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LEVEL II

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Semiannual Technical Summary

ARPA Authoring System

31 March 1978

Prepared for the Defense Advanced Research Projects Agency
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Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LEXINGTON, MASSACHUSETTS

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Raymond L. Loiselle, Lt. Col., USAF
Chief, ESD Lincoln Laboratory Project Office

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A test of the ARPA Authoring System for development of lessons in the on-the-job environment is described. A new version of the procedures that compensate for the lack of an educational expert to guide the authors at the work site is reviewed. Conditions are listed that may affect the efficiency of the authoring activity – the kind of author, kind of lesson, author experience, and setting.

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ARPA AUTHORING SYSTEM

SEMIANNUAL TECHNICAL SUMMARY REPORT
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1 OCTOBER 1977 – 31 MARCH 1978

ISSUED 24 AUGUST 1978

LEXINGTON MASSACHUSETTS

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A test of the ARPA Authoring System for development of lessons in the on-the-job environment is described. A new version of the procedures that compensate for the lack of an educational expert to guide authors at the work site is reviewed. Conditions are listed that may affect the efficiency of the authoring activity – the kind of author, kind of lesson, author experience, and setting.

CONTENTS

ARPA AUTHORING SYSTEM

I. INTRODUCTION

The ARPA Authoring System is a set of management and materials preparation procedures for use in on-the-job training environments. It differs markedly with respect to subject matter, author qualification, and management from methods of lesson preparation usually found in school environments. The area of application is Formal On-the-Job Training as defined in the Interservice Procedures for Instructional Systems Development.* The conditions assumed are those listed as favorable to the on-the-job environment as the setting: few trainees are in training at a given time, training resources are available on site, and there is time to train new personnel. The focus is on the training of novice technicians to operate and maintain equipment and systems. It is the kind of training that bridges the gap between technical schooling and readiness to perform actual work.

The authoring procedures reported here are part of a system to remove availability of the trainer as the limiting factor in this setting. The goal is to capture task-oriented training in lesson materials, and to deliver it by means of a computer-based instructional unit when it is needed.

A qualified technician or technical operator must serve as the author, but it is not practical to take the time to train this expert to become a lesson designer. As an alternative, the training experience of the experts is relied upon, and they follow a procedure to prepare lessons that mimic their usual tutorial mode of instruction. This is the approach developed here, and the kind of material produced is called a task lesson.

Authoring operations are being conducted by military personnel, Senior Airmen and Technical Sergeants at the Group level in the Tactical Communications Area of the Air Force Communications Service and in units of the Air National Guard. Training tests will be conducted at the 2nd and 5th Combat Communications Groups. The purpose of the tests is to evaluate the lessons and thus to validate the authoring procedures.

II. THE PROCEDURES

The procedures for the management of the authoring process presented in the previous Semiannual Technical Summary† are being employed in the development of lessons for the test. The five stages of these procedures are summarized in Table I. The participants listed in this table have been changed to conform to changes in conditions and to reflect recent data gathered in the field.

The procedures for Stage 3, Lesson Preparation, were reworked at the outset of the test operations. This was necessary because, contrary to expectation, no educational specialist was available to assist authors. As a consequence, although the revised lesson development procedures follow the original ones, they were narrowed in scope and made more explicit in specifying what the author is to do.

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* Interservice Procedures for Instructional Systems Development, TRADOC Pamphlet 350-30, U.S. Army (1 August 1975).

† Semiannual Technical Summary Report on the ARPA Authoring System, Lincoln Laboratory, M.I.T. (30 September 1977), DDC AD-A052464/5.

