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ABSTRACT

An explication of the modification to the research design for the second implementation of the United States Naval Academy leadership course developed by the Westinghouse Learning Corporation is provided. A comparison is made, where applicable, of the results of the experimental manipulations in the spring and fall implementations. A summary of the results of the two research efforts is also provided. EM 010 418 through EM 010 447 and EM 010 451 through EM 010 512 are related documents. EM 010 418, EM 010 419, and EM 010 484 are the final reports. (Author/RH)

Westinghouse Learning Corporation

Contract No. N00600-68-C-1525

REPORT OF PHASE III RESEARCH FINDINGS: FOR A MULTIMEDIA COURSE IN LEADERSHIP, PSYCHOLOGY AND MANAGEMENT

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I. INTRODUCTION

This report describes the results of several studies conducted during the second implementation of the individualized, multimedia Leadership, Psychology and Management course developed by Westinghouse Learning Corporation (WLC) for the United States Naval Academy (USNA). These studies form part of a comprehensive investigation of factors influencing student achievement intended to guide continuing improvement of the course and to have wide ranging application in the field of educational technology.

The research conducted during the fall 1970 semester basically was a replication of the research efforts engaged in during the first implementation of the course in the spring semester of 1970. This report will provide a brief description of the initial research plan which was reported in detail in TR-6.12a Report of Phase II Research Findings, Part I: Conditions of Instruction. The major emphasis will be directed toward an explication of the modifications to the research design for the second implementation, and comparison, where applicable, of the results of the experimental manipulations in the spring and fall implementations of the course.

The WLC research plan has the distinction of being one of the first to provide a joint examination of factors in all major categories relevant to the design of an instructional system, including media, presentation forms, task requirements, student characteristics, and operational organization. The WLC plan is unique both in the number of factors investigated and in the use of an entire ongoing course system as an experimental vehicle permitting empirical findings to be extracted relevant to the influence of each factor singly and in combination. It is expected that experiments of this type, as part of a concentrated effort in educational research, may eventually result in a comprehensive understanding of the educational process, so that an instructor may choose with confidence the most effective media and presentation forms to teach a particular type of student a particular type of task.

II. BACKGROUND OF THE RESEARCH

In this section an informal analysis of educational systems is presented leading to the identification of major classes of variables important in the development of a comprehensive educational technology. An important distinction between presentation and media variables is then described in relation to conceptual organization of these variable classes based on Tosti and Ball's (1969) instructional design and media selection model.

Variables in Instructional Systems

Instructional systems may be analyzed as an interactive process among components of (1) designed behavioral objectives, (2) student, (3) materials designed to change student behavior toward the designed objectives, (4) media presenting materials to the student, and (5) operational organization bringing these components into articulation. The nature of such a system is illustrated in Figure 1.

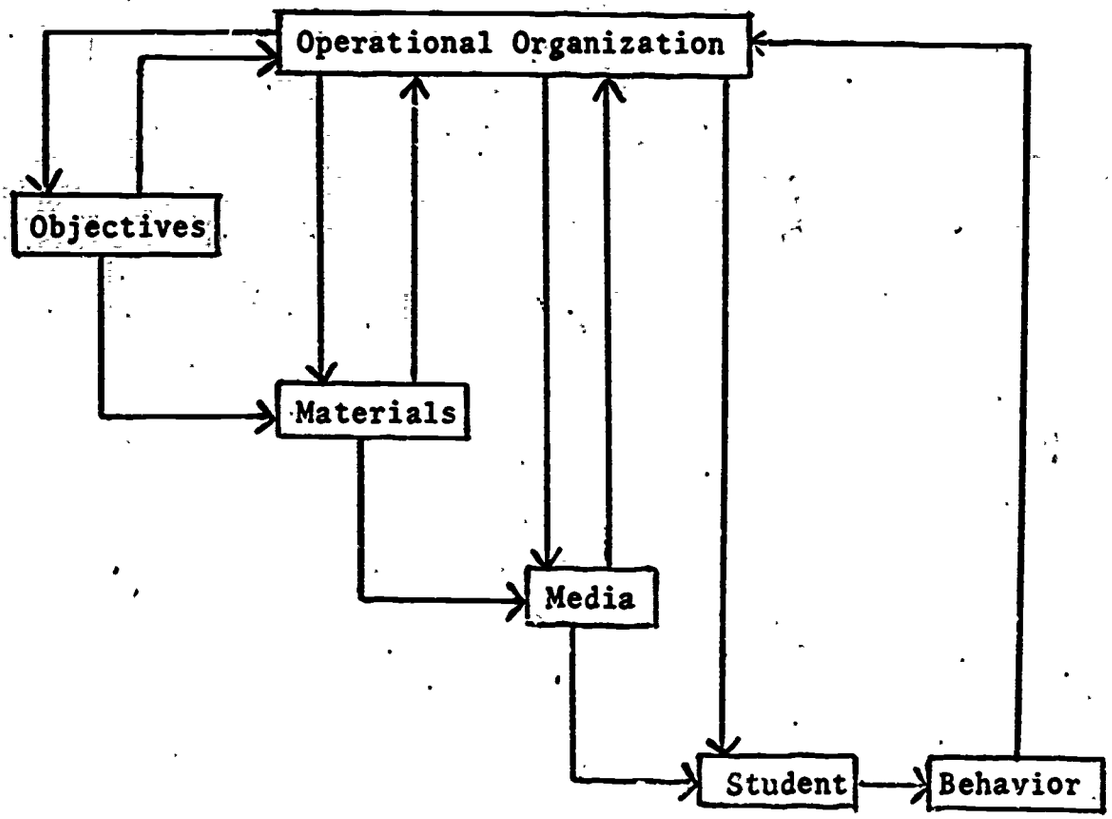

Figure 1. Components of educational system.

An analysis of this kind clarifies several points in relation to instructional systems. First, evaluation of a system rests primarily on examination of the correspondence between objectives desired and behavioral changes achieved. Other criteria, such as the desirability of objectives and cost-effectiveness are external to the system and concern the utility of the system as a component in larger social systems. Second, research on instructional systems requires the manipulation or measurement of characteristics (variables) differing among individual examples of the same component, and study of the associated modifications in the behavioral output. Clearly, evaluation of a standing instructional system may proceed, given information on objectives and behavior change, but when a discrepancy is discovered between these, efforts must return to the research domain to discover how to modify the system to eliminate the discrepancy.

