32,10) (32,11),(32,12)

35 characters per line for each choice beginning at column 38
1 or 2 lines available per choice for up to 6 choices
if 2 lines used for one choice second line begins at column 38

OPTION BAR: F2:HELP F4:REVIEW* F5:SUMMARY* F6:EXIT F7:TEST* F9:QUIT

CRITERION SCREEN

LOCATION AREA 1
MESSAGE AREA 3
OPTION BAR AREA 1
CARRIAGE RETURN
RESPONSE AREA
HINT/FEEDBACK 1

CRITERION QUESTION AREA

(22,8),(72,8),(22,20),(72,20)

Background Color ***BLACK***
Foreground Color ***WHITE***

Centered vertically as much as possible
Left Justify up to 51 characters per line
13 lines available for question and possible answers or answer space
Maximum of 8 lines per paragraph (single spaced)

RESPONSE AREA if question is multiple choice / ordering / T or F

NO RESPONSE AREA if question is matching / short answer

Error message in the **MESSAGE AREA** is used if incorrect key is hit

HINT/FEEDBACK AREA is used if F8 is pressed or for feedback to the responses to the criterion questions

OPTION BAR: F1:BACK F3:CONT* F5:SUMMARY F6:EXIT F8:HINT F9:QUIT

SUMMARY SCREEN

LOCATION AREA 2
MESSAGE AREA 2
OPTION BAR AREA 2
CARRIAGE RETURN

TEXT OR GRAPHICS:

(22,2),(77,2),(22,20),(77,20)

Background Color ***BLACK***
Foreground Color ***WHITE***

Centered vertically as much as possible
Up to 56 characters per line
19 lines available
Maximum of 8 lines per paragraph (single spaced)
Single blank line between paragraphs
1 screen is optimal - no more than 2

OPTION BAR: F6:EXIT F9:QUIT

INFORMATION SCREEN

LOCATION AREA 1
MESSAGE AREA 1
OPTION BAR AREA 1
CARRIAGE RETURN

MESSAGE AREA:

(22,2),(77,2),(22,7),(77,7)

Background Color: ***BLACK***
Foreground Color: ***BLUE*** positive
MAGENTA negative
GREEN neutral

Large letter message such as "CONGRATULATIONS" or "NICE WORK"
May be empty

TEXT AREA:

(22,9),(77,9),(22,20),(77,20)

Background Color: ***BLACK***
Foreground Color: ***WHITE***

Centered vertically as much as possible
Up to 56 characters per line
12 lines available
Maximum of 8 lines per paragraph (single spaced)
For short messages (less than 5 lines total) double space
Single blank line between paragraphs

OPTION BAR: F2:HELP F6:EXIT F9:QUIT

HELP SCREENS

HELP MENU:

LOCATION AREA 2
MESSAGE AREA 2
OPTION BAR AREA 2
RESPONSE AREA

MENU TITLE AREA:

(30,3),(64,3)

Background Color: ***BLACK***
Foreground Color: ***WHITE***

Centered
Up to 35 characters
1 line available
First character of each word capitalized

MENU TEXT AREA:

(23,5),(72,5),(23,20),(72,20)

Background Color: ***BLACK***
Foreground Color: ***WHITE***

IINFORMATION AREA (23,6),(72,6),(23,7),(72,7)

Up to 50 characters per line
2 lines available
Text to read: Enter the letter of the topic of interest
in the space provided.

SELECTION AREA (25,8),(72,8),(25,20),(72,20)

May be divided into two columns
(starting positions 25 and 50)
At least 3 spaces between columns
13 lines available
Single spaced list of choices
Continued onto additional screens
Alpha choice indicator
Maximum 17 characters per item being defined
(may use more characters by using two lines)

OPTION BAR: F1:BACK* F6:EXIT F9:QUIT

HELP INFORMATION

LOCATION AREA 2
MESSAGE AREA 2
OPTION BAR AREA 2
CARRIAGE RETURN

WORD/CONCEPT TITLE AREA:

(25,4),(60,4),(25,5),(60,5)

Background: ***BLACK***
Foreground: ***WHITE****

Left justified
Word/concept followed by ':'
Capitalized if less than four words in length
2 lines available

DEFINITION AREA:

(25,7),(77,7),(25,20),(77,20)

Background: ***BLACK***
Foreground: ***WHITE***

Left justified
Up to 53 characters per line
14 lines available
Maximum of 8 lines per paragraph (single spaced)
Single blank line between paragraphs
May contain additional screens

OPTION BAR: F1:BACK* F6:EXIT F9:QUIT

TEST SCREEN

LOCATION AREA 1
MESSAGE AREA 1
OPTION BAR AREA 1
CARRIAGE RETURN

(22,3),(77,3),(22,19),(77,19)

Background: ***BLACK***
Foreground: ***WHITE***

No feedback area needed
Message for last screen will appear in Message area
Horizontal centering for question
Vertical centering for answer choices on matching questions
Up to 56 characters per line
17 lines available for question text
Fill-in or short answers require the blank to be one continuous underline of 30 characters in length. If more than 4 words are required for an answer, there is to be no underline and the answer is to be supplied in "free space". The last word before a fill-in should not give any clue to the correct answer, that is, a(n) should be used.
Error messages appear in the lower left hand corner of screen, in the case of supplying an answer which is out of range.

RESPONSE AREA if question is multiple choice / true/false / ordering

NO RESPONSE AREA for matching short answer

OPTION BAR: F1:BACK F3:CONT F6:EXIT F9:QUIT

EVALUATION SCREEN

LOCATION AREA 1
MESSAGE AREA 1
OPTION BAR AREA 1
RESPONSE AREA 1
CARRIAGE RETURN

(22,4),(72,4),22,20),(72,20)

Background Color: ***BLACK***
Foreground Color: ***WHITE***

Responses to linear rating scale and multiple choice questions will be made in the response area.