TABLE I

MANAGEMENT PROCEDURES FOR TASK LESSON DEVELOPMENT
(Duration and Man-Hours Estimated for Preparation of a 1-Hour Lesson)

		Man-Hours
Stage 1. Training Program Planning		
Location:	Work Site	
Product:	List of Lesson Topics	
Duration:	1 to 2 Days	
Personnel:	Work Manager	1
	Training Manager	1
Stage 2. Lesson Specification		
Location:	Work Site	
Product:	Lesson Specification	
	Lesson Validation Plan	
Duration:	2 Days	
Personnel:	Author	4
	Technical Advisors (2)	10
	Training Manager	4
Stage 3. Lesson Preparation		
Location:	Authoring Center	
Product:	Lesson in Draft Form	
Duration:	30 Days	
Personnel:	Author	200
	Technical Advisor	12
	Trainees (4)	4
Stage 4. Conversion to Medium (Lincoln Terminal System)		
Location:	Authoring Center	
	Fiche Production Facility	
Product:	Lesson on Microfiche	
Duration:	30 Days	
Personnel:	Author	12
	Artist/Typist	4
	Photographer	20
Stage 5. Lesson Evaluation		
Location:	Work Site	
Product:	Lesson Revisions	
Duration:	10 Days	
Personnel:	Author	8
	Technical Advisors (2)	8

Following the procedure enables a subject-matter expert to develop an effective task lesson without prerequisite training in educational techniques. The lesson is prepared according to the Lesson Specification and instructs on the performance of a task according to a standard work procedure. Authors work largely on their own, aided at times by an experienced author or course-development manager. The four parts of the lesson preparation procedure are briefly described.

A. Part 1 – Outlining the Task

Part 1 provides a means for the author to decide how to break the task into major parts of the work performance. Each part becomes the focus of a subunit of the lesson.

B. Part 2 – Preparing Block Diagrams

Part 2 helps the author to plan the lesson before drafting the frames. It is based on a generalized "Block Diagram" for each part of the lesson, as shown in Fig. 1. Eight training functions are represented by the blocks, and the author fills in notes in those considered essential to achieve the training goals. Blocks 1 to 4 are concerned with the explanation that the author provides prior to the performance required; Blocks 5 to 8 present the task itself.

The Blocks may be grouped in pairs according to the general training function they serve:

Blocks 1 and 5	Present basic information
Blocks 2 and 6	Present basic information in more detail
Blocks 3 and 7	Evaluate behavior
Blocks 4 and 8	Present corrective information

If all four functions are served well for both the explanatory and task phases of each part, the trainee will have the opportunity to learn and the performance monitoring will assure that learning does in fact occur.

C. Part 3 – Making a Rough Draft

The purpose of Part 3 is to convert the lesson design in the block diagrams to frames in rough draft form. Three kinds of information make up a frame – Visual, Comment, and Interaction. The visual contains all the basic technical information. Comment, in audio or printed form, directs the attention of the trainee to aspects of the situation critical for learning. Interaction is determination of the next frame based either (1) on an option expressed by the trainee, or (2) on an outcome of a test specified by the author.

Some important matters are introduced here, such as the optimum size of frames, the need for clear instructions, the format of the visuals, ways to use audio or other comment, modes of interaction, instructions to the training assistant, and so forth.

D. Part 4 – Finishing Materials for the Delivery Unit

The final part contains many detailed instructions on laying out the visuals, writing out comment for transcription to audio, and specifying frame data to support computer-assist functions. Some of these are quite specific to the Lincoln Terminal System mode of delivery, but most are not. Roughly 50 percent of the author's effort in lesson preparation is in this part of the process, the "getting it right" after "getting it down."