Corresponding to each component of the instructional system are a large number of variables potentially important in determining the final behavior change effected. The instruction system designer is, however, not equally free to manipulate or select settings for the variables in all categories. Once objectives for

a given target population of students are established for the system, the range of variation in task variables is fixed by the objectives, and student variables are fixed by the definition of the target population. The system designer must then work with the presentation variables of the materials, media variables, and operational variables to arrange an optimally effective system for the particular types of tasks and students involved. From this point of view, presentation, media, and operational variables are of primary research interest, while task and student variables are of interest mainly in relationship to the other categories of variables.

Informal analyses of this type have provided heuristic guidelines in the development of WLC's research plan, and should prove useful in similar efforts in the future.

Presentation Variables

One of the important questions in current educational research is, "Which media will teach a given unit of instructional material most effectively?" With the introduction of so many different technological aids (including teaching machines, programed texts, television, film, cartridge tape, and computerized instruction) there is a steadily increasing variety of devices available

for use in any instructional program. The problem is to decide what medium is best for a particular purpose, and how to efficiently utilize its capabilities.

In addressing this problem, Tosti and Ball (1969) have developed a model for instructional design and media selection in which a distinction is made between medium and presentation:

> Media researchers to date have not chosen to distinguish a presentation form from the media which carry it. The new model requires that such a separation be made.
>
> The media in instructional systems carry not only the data of the instructional message, but also data on students' responses and various bits of data necessary to maintain the operating systems. It is this conglomerate of information carried by a medium which will be called the presentation.
>
> Presentation forms will be explicitly structured to communicate all data (stimulus, response, system control, student control) necessary for an efficient student-system interface. A student does not learn from the media. He learns from the presentation form. Media do little more than deliver the information to be learned in whatever presentational form previously decided upon. Some media organizations have maintained that media choice may contribute to learning efficacy because of a student's media preference characteristics or because of media dependent cues. However, the importance of these two ideas is

minimal when a separate presentation design is implemented.

To illustrate the distinction that Tosti and Ball have made, consider an instructor giving a lecture to one group of students. This lecture is videotaped and later shown to another group of students. Both groups would experience the same presentation design; only the medium would be different.

Also consider one lecture in which the instructor never answers questions, and another lecture where the instructor answers every question. In this case, the media are the same (lecture), but the presentation of the two lectures is different.

The instructional design model which Tosti and Ball have developed is essentially a taxonomy of instructional presentation variables, independent of media device, content, and external constraints. Using this taxonomy, it becomes possible to precisely describe any instructional sequence by identifying its characteristics along basic dimensions which are common to all instructional presentations. Since the specification of presentational variables is a critical consideration in educational research, the application of Tosti and Ball's model may result in a significant improvement in the quality of

studies in educational technology and in the generalizability of their findings. The presentation taxonomy may be of comparable value to other educational classification systems. As Bloom (1956) commented on the taxonomy of education objectives:

> ...(the taxonomy) is expected to be of general help to all teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problems. It is especially intended to help them discuss these problems with greater precision.

The application of the Tosti and Ball model involves the determination of a precise presentation design for each instructional objective. Media are then selected on the basis of their limitations in presenting the presentation design intact. The primary question raised by the Tosti and Ball model is whether variations of conditions of instruction in the presentation design domain are of greater or lesser importance than variation in the media domain with respect to student achievement. The implication is that if the presentation design is held constant over a unit of instruction the use of different media should not result in differential levels of achievement. Conversely variations in the presentation design with the medium constant over a unit of instruction should result in differential levels of achievement.

It would appear that a detailed behavioral analysis of individual learning events would require the specifications of a host of subsidiary variables associated with each of the Tosti and Ball presentation variables. The general approach used here was to investigate the presentation design--media controversy over larger units of instruction involving similar types of instructional objectives.

In each of the hypotheses to be tested during the Leadership Management course, the experimental treatments have been defined with reference to the six dimensions of presentation of Tosti and Ball's model. The dimensions of presentation are discussed in detail in the following section.

Dimensions of Presentation

Dimensions of presentation have been derived by a logical analysis of instructional systems (Tosti and Ball, 1969). These systems possess three basic capabilities:

a. The transmission of instructional information (stimulus capability)

b. Accepting measurable behavior of the student (response capability)

c. Changing the presentation based on the behavior of the student (management capability)

Each capability may be further differentiated in terms of two attributes: form and frequency. The result of this analysis is a 3 x 2 matrix, represented in Table 1, in which six dimensions of presentation are generated. Further study of common or possible instructional procedures reveals a number of levels or categories associated with each dimension, also listed in Table 1.

The following subsections give a detailed description of each dimension and its levels or categories. Discussions of research findings relating to the dimensions will be presented in connection with the experiments involving those dimensions.

Stimulus form (representation). This dimension is related most directly to media. It characterizes the dominant mode of sensory reception (by the student) of the instructional material, inherent in the means of representation of stimuli. There are three categories within this dimension:

a. Verbal-written -- written material, such as printed text
b. Verbal-spoken -- voice transcriptions, such as from a lecturer, videotaped lecture, or tape recorder

TABLE I

SYSTEM CAPABILITY MATRIX AND

DIMENSIONS OF PRESENTATION[a]

System Capability	Attributes of System Capability	
	Form	Frequency
Stimulus	Stimulus Representation Verbal-written Verbal-spoken Pictorial	Duration Transient-Persistant Length of time the presentation remains intact a. low b. intermediate c. high
Response	Response Demand Overt-written Overt-spoken Covert	Response-Demand Frequency Infrequent-Frequent Frequency of response required a. low or zero b. intermediate c. high
Management	Management Form Repetition Multi-level Multi-form Error-diagnostic	Management Frequency Infrequent-Frequent Frequency of decision to change presentation a. low or zero b. intermediate c. high

[a] After Tosti and Ball, 1969.

c. Pictorial -- illustrative material, such as pictures

In many presentations, two or more stimulus forms may be used simultaneously. A book may display both illustrations and prose. An educational television program conveys both a picture and lecture. Other presentations can require media-mixes such as the teacher-blackboard combination. Less common is the simultaneous employment of two variations of the same stimulus presentation, i.e., requiring the student to read and listen to the same verbal presentation.

Stimulus frequency (duration). Tosti and Ball (1969) have explained stimulus frequency as follows:

> Presentation varies on this ordinal dimension from transient to persistent, depending upon the duration of the simulus. Movies usually are conveyors of more transient presentation, and texts display relatively persistent ones. A classroom presentation by lecture is more transient than one which is delivered by the blackboard.