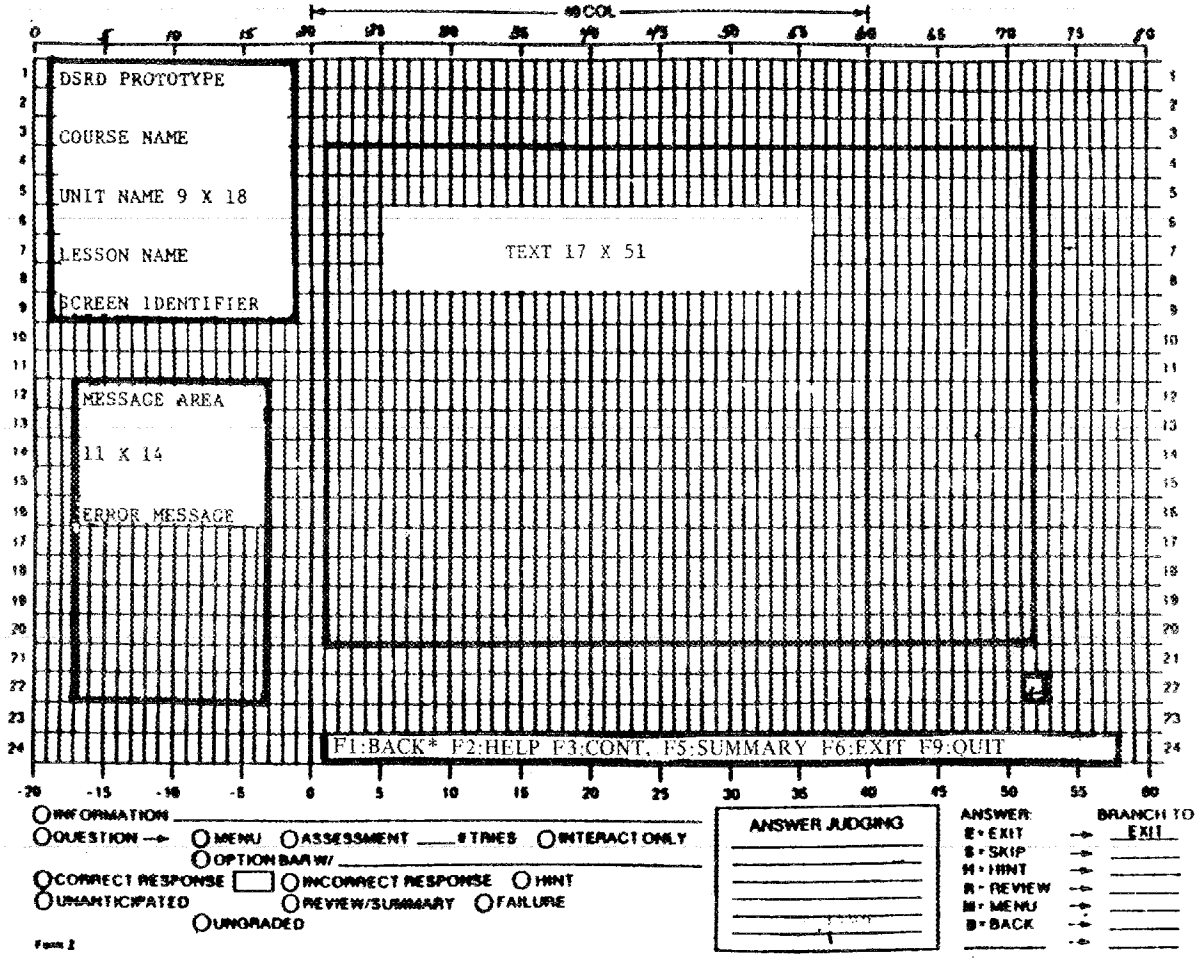
1	2	3	4	5	6

Other responses (open ended, short statements etc.) will be made in the general display area, beneath the question being answered. Spacing will depend on the question.