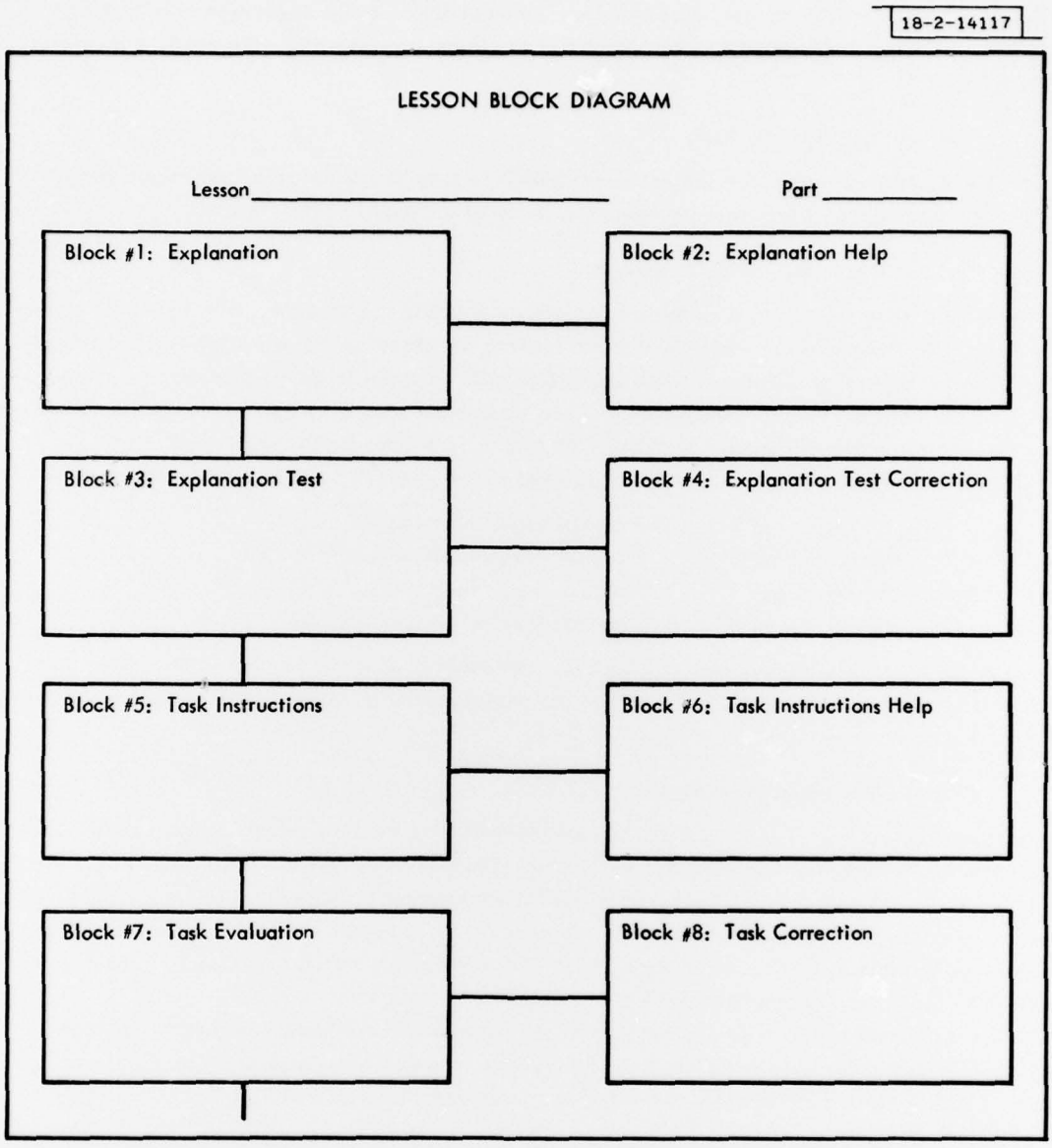

Fig. 1. Form of Lesson Block Diagram used by author to plan lesson.

III. AUTHORING ACTIVITY

The area of application for the test is learning to execute maintenance procedures on the AN/TRC-97A radio set, a large transmitter/receiver located in a mobile communications van. The list of thirty topics chosen is shown in Table II. The primary center of the lesson-preparation effort has been in operation since 1 October 1977 at the 5th Combat Communications Group at Robins Air Force Base. The data on production of the first thirteen lessons in the period 6 September 1977 to 22 March 1978 have been analyzed. The data include the number of work days required to complete a lesson, and the man-hours of the personnel involved. The major finding so far has been that there was a system warmup effect. The results are summarized in Table III which shows a comparison between the initial set of six lessons and the next seven. It is apparent from these data that there was an improvement in work days and amount of labor for the author and support personnel, although the size of a lesson remained constant. These effects may be explained as due to learning by the original team of authors who subsequently served as author supervisors, and by the introduction of the more-detailed lesson procedures.