Transient presentations are usually instructor controlled. As in most films and lectures, the stimuli are available to the student for a fixed period of time. Persistent presentations are usually student controlled. An example would be the PI text, in which the student proceeds at his own rate and may study a unit of instructional

material for as long as he likes. Essentially, a presentation form is categorized as "transient" or "persistent" depending on the length of time the presentation stimuli remain unchanged.

Response demand. This dimension characterizes the types of behaviors which students are expected to perform in an instructional situation. The four categories within this dimension are:

a. Covert
b. Overt-written
c. Overt-vocal
d. Passive

In a PI text, the student is asked to write the answers to small units of materials. This presentation design has an overt-written response demand. A student who is asked a question in a group discussion usually answers in the overt-vocal form. The covert category describes situations where the student is asked a question, but is not required to answer with a specific, overt (observable) response. For example, the instructor giving a lecture might say, "Think of what would happen if we mixed sodium and water." The passive category describes those presentations in which questions are not overtly asked, and the student is not expected to respond

with specific overt or covert responses. Many lectures and most films are in this category. The student is only required to look and listen. However, the label "passive" should not imply that the student is doing nothing; he may be thinking intently, formulating questions about the material, or taking notes. This behavior, however, is controlled by the student, not by the instructional material. Where it is the intent of the instruction to evoke relatively specific behaviors in the learner, that presentation is categorized as either overt-written, overt-spoken, or covert.

Response demand frequency. This dimension describes how frequently the student is expected to respond (overtly or covertly) in a given period of instruction. A PI text normally has a response demand after every frame. A lecture of film may be presented with no response demands in the entire session (or module). In any medium, questions or problems may be interposed at various intervals during the instructional sequence. This presentation design would have some intermediate response demand frequency. This variable may provide a better conceptualization of what has been termed "step size" than any other.

In a temporal sequence of instruction, there are three general dimension categories:

a. High response demand frequency -- relatively frequent demand for a response in an instructional sequence, such as in programed texts where a response is required in each frame.

b. Medium response demand frequency -- relatively moderate frequency of demand for a response, such as questions which follow ten minutes of videotaped lecture.

c. Low response demand frequency -- low demand for a response, as when a "review" question follows a chapter of textual material.

Management form. Instructional management can be defined as those activities involved in the decision to assign a specific learning exercise to a given student, based on the assessment of some behavior of that student. One common example of instructional management occurs when the teacher, who discriminates that a student is having difficulty with learning a particular skill, makes the decision to assign special homework or decides to provide individual tutoring. The general logic of this activity, i.e., assessing behavior, selecting presentation, and then having the student engaging in new activity, can be extended to provide the foundation for rules employed in most new individualized instructional systems and computer-managed classroom programs.

Every instructional system involves three management elements:

a. Repertoire assessment -- appraisal of data and analysis of behavior competencies

b. Selection decision -- selection of a goal as a result of decisions based on assessment

c. Activity -- actions following from decision.

It is evident that the elements of instructional management can vary in their composition, depending on the purpose of management. Tosti and Ball (1969) isolated five purposes that may be achieved.[1] These are:

a. Need management -- to ensure students receive only those materials which they require to meet their objective.

b. Achievement management -- to ensure all students have mastered the objectives of the segment.

c. Prescription management -- to ensure a given student receives the most appropriate materials to meet the objectives in terms of his individual characteristics.

d. Motivation management -- to ensure continual student contact with the materials and to

[1]Tosti and Ball (1969) originally identified a sixth type, that of operational management. In the current presentation, this category is included among the operational system variables, since the management activities are rarely contingent on assessment of an individual student's performance.

increase student learning rate.

e. Enrichment management -- to provide for additional information relevant to objectives, but not necessary for their achievement.

The present research is primarily concerned with achievement management. Therefore, the four categories in the Management Type dimension presented below are the different procedures which may be used in management for achievement.

It frequently happens that a student is not responding to the presentation in a manner which allows him to reach the objectives. There are four strategic subclasses of management responses to such situations.

a. Repetition -- If the student fails to reach the objective, repeat the same presentation or continue through similar presentations until he does. Continuous practice is one variation of this strategy.

b. Multiform -- If the student fails to reach the objective with one presentation form, select a parallel but different form, e.g., Project PLAN (Flanagan, 1967).

c. Multilevel -- If the student fails to reach

the objectives with the presentation form, select a lower level (more expanded) form e.g., PROMOD (C'de Baca, 1968).

d. Error-Diagnostic -- If an error is made at any point within the presentation, action designed to correct that specific error is selected, e.g., intrinsic program presentation or computer assisted instruction (CAI) presentation. It is necessary when using the error-diagnostic strategy to classify errors as:

1) input errors -- due to poor presentation design.

2) processing errors -- due to the student's lack of the assumed appropriate repertoire on which the learning material was built, or the student's use of an inappropriate approach to the solution.

3) output errors -- due to carelessness, poor attention, and chance error (failed to attend to a significant stimulus).

Management frequency. "This dimension is ordinal and is ordered according to the relative frequency of the decision to modify the presentation" (Tosti and Ball, 1968). The concept of decision-making in presentation design is more clearly exemplified in tutoring.

Typically, the student is directed to answer a question posed by the tutor, and a decision is made by the tutor about what he should next present, on the basis of that response. A similar instructional management form is used in PI. If an answer is incorrect, the student may be directed to any one of a number of remediation frames.

Other media may also vary in decision frequency. An instructor may ask his class a question in the middle of his lecture to see if they are understanding the material. Depending upon the students' answers, the instructor may decide to continue with the planned lecture, to review the same material, or to start a new topic. For any presentation form, the decision frequency may vary from a decision every frame to no decision at all.

In a temporal sequence of instruction, there are three general categories:

a. High management frequency -- relatively high frequency of decision to alter the presentation, based on the student's response to a question. Management frequency may be built into the instructional system, as in a text where the decision is made on the basis of a response to every frame or to remediate him on the same frame. The management frequency may also be determined extemporaneously, as when a lecturer asks a class a question; if no one

answers, the lecturer may decide to review previous content.

b. Medium management frequency -- relatively moderate frequency of decision to alter the presentation based on the student's response, such as having a quiz after a 10-minute film, and on the basis of the student's score, either repeating the film or proceeding to new material.

c. Low management frequency -- relatively low frequency of decision to alter instruction based on the student's response to a question, such as a lecturer giving a quiz after 40 minutes of lecture; basing the decision on the student's score, the instructor either assigns homework problems or does not.