OPTION BAR: F1:BACK F3:CONT F6:EXIT F9:QUIT

Appendix E

SCREEN DESIGN



PROGRAM LESSON TEXT

SCREEN NO ____

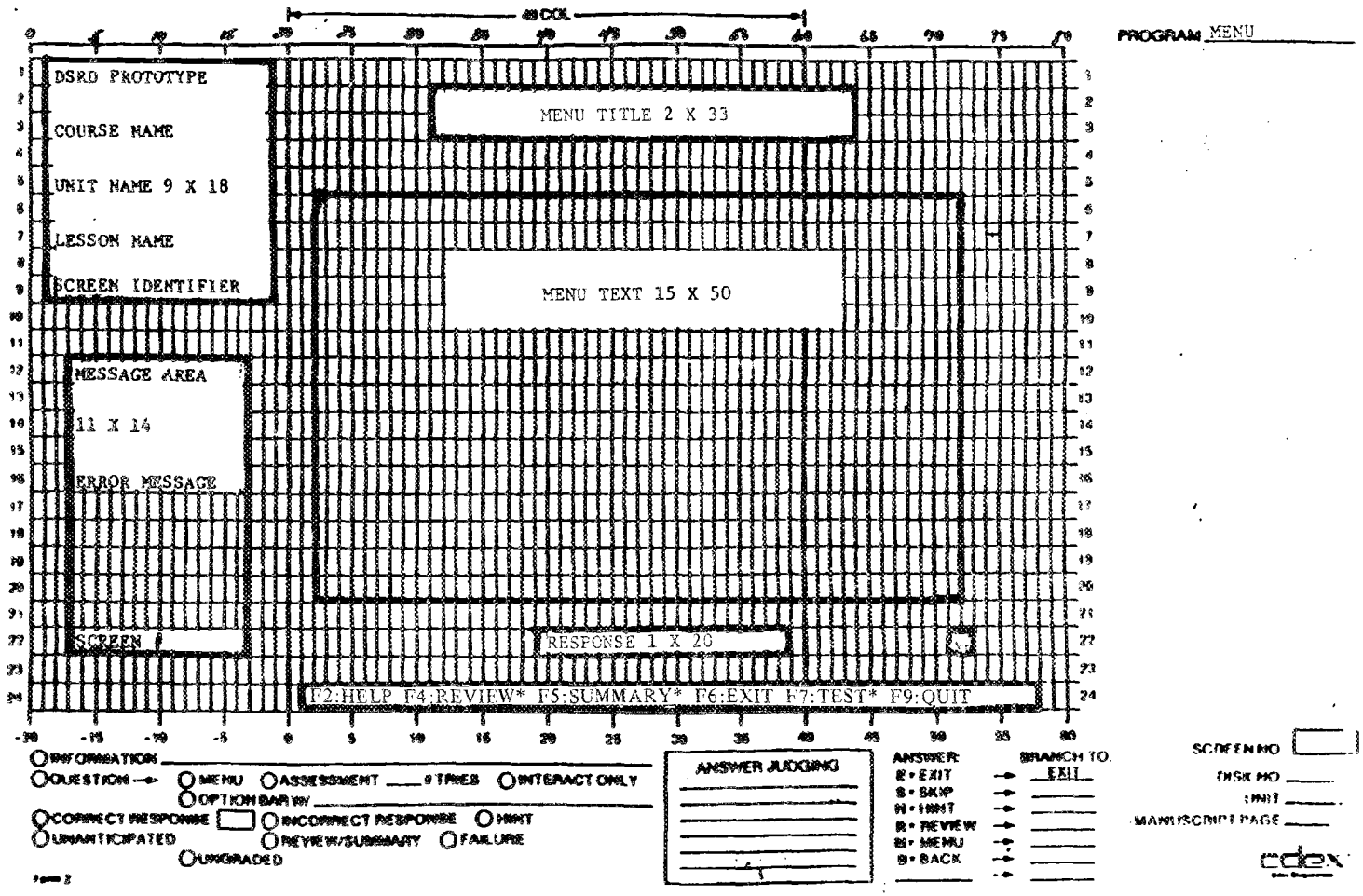
DISK NO ____

UNIT ____

MANUSCRIPT PAGE ____

cdex

Form 2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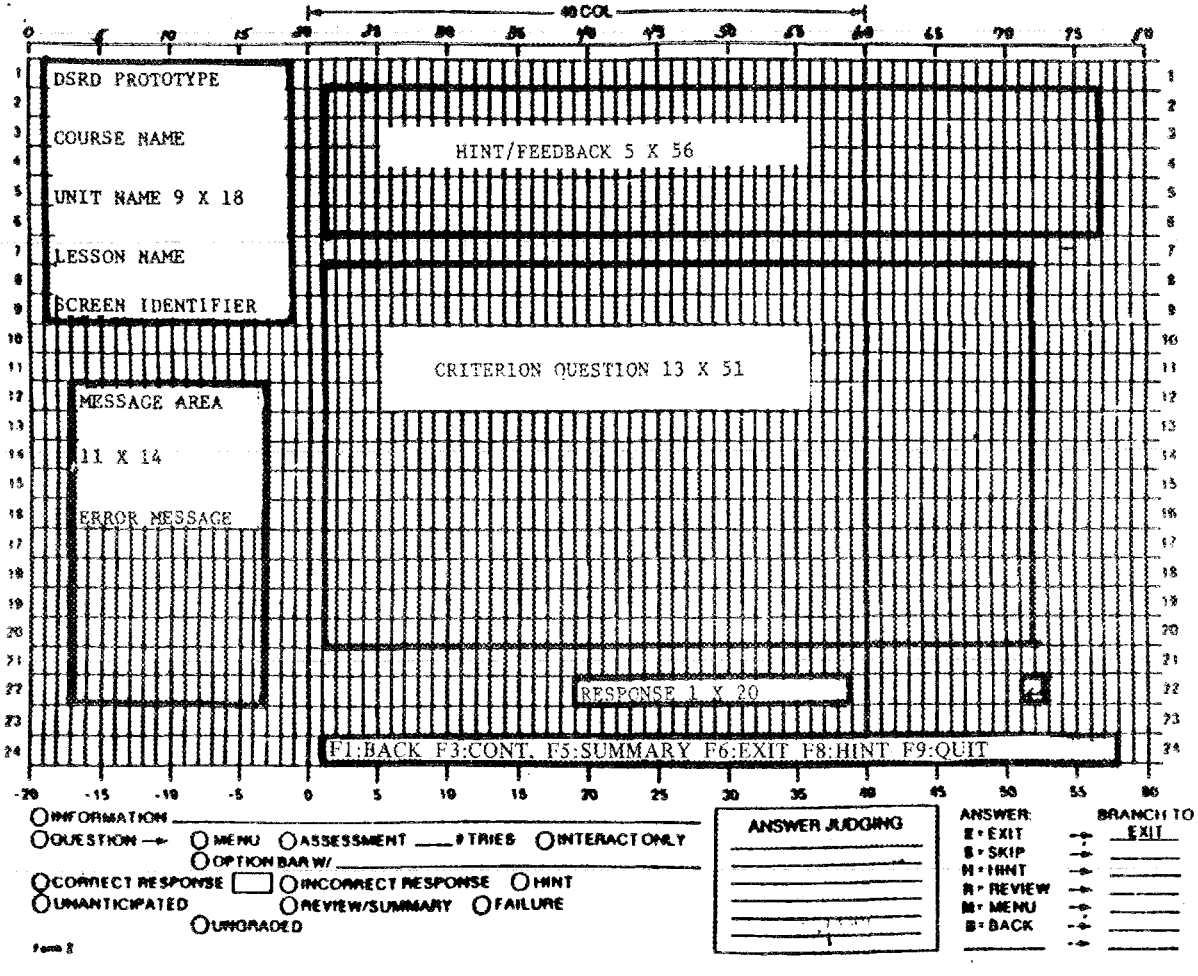
PROGRAM MENU
DSRD PROTOTYPE
COURSE NAME
UNIT NAME 9 X 18
LESSON NAME
SCREEN IDENTIFIER
MENU TITLE 2 X 33
MENU TEXT 15 X 50
MESSAGE AREA
11 X 14
ERROR MESSAGE
SCREEN #
RESPONSE 1 X 20
F2:HELP F4:REVIEW* F5:SUMMARY* F6:EXIT F7:TEST* F9:QUIT
INFORMATION
QUESTION
MENU
ASSESSMENT
TRIES
INTERACT ONLY
OPTION BAR w/
CORRECT RESPONSE
INCORRECT RESPONSE
HINT
UNANTICIPATED
REVIEW/SUMMARY
FAILURE
UPGRADED
ANSWER JUDGING
ANSWER:
BRANCH TO:
E = EXIT
S = SKIP
H = HINT
R = REVIEW
M = MENU
B = BACK
EXIT
SCREEN NO
DISK NO
UNIT
MANUSCRIPT PAGE
cdex



PROGRAM CRITERION

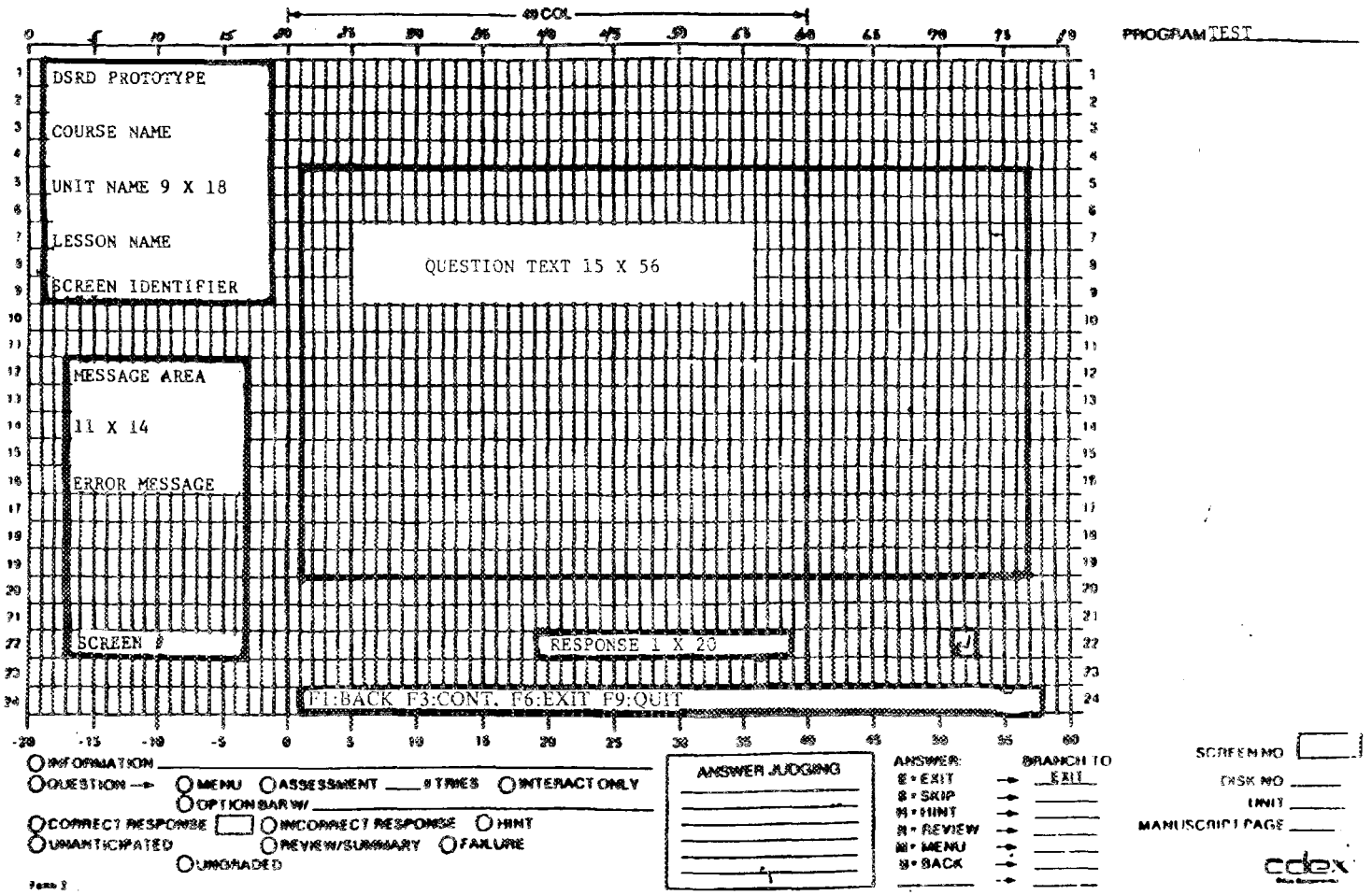
○ INFORMATION
○ QUESTION → ○ MENU ○ ASSESSMENT ___ # TRIES ○ INTERACT ONLY
○ OPTION BAR W/ ___
○ CORRECT RESPONSE ☐ ○ INCORRECT RESPONSE ○ HINT
○ UNANTICIPATED ○ REVIEW/SUMMARY ○ FAILURE
○ UNGRADED