The numbers in Table I, reported in the previous Semiannual Technical Summary,* have been updated as a result of this authoring experience. The main changes have been to increase the time authors spend in lesson preparation and to decrease the contribution of other participants; the time allotted to the educational advisor was reallocated because none was available. A general factor that will affect the interpretation of these data is whether the lessons will average 1 hr in duration as assumed. As yet, there are no data to confirm or deny the accuracy of this estimate.

The conditions of authoring were not quite the same as anticipated. The variables originally planned for the test were:

(a) Lesson Preparation Order – first vs second effort by each author
(b) Type of Lesson – task-with-explanation vs pure procedure
(c) Type of Author – technician vs technical support personnel

For the most part, each author has been assigned two lessons and the lessons vary substantially along the task-with-explanation/pure procedure dimension. However, with respect to Type of Author, work managers have not assigned technical support personnel to this duty. An unanticipated variable of interest has appeared. A substantial number of lessons will be developed at each of three locations:

- The main authoring center (5th Combat Communications Group)
- A satellite authoring center (2nd Combat Communications Group)
- Scattered units of the Air National Guard

A comparison of lesson production and training data under these conditions will suggest whether lessons must be produced at an authoring center for the sake of efficiency and/or effectiveness.

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* Semiannual Technical Summary Report on the ARPA Authoring System, Lincoln Laboratory, M.I.T. (30 September 1977), DDC AD-A052464/5.

TABLE II

LESSONS UNDER DEVELOPMENT FOR THE AN/TRC-97A RADIO SET

Performance Checks	Shelter and Equipment Turn-On Normal and Emergency Turn-Off Power Amplifier Turn-On Power Amplifier Turn-Off Multiplexer Loop Performance Check Synthesizer Frequency and Power Check Exciter Performance Check RF Loop Performance Check Receiver (FM) Quieting Performance Check
Adjustments and Alignments	Multiplexer Voltage Regulator and Master Oscillator Alignment A7 Test Set Operation and Alignment Multiplexer Transmit Path Alignment Multiplexer Receive Path Alignment Multiplexer Alarm Alignment Multiplexer Ring Window Alignment Modulator Alignment Threshold Extender Adjustment Signal Comparator Alignment Radio Net Gain Adjustment RF Power Monitor Meter Calibration Power Amplifier Low Power Alarm and A24 Monitor Alignment Teletype Adjustment A21 Power Supply Alignment
Operations	Operation of the Pocket Transit Remote Alarm Monitor (BZ-109) Jamming and ECM Operation of the Control Monitor Operation of Test Equipment Site Installation Van Orientation

TABLE III

COMPARISON OF MEASURES OF LESSON PRODUCTIVITY FOR THE FIRST AND SECOND SETS OF LESSONS

	First Set	Second Set
Average Time per Lesson (work days)	66	38
Author Labor per Lesson (man-hours)	255	172
Support Labor per Lesson (man-hours)	104	31
Total	359	203
Average Lesson Size (frames)	37	39
Number of Lessons	6	7

IV. LESSON TESTS

An evaluation of the lessons is planned as a means to validate the authoring procedures. The training data recorded on the cassette tape on the Lincoln Terminal System delivery unit will be analyzed to detect flaws in the lesson design. Also, the command, the Air Force Communications Service, is hiring an independent research organization to conduct a formal training validation study. There will be a comparison of the performance of personnel trained in the conventional manner with those on the ARPA Authoring System materials. These results will constitute a direct test of the relative effectiveness of training mediated by the authoring procedures.