It should be noted that the response-demand frequency must be equal to or more than the management frequency; decisions about a response cannot be made more frequently than one calls for that response. An example of a presentation in which response-demand frequency exceeds management frequency is the lecturer who frequently asks the class "rhetorical questions"; the lecturer does not change his presentation on the basis of the student's (covert) responses, yet he does call for those responses. In this case the response-demand frequency would be high but the management frequency would be low. (See Table 1)

Task Variables

The conditions of instruction investigated were designed to affect the processes of learning in a comprehensive fashion, altering the instruction related to every objective of a segment in specified ways. The main question raised by the classifications of types of learning is whether or not the presentation variables and media havesimilar effects on the achievement of different types of objectives.

Early in WLC analysis of content and objectives for the USNA Leadership course, it became apparent that most of the terminal objectives of the course represented the types of learning (tasks) indicated by Gagne (1965) to be principles and problem solving with enabling objectives at the levels of verbal associations, multiple discrimination, and concepts in Gagne's hierarchy of learning tasks. It was also recognized that most of the elements involved in these objectives could be further analyzed as rules and examples in accordance with Evans, Homme, and Glaser's (1962) RULEG system. Furthermore, the objectives could be further identified according to Bloom's (1956) taxonomy as involving either knowledge of leadership and management elements or application of those

elements in realistic naval situations.

As a result of these findings, WLC developed a system of formats to be used as guidelines in the writing of specific enabling and terminal objectives. This classification scheme represents a derivation and extension of Bloom's (1956) Taxonomy, Gagne's (1965) learning types, and Evans, Homme, and Glaser's (1962) RULEG system, serving to coordinate features of each.

Behavioral objectives were prepared, in most cases, in accordance with the four formats listed below:

a. Type 1 (Definition - Identification)
Given the instruction to identify the correct (purpose of/definition of/description of/use of) concept X, the M will select from several choices the correct (purpose of/definition of/description of/use of) concept X.

b. Type 2 (Discrimination-- Comparison)
Given the instruction to evaluate the relationship between/defining attributes of/ contrast between/comparison among) classes X, Y, Z...N, the M will be able to select from several choices the paragraph (which illustrates/ describes/differentiates/identifies) this (relationship between defining attributes of contrast between/comparison among) classes X, Y, Z...N.

c. Type 3 (Generalization - Problem Identification)

1) Deductive

Given examples of X, the M will be able to select from several choices the example which illustrates principle Y.

2) Inductive

Given an example of X, the M will be able to select from several choices which principle (X, Y, or N) is (shown/exemplified/demonstrated) by the example.

d. Type 4 (Problem Solving)

When asked to evaluate a situation which is an example of class X, the M will select from several choices the correct (solution/approach/method/resolution of/reaction to) the situation using principle Y.

Test items were developed from the statement of objectives for the criterion-referenced Progress Check tests and Administrative test which served as direct measures of achievement for purposes of evaluation. Performance on these tests thus represents learning of all four types given above, when the instructional materials are developed to explicitly teach those objectives.

The primary variables representing different classes of learning, however, were the Cumulative Posttest (CPT) items developed as special norm-referenced research tests.

These tests were developed to have approximately equal numbers of items representing acquisition of knowledge (Type I items). and application of knowledge (Type II items), roughly corresponding to Bloom's categories of knowledge and applications. As items designed for content validity with high discriminative power, both types of items tap abilities in Bloom's other categories of comprehension, analysis, synthesis and evaluation.

Operationally, the distinction between Type I and II CPT items rests almost entirely on the presence or absence of naval situational examples in the stems or distractors. Thus there are some items which do not correspond precisely to Bloom's distinction between knowledge and applications. The use of this operational criterion of distinction, however, appeared compelling after a careful analysis of content represented in the behavioral objectives.

The specific question raised in the present research is whether media and presentation variables have similar effects: (1) averaged over specific criterion behavior of all types as indexed by the Progress Checks, and (2) on criterion-related behavior involving comprehension, analysis, synthesis, and evaluation of knowledge and the application of knowledge as measured in the CPT tests.

III. THE RESEARCH PLAN

Course Structure

The Leadership Management course was first organized in terms of elemental blocks of content and related tests of student achievement, which were temporally sequenced without regard to research constraints. Additional elements of structure were then inserted for research purposes. This procedure insured that a basic course structure was achieved from which the research elements could easily be detached for purposes of final course packaging and implementation. The course structure may be described in terms of the four categories outlined below.

Part. The content is divided into 12 parts, corresponding to 12 chapters of the basic content outline. Each part is a formal designation of a large topic area, representing a substantial number of closely related terminal objectives relatively independent of the objectives of other parts. The objectives of any one part could be considered to be subsumed under one of the broad aims (macro-objectives) of the course. The part served primarily as an aid in fractionating the developmental work on materials.

Segment. In terms of content, a segment is a sub-collection of learning objectives within a part, which are closely related in the development of a behavioral

hierarchy of competence and in the sequencing of instructional events. A total of 59 segments were incorporated in the 12 parts of the course. The content headings of each segment are listed in Table 2 under their respective parts.

Except for revisions based on data obtained from the first implementation (Spring 1970), the content of the parts and segments remained the same for the second implementation (Fall 1970). There were some changes in medium in which some of the segments were programed. These changes from the spring 1970 to the fall 1970 run are indicated in Table 2. A more complete description of the media used in each of the two runs can be found in TR6.11, Phase II Evaluation Report and TR6.15, Phase III Evaluation Report. Changes to the research from the spring to the fall run are indicated in Table 2, and discussed in detail in the next section (Experimental Design) of this report.

Conceived operationally, the segment is the basic instructional unit in the development and production of materials, and serves as the logistical unit in implementation for purposes of scheduling and assessment of progress through the course materials. Essentially, the segment is analogous to a class period or lesson in other instructional systems, requiring 40 to 80 minutes of student time, and provides the basis for manipulation of