ANSWER JUDGING

ANSWER:	BRANCH TO
E = EXIT	EXIT
S = SKIP	
H = HINT	
R = REVIEW	
M = MENU	
B = BACK	

SCREEN NO ☐
DISK NO ___
UNIT ___
MANUSCRIPT PAGE ___

cdex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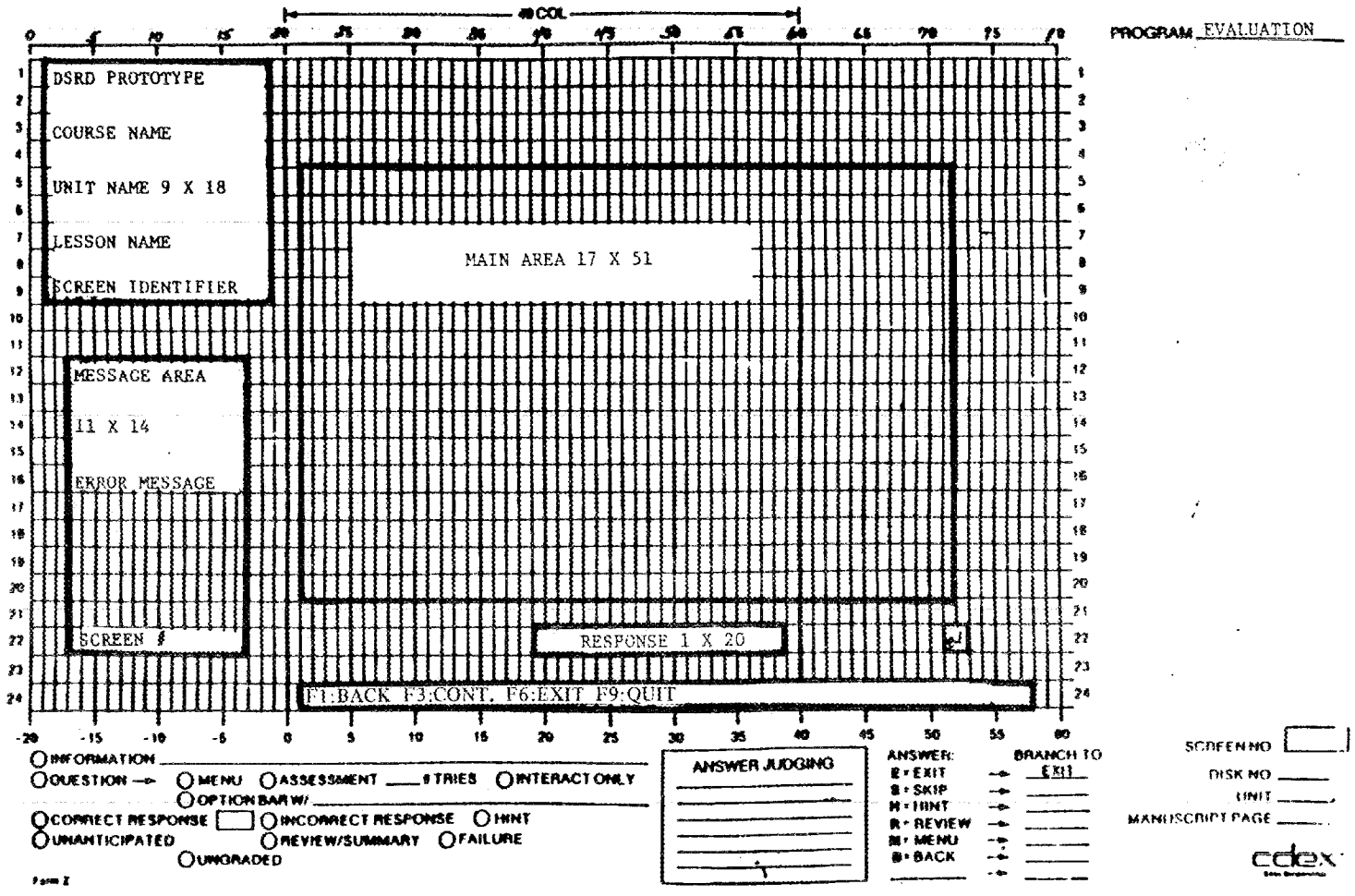
PROGRAM TEST
DSRD PROTOTYPE
COURSE NAME
UNIT NAME 9 X 18
LESSON NAME
SCREEN IDENTIFIER
QUESTION TEXT 15 X 56
MESSAGE AREA
11 X 14
ERROR MESSAGE
SCREEN #
RESPONSE 1 X 20
F1:BACK F3:CONT. F6:EXIT F9:QUIT
INFORMATION
QUESTION
MENU
ASSESSMENT
TRIES
INTERACT ONLY
OPTION BAR W/
CORRECT RESPONSE
INCORRECT RESPONSE
HINT
UNANTICIPATED
REVIEW/SUMMARY
FAILURE
UNGRADED
ANSWER JUDGING
ANSWER:
BRANCH TO
E = EXIT
EXIT
S = SKIP
H = HINT
R = REVIEW
M = MENU
B = BACK
SCREEN NO
DISK NO
UNIT
MANUSCRIPT PAGE
cdex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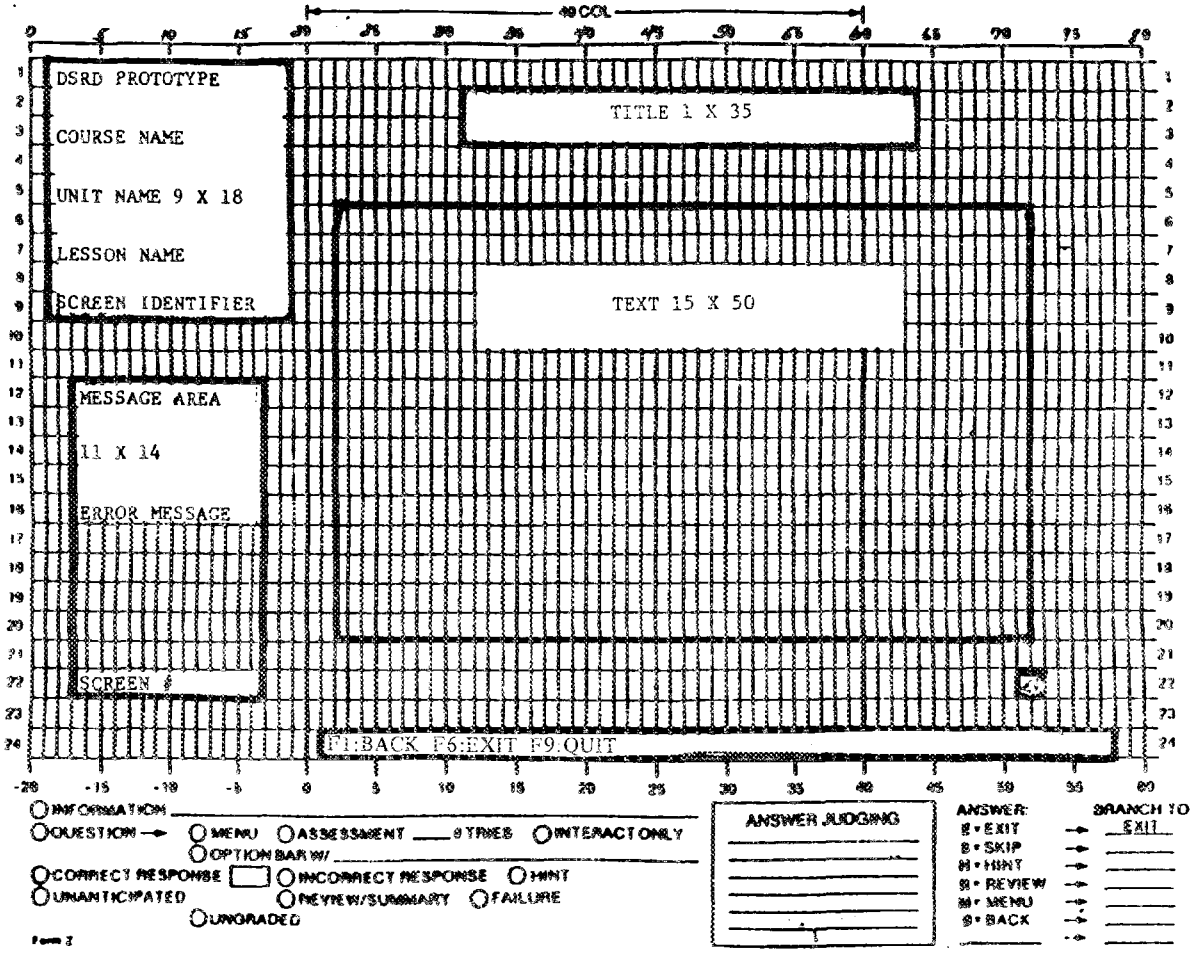
COURSE NAME
UNIT NAME 9 X 18
LESSON NAME
SCREEN IDENTIFIER
MAIN AREA 17 X 51
MESSAGE AREA
11 X 14