TABLE 2

OUTLINE OF COURSE STRUCTURE AND MEDIA

Part & Segment Number	Content Heading	Spring CPT Unit[a]	Fall CPT Unit[a]	Spring Medium[b]	Fall Medium[b]
	PART ONE: OVERVIEW OF LEADERSHIP				
1.1	Concepts of Leadership	NR	NR	ST	ST
1.2	Standards of Leadership in the Naval Service	NR	NR	F-GD	F-GD
	PART TWO: INDIVIDUAL BEHAVIOR				
2.1	Introduction to Psychology	NR	R	ST	ST
2.2	Behavior and its Observation	1	1	AT- or VT-PB	AT-PB
2.3	Learning	1	1	AT- or VT-PB	AT-PB
2.4	Factors Affecting Learning	1	1	AT- or VT-PB	AT-PB
2.5	Attention and Perception	1	1	AT- or VT-PB	AT-PB
2.6	Motivation	2	2	ST	ST
2.7	Conflict	2	2	ST	ST
2.8	Neurotic and Psychotic Reactions	2	2	ST	ST
2.9	Personality	NR	R	LAS	ST
	PART THREE: GROUP DYNAMICS				
3.1	Characteristics of Groups	3	3	AT- or VT-PB	AT-PB
3.2	The Relationship of the Leader to the Group	3	3	AT- or VT-PB	AT-PB
3.3	Group Interactions	3	3	AT- or VT-PB	AT-PB
3.4	Conformity as a Factor of Group Behavior	3	3	AT- or VT-PB	AT-PB
3.5	Relation of the Individual to the Group	NR	R	ST	ST
	PART FOUR: ACHIEVING EFFECTIVE COMMUNICATION				
4.1	Importance of Interpersonal Communication	4	4	LT	LT
4.2	Types of Communication	4	4	LT	LT
4.3	The Communication Process (Receiver and Barriers)	4	4	LT	LT
4.4	The Communication Process (Sender and Feedback)	5	5	AT-IP	AT-IP or ATS-IP
4.5	Formal Communication and its Dimensions	5	5	AT-IP	AT-IP or ATS-IP
4.6	Informal Communication	5	5	AT-IP	AT-IP or ATS-IP
4.7	Communication Under Battle Situations	5	5	AT-IP	AT-IP or ATS-IP

Part & Segment Number	Content Heading	Spring CPT Unit[a]	Fall CPT Unit[a]	Spring Medium[b]	Fall Medium[b]
	PART FIVE: MILITARY MANAGEMENT				
5.1	Introduction to Management and the Management Process	NR	14	ST	ST
5.2	Decision Making and Creativity	NR	14	ST	ST
5.3	Objectives	NR	14	ST	ST
5.4	Planning	6	6	LT	LT
5.5	Organizing: Principles and Process	6	6	LT	LT
5.6	Organizing: Structure	6	6	LT	LT
5.7	Organizing: Charting	7	7	AT- or VT-PB	AT-PB
5.8	Directing	7	7	AT- or VT-PB	AT-PB
5.9	Controlling	7	7	AT- or VT-PB	AT-PB
5.10	Coordinating	7	7	AT- or VT-PB	AT-PB
	PART SIX: AUTHORITY AND RESPONSIBILITY				
6.1	Concept of Authority	8	8	ST	ST
6.2	Why People Accept/Resist Authority	8	8	ST	ST
6.3	Delegation of Authority; Line-Staff Relationship	8	8	ST	ST
6.4	Responsibility	NR	R	ST	ST
	PART SEVEN: LEADERSHIP BEHAVIOR AND STYLE				
7.1	Leadership Behavior	9	9	AT- or VT-PB	AT-PB
7.2	Leadership Style	9	9	AT- or VT-PB	AT-PB
7.3	Determiners of Leadership Style - The Leader	9	9	AT- or VT-PB	AT-PB
7.4	Determiners of Leadership Style - The Group and The Situation	9	9	AT- or VT-PB	AT-PB
7.5	Participative Leadership	NR	R	VT-PB	AT-PB or ATS-PB
	PART EIGHT: SENIOR-SUBORDINATE RELATIONSHIPS				
8.1	Organizational Structure & Social Distance in Senior-Subordinate Relationships	10	10	LT	LT
8.2	Officer-Enlisted Relationships	10	10	LT	LT
8.3	Assumption of Command and Formal & Informal Leader Relationships	10	10	LT	LT
8.4	Introduction to Counseling	11	11	LAS	ST
8.5	The Counseling Process	11	11	LAS	ST
8.6	Relations with Seniors and Contemporaries	11	11	LAS	ST
	PART NINE: MORALE - ESPRIT DE CORPS				
9.1	Morale	NR	R	VT-PB	AT-PB or ATS-PB

Part & Segment Number	Content Heading	Spring CPT Unit[a]	Fall CPT Unit[a]	Spring Medium[b]	Fall Medium[b]
	PART NINE: MORALE - ESPRIT DE CORPS (CON'T)				
9.2	Group Solidarity and Esprit	NR	R	VT-PB	AT-PB or ATS-PB
	PART TEN: DISCIPLINE				
10.1	Introduction to Discipline	NR	R	AT-IP	AT-IP or ATS-IP
10.2	Development and Maintenance of Discipline	NR	R	AT-IP	AT-IP or ATS-IP
	PART ELEVEN: PERSONNEL EVALUATION				
11.1	The Role of Evaluation	12	12	ST	ST
11.2	Enlisted Performance Evaluation	12	12	ST	ST
11.3	Officer Evaluation	12	12	ST	ST
	PART TWELVE: APPLIED LEADERSHIP				
12.1	Measurement of Effective Leadership	13	13	CAI	CAI or CAIS
12.2	Generally Recognized Characteristics of an Effective Leader	13	13	CAI	CAI or CAIS
12.3	Techniques of Assuming Command	13	13	CAI	CAI or CAIS
12.4	"That's an Order!"	13	13	CAI	CAI or CAIS

[a] NR refers to a nonresearch segment, thus not assigned to a CPT unit.
R refers to a research segment that did not involve a Cumulative Posttest.

[b]
ST = Syndactic (multi-level) Text
F-GD = Film, Group Discussion
AT = Audiotape
ATS = Audiotape Script
VT = Videotape
PB = Panel Book
LAS = Learning Activities Summary
LT = Linear Text
IP = Intrinsic Program
CAI = Computer Assisted Instruction
CAIS = Computer Assisted Instruction Script

the real-time parameters of the course.

At the completion of each segment, a progress check (PC) test was administered to assess the student's attainment of the terminal and enabling objectives of the segment. PC's are composed of 10 criterion-referenced items, developed directly from the behavioral statement of segment objectives.

Module. A module is a particular instructional condition used to prepare and deliver materials for a segment, identified in terms of the categories of the Tosti and Ball (1969) model. Several parallel modules were prepared in each segment utilized for research purposes, representing variations specified by the experimental designs. The different modules of a segment are distinguishable from one another by differences in presentation design and/or media, although the content is the same. Specifications of the modules for each segment are outlined in later sections of the paper giving the design of each experiment.

Cumulative Posttest unit. The cumulative posttest (CPT) unit is a group of three or four adjacent segments within a part. In the Spring 1970 run, there were 13 CPT units involving 45 of the 59 segments of the course, as listed in Table 2. The primary criteria for grouping segments into CPT units were that the segments dealt with similar types of content and objectives, and that the instructional sequences relating to particular concepts which were initiated in the unit would also terminate in

the same unit. All segments in a CPT unit were developed in the same medium and with the same variations in instructional conditions between modules.

In the second implementation (Fall 1970), there were 14 CPT units involving 48 of the 59 segments. In addition, research using progress checks as the dependent measure was conducted involving 9 additional segments.

The CPT unit is the fundamental unit of instruction for research purposes, providing the framework on which the experimental designs were constructed. The students were divided into groups assigned to different modules in the CPT unit. A student in any one group would thus encounter the same experimental conditions in progressing through the three segments of the unit, and would take three PC's, one after completing his module of each segment. After completing the segments and PC's all students then take the CPT, a test administered to assess overall achievement level under the experimental conditions represented in the CPT unit.

Performance on the CPT was the primary dependent measure for research purposes. Each CPT was composed of 10 multiple-choice items for each segment in the unit, so that CPT's for 3 segment units had 30 items, and CPT's for 4 segment units had 40 items. There were approximately equal numbers of two types of items: Type I, representing

acquisition of knowledge of the concepts and principles in the unit, and Type II, representing application of those concepts and principles in the unit in relation to realistic examples of leadership situations.

CPT items were designed to have content validity in relation to the objectives of the unit, but unlike the PC items, also to have high difficulty and discrimination power. The CPT tests thus provided norm-referenced rather than criterion-referenced measures of achievement level. Many items were designed to measure the ability to integrate behaviors from different segments in the unit. An effort was made, however, to maintain an equitable representation of content from the several segments of the unit.

Following completion of the CPT, each student is given remediation on segments where his PC test performance is below 80%. The remediation consists of repetition of the same instructional materials previously used with the segment, or materials of an alternative module thought to be more effective. On completing remediation, the student repeats the PC's for those segments and then proceeds to the next segment.

Media. Course materials were prepared using eight media:

a. audiotaped lectures with accompanying panelbook (AT-PB)

b. audiotape script with accompanying panelbook (AT-PB)

c. syndactic text -- summary statement on concepts in text followed by frame sequence in text (ST)

d. audiotape with intrinsically programed text (AT-IP)

e. audiotape script with intrinsically programed text (ATS-IP)

f. computer assisted instruction (CAI)

g. computer assisted instruction script (CAIS)

h. linear programed text (LT)

i. film and group discussion (F-GD)

The nature of these media are explained in more detail in the Phase III Evaluation Report (TR6.15).

Experimental Design

Spring 1970. Table 3 presents a summary of the research plan for the spring 1970 run of the course. Experiment I involved 16 segments in which two variables were manipulated. Each student worked through two consecutive CPT units in videotape and two consecutive CPT units in audiotape. Half of the students had high RDF presentations and half had low RDF presentations. Experiment II involved nine segments in which two variables were being manipulated with the medium of linear text being used in all segments. Each of the students worked with each of the three types of response demand (i.e., covert in CPT 4, overt-spoken in CPT 6 and overt-selected in CPT 10)

TABLE 3

SUMMARY OF THE RESEARCH PLAN
For the Spring 1970 Run

EXPERIMENT	CPT & SEGMENT	MEDIA	VARIABLES	CONDITIONS
				A B
I	CPT 1 2.2-2.5 CPT 3 3.1-3.4 CPT 7 5.7-5.10 CPT 9 7.1-7.4	Taped Lecture, Audio & Video (with Panel Book)	A. Response Demand Frequency (RDF) B. Media (Audiotape vs Videotape)	1. High RDF-Videotape 2. High RDF-Audiotape 3. Low RDF-Videotape 4. Low RDF-Audiotape
				A B
II	CPT 4 4.1-4.3 CPT 6 5.4-5.6 CPT 10 8.1-8.3	Linear Text	A. Response Demand Frequency (RDF) B. Form of Response Demand (RD)	1. High RDF-Overt selected RD 2. High RDF-Overt spoken RD 3. High RDF-Covert RD 4. Low RDF-Overt selected RD 5. Low RDF-Overt spoken RD 6. Low RDF-Covert RD
				A B
III	CPT 5 4.4-4.7 CPT 13 12.1-12.4	Audiotape/Intrinsically Programmed Booklet (AT/IP) Computer Assisted Instruction (CAI)	A. Response Demand Frequency (RDF) B. Management Frequency	1. High RDF-High MF 2. High RDF-Medium MF 3. High RDF-Low MF 4. Low RDF-Low MF These conditions apply for both AT/IP & CAI.
IV	CPT 2 2.6-2.8 CPT 8 6.1-6.3 CPT 12 11.1-11.3	Syndactic Text	Remediation method	1. High RDF Remediation 2. Low RDF Remediation 3. No Remediation
V	CPT 11 8.4-8.6	Learning Activity Summary (LAS)	Peer Interaction	1. Peer Interaction 2. No Peer Interaction

in different sequences. Half of the students were given high RDF presentations across all segments and half were given low RDF presentations. Experiment III covered eight segments in which two variables were manipulated. Each student was presented only one of the four conditions or modules in CPT 5 and 13 and it was the same one in both CPT units. As indicated in Table 3, the medium used in CPT unit 5 was audiotape/intriniscally programed booklet, and in CPT unit 13 the medium was Computer-Assisted Instruction. Experiment IV involved 9 segments in which the remediation method was varied. Each student worked through one CPT unit in each of the three conditions. Finally, Experiment V covered three segments in which peer interaction as opposed to individual study was investigated.

The reader should refer to TR6.12a Phase II Research Findings, Part I: Conditions of Instruction for a detailed discussion of these experiments and their outcomes.