ERROR MESSAGE
SCREEN #
RESPONSE 1 X 20
F1:BACK F3:CONT. F6:EXIT F9:QUIT
INFORMATION
QUESTION
MENU
ASSESSMENT
TRIES
INTERACT ONLY
OPTION BAR W/
CORRECT RESPONSE
INCORRECT RESPONSE
HINT
UNANTICIPATED
REVIEW/SUMMARY
FAILURE
UNGRADED
ANSWER JUDGING
ANSWER:
BRANCH TO
E = EXIT
S = SKIP
H = HINT
R = REVIEW
M = MENU
B = BACK
PROGRAM EVALUATION
SCREEN NO
DISK NO
UNIT
MANUSCRIPT PAGE
cdex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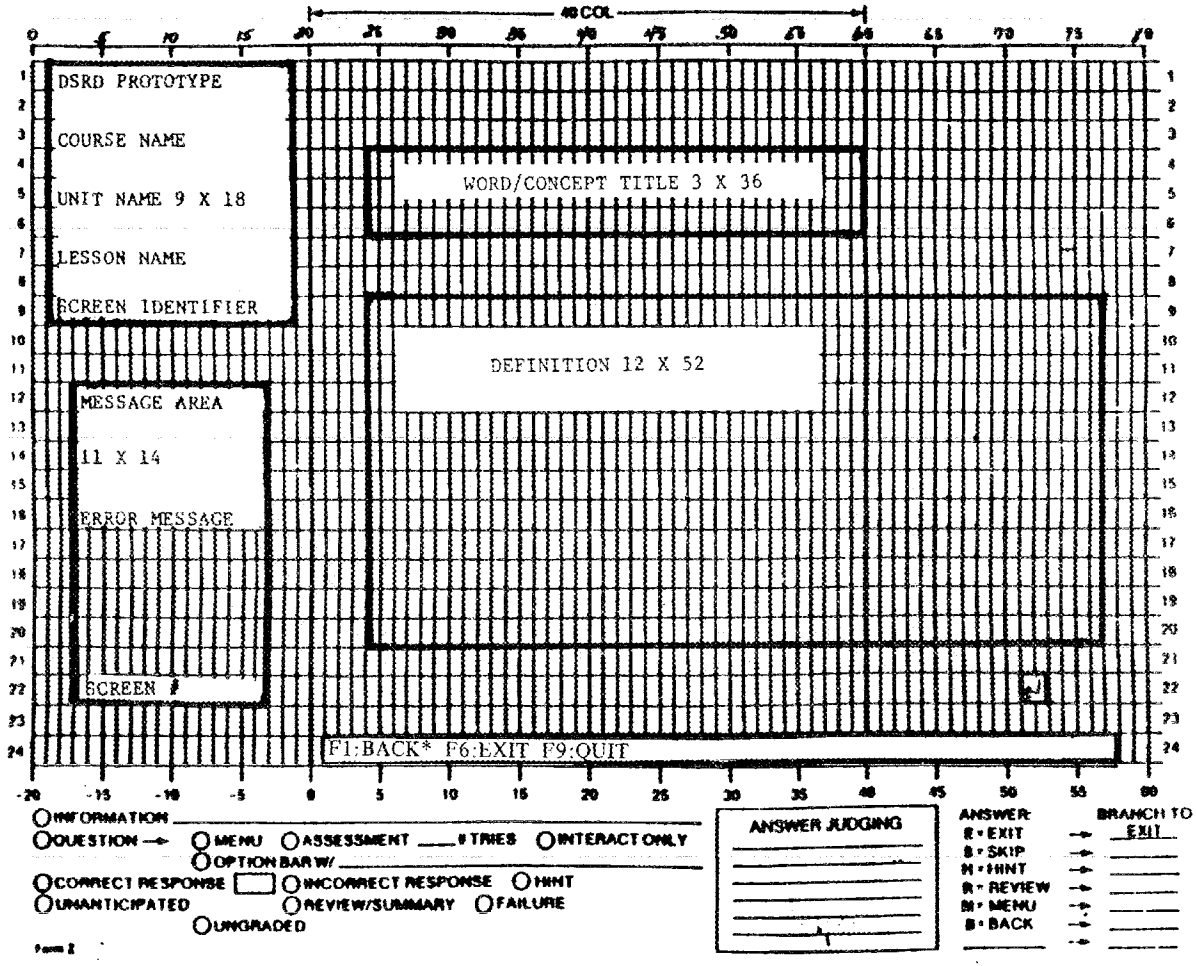
COURSE NAME
UNIT NAME 9 X 18
LESSON NAME
SCREEN IDENTIFIER
TITLE 1 X 35
TEXT 15 X 50
MESSAGE AREA
11 X 14
ERROR MESSAGE
SCREEN #
F1:BACK F6:EXIT F9:QUIT
INFORMATION
QUESTION
MENU
ASSESSMENT
TYPES
INTERACT ONLY
OPTION BAR W/
CORRECT RESPONSE
INCORRECT RESPONSE
HINT
UNANTICIPATED
REVIEW/SUMMARY
FAILURE
UNGRADED
ANSWER JUDGING
ANSWER:
BRANCH TO
E = EXIT
EXIT
S = SKIP
H = HINT
R = REVIEW
M = MENU
B = BACK
PROGRAM HELP MENU
SCREEN NO
DISK NO
UNIT
MANUSCRIPT PAGE
cdex