Fall 1970. The changes made to the research plan for the Fall run are indicated in Tables 4 and 5. In Experiment I the use of videotape was dropped. The new variables that were manipulated were the form of the response (RD) and provision of confirmation (knowledge of results). In Experiment II the overt-spoken RD type was replaced with one that required the midshipmen to underline their response. In the Spring run, performance where Computer-Assisted Instruction (CAI) was used was exceptionally high and there

TABLE 4

SUMMARY OF THE RESEARCH PLAN
For the Fall 1970 Run

EXPERIMENT	CPT & SEGMENT	MEDIA	VARIABLES	CONDITIONS
I	CPT 1 2.2-2.5 CPT 3 3.1-3.4 CPT 7 5.7-5.10 CPT 9 7.1-7.4	Audiotape (with Panel Book)	A. Response Demand Frequency (RDF) B. Form of Response Demand (RD) C. Confirmation	A B 1. High RDF-Confirmation 2. High RDF-No Confirmation 3. Low RDF-Confirmation 4. Low RDF-No Confirmation These conditions apply with both overt and covert responding.
II	CPT 4 4.1-4.3 CPT 6 5.4-5.6 CPT 10 8.1-8.3	Linear Text	A. Response Demand Frequency (RDF) B. Form of Response Demand (RD)	A B 1. High RDF-Overt selected RD 2. High RDF-Overt underline 3. High RDF-Covert RD 4. Low RDF-Overt selected RD 5. Low RDF-Overt underline 6. Low RDF-Covert RD
III	CPT 5 4.4-4.7 CPT 13 12.1-12.4	Audiotape/Intrinsically Programed Booklet (AT/IP) Computer Assisted Instruction (CAI)	A. Response Demand Frequency (RDF) B. Management Frequency (MF) C. Media (Script vs Audiovisual)	A B 1. High RDF-High MF 2. High RDF- Medium MF 3. High RDF-Low MF 4. Low RDF-Low MF 5. High RDF-High MF (script) These conditions apply for both AT/IP & CAI.
IV	CPT 2 2.6-2.8 CPT 8 6.1-6.3 CPT 12 11.1-11.3	Syndactic Text	Remediation method	1. High RDF Remediation 2. Low RDF Remediation 3. No Remediation
V	CPT 11 8.4-8.6 CPT 14 5.1-5.3	Syndactic Text	Advance Organizer (Content map)	1. Content map 2. No content map

was some question whether it was due to the medium itself or to the content programed for it. Therefore, an additional condition was added to Experiment III. This condition involved the use of a script version of the CAI and audiotape/IP presentations. In Experiment IV the conditions remained the same, but the students were forced through the remediation sequence which they encountered. Experiment V saw the greatest change. The LAS units were re-written in Syndactic text format, the use of the content map was investigated, and another CPT unit (involving 3 additional segments) was added.

Some questions were added to the overall research plan that involved the use of the progress check data rather than the CPT data. These subsidiary questions involved the use of nine more segments in the research effort as is shown in Table 5. In the first analysis the variables of advance organizers and the use of a special revealed answer form were manipulated. Each student saw each of the four conditions. The question had been raised whether a paper version would be as effective as the hardware bound versions (i.e., CAI and audiotape). Therefore, in segment 7.5, in addition to the use of the advance organizer, the effectiveness of the audiotape script as opposed to the tape itself was studied. The third subsidiary analysis looked at the same variables as the second but it included the use of the type with the intrinisically programed booklet as well as the panelbook.

TABLE 5

SUMMARY OF THE RESEARCH PLAN
For the Fall 1970 Run
Subsidiary Questions Using Progress Check Data

	Segment	Media	Variables	Conditions
1.	2.1 2.9 3.5 6.4	Syndactic Text	A. Advance Organizer (Content map) B. Special Answer Form	1. Answer form - map 2. Answer form - no map 3. No answer form - map 4. No answer form - no map
2.	7.5	Audiotape/Panel Book Audiotape Script/Panel Book	A. Advance Organizer (Content map) B. Medium (Audio and script)	1. Audiotape - map 2. Audiotape - no map 3. Audiotape Script - map 4. Audiotape Script - no map
3.	9.1 9.2 10.1 10.2	Audiotape/Panel Book Audiotape Script/Panel Book Audiotape/Intrinsically Programed Booklet Audiotape Script/ Intrinsically Programed Booklet	A. Advance Organizer (Content map) B. Medium (audio and script)	1. Audiotape Script - map 2. Audiotape - map 3. Audiotape Script - no map 4. Audiotape - no map (The above conditions apply for the Panel Books [9.1-9.2] and the Intrinsic Booklets [10.1-10.2]

Each student saw each of the four basic conditions, two with the panelbook and two with the intrinsic booklet.

The final difference between the two implementations dealt with the dependent measures used. In the spring run, the data were analyzed with respect to type I and type II CPT scores as well as Total CPT scores. In addition, the analyses were conducted using progress check performance as a dependent measure. In the fall run only total CPT scores were used in the major experiments. Progress check data were used, however, in the subsidiary analyses.

IV. RESEARCH IMPLEMENTATION

Students

Forty-four third classmen (sophomores) from the United States Naval Academy were enrolled in the Leadership, Psychology and Management course.

Before commencing work on the course materials, each student was randomly assigned to a track. This student track indicated the precise module of materials a student would use in each of the 59 segments of the course.

Materials

The basic course structure was discussed in Chapter III, and Table 2 presented an outline of the course structure and the media used. The segments listed in Table 2 are core segments. That is, they are required segments which include all of the information pertinent to the attainment of the requisite behavioral objectives. In addition to core segments there were depth core and enrichment segments. Depth core segments were associated with one or more segments and were directed toward amplifying the learning objectives of those segments. Depth core segments included in the second implementation were film, group discussions, and classroom lectures by the USNA instructor. Unlike core segments, depth core were scheduled by the instructor with respect to time and place. Student attendance was

required. Enrichment segments were related to but not essential to the mastery of terminal objectives. They were optional to students who desired more information than that presented in core segments.

The specific media used for each segment are indicated in Table 2. A description of the media and each of the variations in presentation form (modules) within each medium is given in Sections V through X.

Tests

Four different tests were used throughout the course. They were the administrative pretest and post-test, the progress check, the cumulative posttest (CPT), and the USNA examination.

The administrative pre and posttest was an 80 point criterion referenced test composed of items representatively sampled from the objective-test item pool. There was at least one administrative test item for each segment of the course. The pretest was given at the beginning of the course, and the posttest was given as part of the final examination.

The progress check was a criterion referenced test of approximately ten items. It was given at the end of each segment.

The cumulative posttest (CPT) was a norm referenced research test composed of positively

discriminating content-related test items. Each CPT was composed of ten items for each segment in the unit. Cumulative posttests were given at the end of each experimental unit.

USNA examinations were a combination of criterion referenced test items selected from the objective-test item pool and items developed by the USNA on-site instructor. These were the only tests in the course which were used to determine the midshipmen's grades.

Procedures

The second implementation of the course was conducted in the Fall of 1970. The course was administered by the USNA on-site instructor, the WLC on-site instructor, and a course administrator. Detailed procedures used in implementing the course are given in the Instructor's Guide (TR6.6).