PROGRAM HELP TEXT

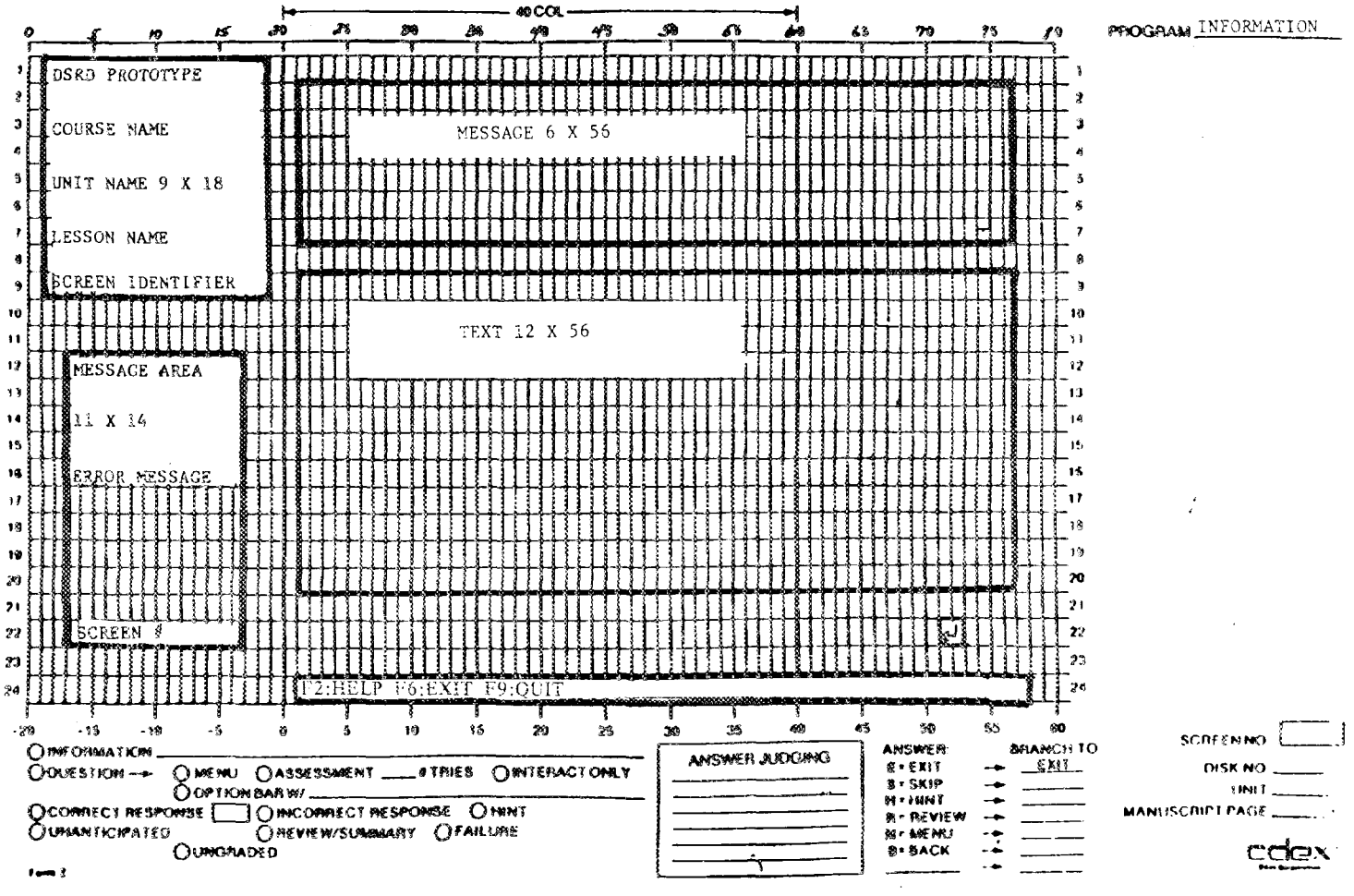
SCREEN NO

DISK NO

UNIT

MANUSCRIPT PAGE

cdex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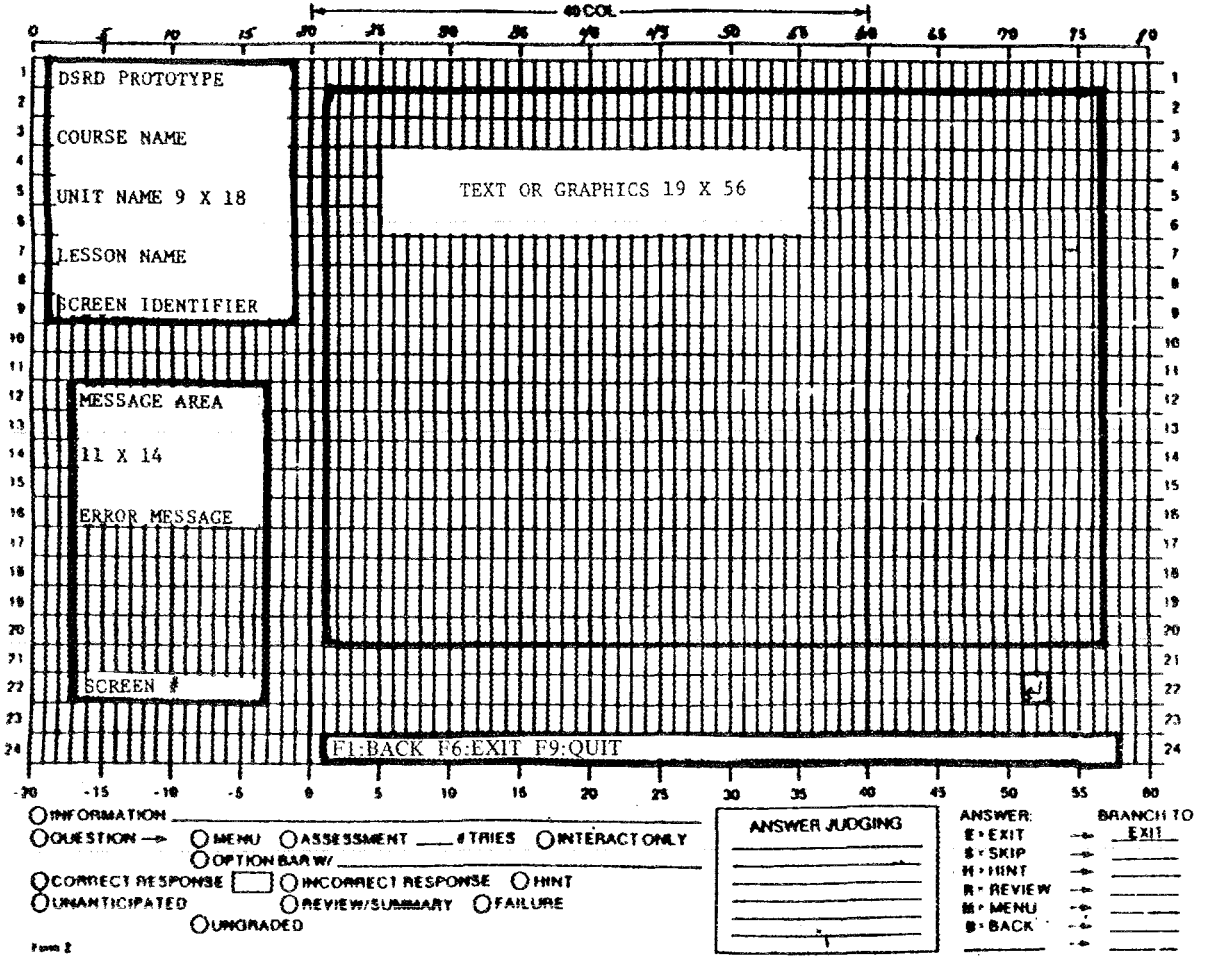
DSRD PROTOTYPE
COURSE NAME
UNIT NAME 9 X 18
LESSON NAME
SCREEN IDENTIFIER
MESSAGE 6 X 56
TEXT 12 X 56
MESSAGE AREA
11 X 14
ERROR MESSAGE
SCREEN #
F2:HELP F6:EXIT F9:QUIT
PROGRAM INFORMATION
INFORMATION
QUESTION →
MENU
ASSESSMENT ___ # TRIES
INTERACT ONLY
OPTION BAR W/
CORRECT RESPONSE
INCORRECT RESPONSE
HINT
UNANTICIPATED
REVIEW/SUMMARY
FAILURE
UNGRADED
ANSWER JUDGING
ANSWER:
BRANCH TO
E = EXIT → EXIT
S = SKIP →
H = HINT →
R = REVIEW →
M = MENU →
B = BACK →
SCREEN NO
DISK NO
UNIT
MANUSCRIPT PAGE
cdex



PROGRAM SUMMARY

SCREEN NO

DISK NO

UNIT

MANUSCRIPT PAGE

cdex

Appendix F

SPECIAL FUNCTION KEYS

SPECIAL FUNCTION KEYS

The options available to the student are Back, Cont. (Continue), Exit, Help, Hint, Test, Return, Review, Quit, and Summary. Individual screens contain combinations of the available options depending on their screen type (see Table 1).

The function of each option is explained to the student in the Introduction. Specific options appear on the option bar of the Introduction screens only after an explanation of that particular option has been made. The exceptions are the Exit, Return, Help, Quit, and Back keys since their usage is somewhat universal and not unique to the NALDA CAI Prototype.

BACK (F1)

The Back option (activated by pressing the F1 function key) returns the user to the previously viewed screen. It is possible to continue using the Back option until the beginning of a module is reached; that is, the first question in a testing sequence or the first screen of a lesson. The Back option does not appear on the option bar of the first screen in any module. If a user tries to back up past the first screen in any module, a message will appear informing the user that that option is not available. In order to move further back, the user must press the Exit option key (F6), which causes the previous menu to be displayed.

The Back option appears on the option bar of the Text, Criterion, Test, Evaluation, Help, and Review screens. It appears on the Help and Review screens only if there is more than one screen.

Backward branching displays screens in the reverse order of presentation followed while going forward in a module. That is, the student will see each screen that was presented during the instruction. If Criterion questions were missed, remedial text was presented. These screens will be in the backward branching path. However, if the lesson has been entered from the last exit point, backing up to screens before the current point of entry will display a "generic" route, since the forward branching from previous sessions is not saved (see Fig. 1). No remedial text that was presented to the student prior to this time will be in the path.

HELP (F2)

The Help option (activated by pressing the F2 key) can be accessed from the Text, Information, and Menu screens. It consists of a glossary of terms used in the CAI, S2K vocabulary, and selected terms from the NALDA application. The Help function also contains very short descriptions of processes the student will need to use within the training package, that is, significant information from the Introduction segment of the CAI package.

CONT. (F3)

The Cont. (Continue) option (activated by pressing the F3 function key) is similar in function to the Return key. Selecting the Cont. option causes branching to the next screen in the sequence. Cont. provides an alternate means of moving forward without providing the input that is normally

Table 1

Available options	
F1:	Back
F2:	Help
F3:	Cont.
F4:	Review
F5:	Summary
F6:	Exit
F7:	Test
F8:	Hint
F9:	Quit
	Return

Lesson text:	
F1:	Back *
F2:	Help
F5:	Summary
F6:	Exit
F7:	Test
F8:	Hint
F9:	Quit
	Return

Menu:	
F2:	Help
F4:	Review *
F5:	Summary *
F6:	Exit
F7:	Test *
F9:	Quit
	Return

Criterion:	
F1:	Back
F3:	Cont.*
F5:	Summary
F6:	Exit
F8:	Hint
F9:	Quit
	Return

Pre/Posttest:	
F1:	Back
F3:	Cont.
F6:	Exit
F9:	Quit
	Return

Evaluation:	
F1:	Back
F3:	Cont.
F6:	Exit
F9:	Quit
	Return

Help:	
F1:	Back *
F6:	Exit
F9:	Quit
	Return

Review:	
F1:	Back *
F2:	Help
F3:	Cont.
F6:	Exit
F9:	Quit
	Return

Summary:	
F6:	Exit
F9:	Quit
	Return

Information:	
F2:	Help
F6:	Exit
F9:	Quit
	Return

Option bar (* indicates conditional option)

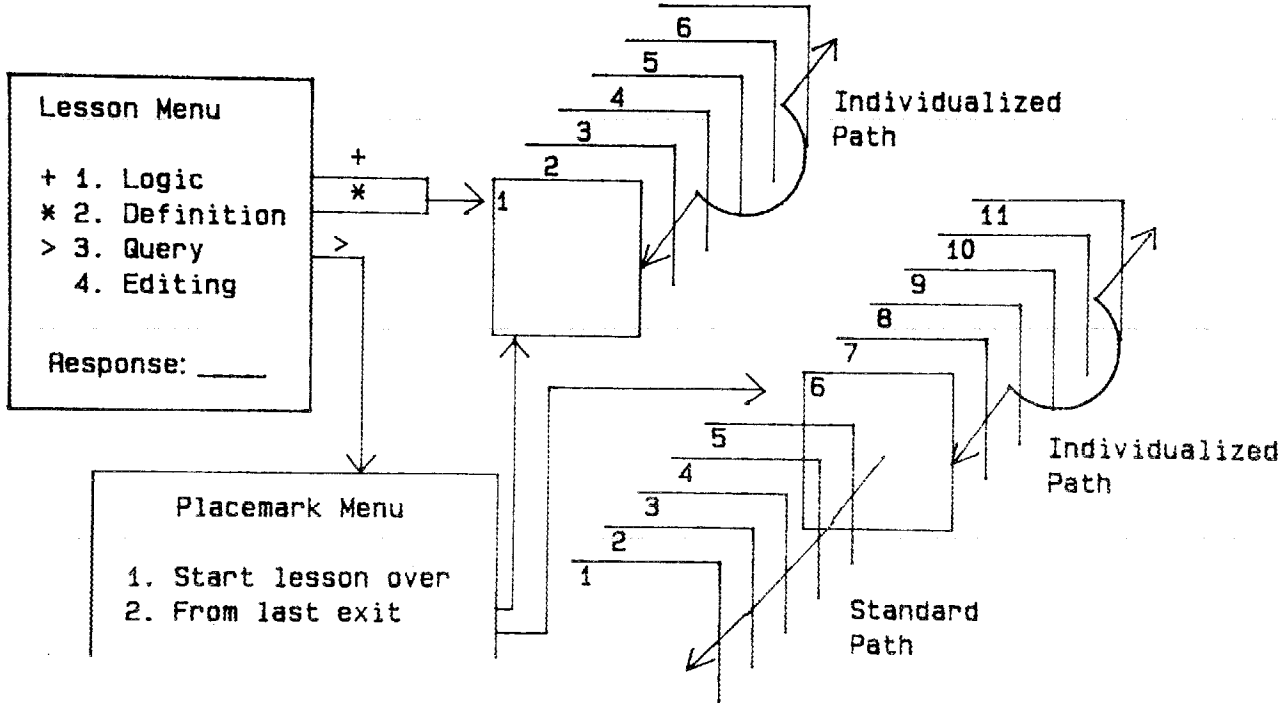


Fig. 1. Backward Branching Schema.

required on a particular screen. The Cont. option may appear on a Criterion screen within a lesson, or on a Test or Evaluation screen. The effect of Cont. is dependent upon the screen from which it is activated.

Cont. appears on the option bar for any lesson passed on the Pretest or after the student has viewed that entire lesson. Once a lesson has been completed, the student has the option of moving through that lesson without providing input. In this way, a student could peruse a lesson or look for a reference or reminder without having to stop to answer criterion questions.

When Cont. is activated from a Criterion screen, the branch continues as though the student had supplied the correct answer. On the Test and Criterion screens the Cont. option, in conjunction with Back, provides the means for a student to skip, review, and change answers. In the case of the Test screens, moving forward without supplying input is the equivalent of entering an incorrect answer. However, if an answer had previously been supplied for the question being displayed and the student presses the F3 (Cont.) key, the original answer remains and is scored accordingly. The student may page forward using the F3 key within the Evaluation section of the CAI without penalty.

REVIEW (F4)

A short interactive lesson Review (activated by pressing the F4 function key) is available to the student after a specific lesson has been completed. The Review offers a very condensed form of the lesson information. It is not intended to take the place of the longer, more detailed, interactive lesson. The student will not be able to access the Review of a lesson directly from within the lesson; the only access is from the option bar on the Lesson Menu.

The Review option appears when at least one lesson title on that menu is preceded by an asterisk (*) or a plus sign (+). When the user selects the Review option, a message appears in the lower left hand area asking the user to indicate which lesson review is desired. If the user elects to review a lesson that has not been completed, a message appears informing the student that the Review for that lesson is not currently authorized.

SUMMARY (F5)

The Summary option (activated by pressing the F5 function key) is available to the student from the Lesson Menu and from within a lesson. The Summary offers a very condensed version of the material within a lesson. It may be in outline or graphic form. The purpose of the Summary is to provide an overview or reminder of information for someone who is familiar with the lesson material; it is not intended to be a replacement for this material.

When the Summary option is chosen from the menu screen, a message appears in the lower left hand area of the screen asking the student to indicate which lesson to summarize. Unlike the Review, the Summary may be selected from the Lesson Menu whether or not an indicator appears before the lesson name. It is not necessary for the student to have completed the lesson in order to see the Summary. The student also has the option of branching to the Summary from within a lesson. Summary is available on the option bar displayed on all Text and Criterion screens within that lesson.

EXIT (F6)

The Exit option (activated by pressing F6) results in an exit from the current module. When the Exit option is activated from a Menu screen, the branch goes to the next higher level menu. It is possible for the student to "back" out of the CAI through a series of Exit options at each menu level.

The Exit option appears on all screen types but functions in a somewhat different manner on the Summary, Review, Help and Test screens. If the student activates the Exit option from a Summary, Review, or Help screen, the branch is back to the screen that was being displayed when the student initiated that module. The Exit option from a Test screen activates a window display requiring the student to confirm the Exit choice. If the Exit option is confirmed, the current testing session is considered to be unsuccessful and the branch is to the Lesson Menu for the appropriate unit.

If the F6 (Exit) key is activated while completing the course evaluation, a message appears reminding the student that the Certificate of Completion will be withheld until the evaluation is completed. If the student still requests an exit, the evaluation is exited and an Information screen is displayed.

TEST (F7)

The Test option (activated by pressing the F7 function key) appears on the Lesson Menu when all of the lessons within a unit have been completed through the Pretest or interactive study. Once this option appears, it is up to the student to determine when the initiate the Posttest for the unit.

HINT (F8)

The Criterion screen is the only screen containing the Hint option (activated by pressing the F8 function key). The purpose of the Hint is to provide additional information in an attempt to guide the student to the correct answer for the criterion question. One hint is available for each Criterion screen.

QUIT (F9)

The Quit option (activated by pressing the F9 function key) appears on all screens. Its function is to take the student from the point where this option is selected to the main menu where an exit can be made out of the CAI. The Quit option is used when an immediate exit from the CAI is desired.

RETURN (↵)

The Return key is used to move forward through a course. Its function is the same as would be expected in regular computer usage. A symbol (↵) appears in the lower right hand corner of the display screen as a visual reminder for the user to press the Return key when finished viewing the current display screen.

Appendix G

CURRICULUM OUTLINE FOR NALDA CAI PROTOTYPE

CURRICULUM OUTLINE FOR PROTOTYPE NALDA CAI

Course I. — INTRODUCTION — The purpose of the Introduction is to acquaint the student with the features of the CAI system.

1. Unit 1 — HOW TO USE THE CAI SYSTEM

A. Lesson 1.1 SCREEN TYPES

1. TEXT screens present the information to be learned.
2. CRITERION screens contain questions and appear within a lesson and test the concepts presented on the Text screens.
3. REVIEW screens are available for each lesson and may be used by the student at any time after the completion of that lesson.
4. SUMMARY screens may be viewed at any time. They consist of a brief outline or schematic diagram of the content of a lesson.
5. TEST screens are presented for the PRETESTS and POSTTESTS.
6. INFORMATION screens notify the students of results of testing sessions, indicate course completion or supply any other information regarding course status.
7. MENU screens for course, unit, lesson, and placemarks allow students to select options for locating their position within the CAI.
8. EVALUATION screens containing questions pertaining to the course are asked upon completion of a course.
9. HELP screens provide information, such as definitions, that will aid the student in studying a course.

B. Lesson 1.2 HOW TO "READ" THE SCREEN

1. The COURSE NAME, UNIT NAME, LESSON NAME, and the SCREEN IDENTIFIER provide a visual reminder of the student's place within a specific CAI course.
2. SCREEN SUMMARY contains a short summary of the main points being presented in the screen text and error messages, graphics and screen position within a sequence.
3. SCREEN POSITION WITHIN A SEQUENCE indicates whether or not the information being displayed continues over more than one screen, such as, page 2 of 4.
4. DESIRED STUDENT ACTION/INPUT indicates the response expected from the student, such as pressing the return key or providing an answer to a question.
5. OPTION BAR lists the possible branches from the current screen, such as, CONT., HELP, EXIT.
6. MESSAGES to the student always appear in the same position and provide feedback.

C. Lesson 1.3 USE OF THE MENU

1. Selection method: Menu choices are made by entering the number of the desired option into the RESPONSE area.
2. Status indicators: The student is kept apprised of progress by indicators on the menu screens.

D. Lesson 1.4 NAVIGATING THROUGH THE CAI

1. Special Function Keys: facilitate movement within the CAI.
2. Movement between CAI and NALDA.

E. Lesson 1.5 TESTS

1. The PRETEST.
2. THE POSTTEST.
3. EVALUATION.

Course II. — SYSTEM 2000

1. Unit 1 — UNDERSTANDING SYSTEM 2000

A. Lesson 1.1 DEFINITIONS AND CONCEPTS

1. Terminology.
2. DBMS Hierarchy.
3. Establishment of Record Relationships.

B. Lesson 1.2 READING THE SCHEMA

1. The DESCRIBE Command.
    a. COMPONENT NUMBER and COMPONENT NAME: unique item indentifiers assigned to each item in the database.
    b. DATA TYPES: define the nature of the data values stored in each component of the database.
    c. KEY/NON KEY: specifies whether an index will be created for that component.
    d. LENGTH OF FIELD: also called picture designation, is an indication of the size of the data value stored for each component.
    e. RECORD RELATIONSHIPS: defines the database hierarchy.

C. Lesson 1.3 USING THE TALLY COMMAND

1. TALLY (TA): allows the user to obtain statistical information about any KEY component in the database.
    a. TALLY/ALL/<components>: reports maximum and minimum data values, number of unique data values and total number of data values for each specified component.
    b. TALLY/EACH/<component>: reports distinct data values and occurrences in ascending order.

2. Unit 2. BASIC S2K DATA RETRIEVAL

A. Lesson 2.1 INTRODUCTION TO QUERY COMMANDS

1. Parts of the QUERY command.
    a. ACTION clause: determines how the output will look.
    b. CONDITIONAL clause: selects the qualified data records.
2. General Format: ACTION CLAUSE WHERE CONDITIONAL CLAUSE.
3. Possible system responses.

B. Lesson 2.2 ACTION CLAUSE

1. Introduction to the ACTION clause: The ACTION clause is the part of the command that tells the computer what to do with the qualified data records.
2. ACTION VERBS.
3. FORMAT OPTIONS.
4. COMPONENT LIST.
5. ORDERED BY (OB) CLAUSE.

C. Lesson 2.3 ADDITIONAL FORMAT OPTIONS

1. REPORT TITLES: the Date Parameter is used to format report headings.
2. COLUMN SPECIFICATION: the Width Parameter is used to change column width and/or column headings.
3. OUTPUT WIDTH SPECIFICATIONS: the Blank Parameter is used to override S2K default spacing between columns.
4. REPORT FOOTNOTES: S2K assumes continuous form with no page breaks unless the FOOTNOTE PARAMETER is used.
5. SPECIFYING MULTIPLE LIST OUTPUT OPTIONS.

D. Lesson 2.4 CONDITIONAL CLAUSE

1. Introduction to Conditional Clause: The CONDITIONAL clause states the conditions a data record must meet in order to be qualified.
2. COMPONENT NAME/NUMBER: the items to be tested against a value that is supplied by the user.
3. RELATION: any one of six relational terms, such as, equal, greater than, less than, greater than or equal to, less than or equal to, or not equal to.
4. VALUE: must be like the component it is being compared to in description.
5. MULTIPLE CONDITIONS: imposing more than one condition for data qualification is possible.
6. QUALIFYING DISJOINT RECORDS.

E. Lesson 2.5 EFFICIENCY

1. DITTO (DI): repeats the entire ACTION clause from the previous command.
2. SAME (SA): eliminates the need to type the same CONDITIONAL clause in successive commands.
3. LIMIT/END LIMIT: controls the amount of data that will be printed.
4. STRING USAGE: stresses looking for previously constructed STRINGS. There may be a STRING available for the particular QUERY needed.
5. ORDER OF KEY/NONKEY ITEMS: allows more efficient searching within S2K.
6. QUERY COMMAND STRUCTURE: based on how S2K processes query. Structure can improve efficiency.
7. PURPOSE OF QUERY EDIT: permits user to recall the last query entered, modify it and submit it for execution rather than having to retype a command that has an error in it.

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