The instructor's basic responsibilities were tutoring students needing remediation, leading group discussions, scheduling and administering depth core segments, scheduling and administering examinations, and determining grades.

The course administrator developed and supervised the logistical procedures of the course, controlled dissemination and collection of all core materials, remediation prescription forms, module questionnaires, progress checks, and cumulative posttests (CPTs). The

course administrator also scored progress checks and CPTs and forwarded data to WLC's computer center.

Students were routed through the course according to procedures outlined in the Student Guide (TR6.5). In brief, students worked through core segments of the course at their own speed. They were allowed to check out materials and study them whenever and wherever they wished. All students were given identical material when they studied a non-research segment; i.e., they were instructed by the same form of presentation. For research segments, they studied by the particular module (form of presentation) to which they were assigned. Students were randomly assigned to modules at the beginning of the course. Each student received his own routing schedule which included not only the sequence of segments he must study but also the schedule for remediation, research tests, and USNA examinations.

Students worked through non-research material by studying a segment, taking a progress check, remediating (if necessary), and then retaking the progress check. The requirement for remediation was based on failure to attain 80% of the objectives as measured by the progress check. If the student failed to meet the 80% criterion on his first try, he was given a remediation prescription form which directed him to specific points in the materials which related to the objectives failed.

If the student failed to meet the 80% criterion following remediation, he reported to the on-site instructor for tutoring.

Students worked through research segments in the same manner as non-research segments except that they did not remediate until after they had completed the entire research unit and taken the cumulative posttest. Specific procedures followed in the research segments are discussed in sections V through X.

Facilities

For the implementation of the course, WLC was provided three classrooms at the Naval Academy. One room which was designated as the administrative office contained desks for the administrative staff and storage space for half of the course materials (including tapes, printed material, tests, forms, and computer cards). The administrative room was used as the site for administrative conferences, for student tutoring, and for distribution and collection of all material.

The second room was used as the principal instruction room. It contained 15 student carrels.

The third room, used as a multi-purpose room, had three carrels to handle overflow from the instructional room. In addition, there were 30 student writing desks which were used during depth core lectures, films, group discussions, and testing.

V. EXPERIMENT I

Introduction

The purpose of Experiment I was to evaluate the effects of variation in response demand frequency (RDF) on student achievement with transient media. Two additional variables investigated were the effects of variation in the form of the response demand (RD) and the effects of provision of confirmation.

RDF was defined earlier as "how frequently the student is expected to respond (overtly or covertly) in a given period of instruction." It is the relative rate of response which is specifically elicited by the presentation design. In most programed instruction, the student is directed to respond in each frame (relatively high RDF). A lecture may proceed through an entire class period without requiring the students to answer a specific question (relatively low RDF).

It should be restated that the RDF is independent of the management frequency and management type dimensions. The answer to a question may or may not lead to a decision to change the presentation form, and an incorrect response may or may not be followed by remediation. An example of a presentation design with high RDF, but low decision frequency and no remediation, would be a film in which verbal-written questions are interposed at various

intervals. Students would be directed to "think of the answer" to each question, and feedback (correct answer) might be given immediately. However, the film would continue regardless of what the student's answers were.

The primary hypothesis tested in this experiment was whether transient presentations with high RDF will be more effective than transient presentations with low RDF. The present hypothesis is important for two practical reasons. First, it is difficult or impossible to have a high individual decision frequency with some forms of basically transient media (such as television, film, videotape, or audiotape). The use of these media could be greatly extended if it was shown that a high RDF by itself produces superior performance. Secondly, in most presentation designs a question is usually the occasion for a decision and for some kind of feedback. Yet feedback and remediation after the answer may be less important than the occurrance of the question per se. In a well constructed presentation design, the inclusion of appropriate questions at optimal intervals may be the most critical factor in producing superior performance.

Method

Design and Analysis. The plan of experiment I is presented in Table 6. The design is a repeated measures half-plaid Latin Square. The students were randomly assigned to the four groups. Two of these groups responded overtly in each of the four experimental combinations of response demand frequency and provision of confirmation. The other two groups responded covertly in each of the four experimental conditions.

Table 6

Plan of Experiment I

Group		Cumulative Post Test Unit			
		1	3	7	9
OVERT	1	High RDF Confirm	Low RDF No Confirm	Low RDF Confirm	High RDF No Confirm
	2	Low RDF No Confirm	High RDF Confirm	High RDF No Confirm	Low RDF Confirm
COVERT	3	Low RDF Confirm	High RDF No Confirm	High RDF Confirm	Low RDF No Confirm
	4	High RDF No Confirm	Low RDF Confirm	Low RDF No Confirm	High RDF Confirm

Materials and Procedures. The segments involved in this experiment were 2.2 - 2.5, 3.1 - 3.4, 5.7 - 5.10, and 7.1 - 7.4, and the medium used was audiotapes with panel-books (see Table 2).

Two basic modules were prepared; they varied in the response demand frequency (RDF) dimension of the presentation design.

One module of the videotape lecture was characterized by high response demand frequency. At appropriate points in the tape, the student was referred to a numbered question in the panelbook. Students read the question and recorded their answers on an answer sheet if they were in the overt response condition, otherwise they simply thought the answer. If the student was in a module where confirmation was provided, he would check his answer and then proceed with the next section of the tape. The number of questions asked ranged from 15 to 22. The low response demand frequency module of the audiotape lecture was developed by simply editing out all but three of the references to questions in the panelbook. All other elements of the audiotape lecture remained the same.

The lecturer for the audiotapes was a commercial radio announcer. The lecturer presented all materials verbatum from a prepared script. All audiotapes were developed in a commercial recording facility. In developing the audio presentations, standard recording tapes were used. For student use, tapes were transferred to C-60 and C-90 cassette cartridges. All charts,

photographs, drawings, etc., accompanying the audiotape lecture were presented in a panelbook.

Results

Mean student performance as a function of response demand frequency, response demand and provision of confirmation is given in Table 7.

Table 7

Mean Percent Correct Responses for Conditions of Instruction In Experiment I

	Confirmation	No Confirmation	
High RDF	65.91	69.54	67.72
Low RDF	65.75	65.91	65.83
	65.83	67.72	

	Confirmation	No Confirmation	
Overt RD	67.98	67.39	67.69
Covert RD	63.68	68.05	65.86

	Overt RD	Covert RD
High RDF	68.78	66.60
Low RDF	66.67	65.06

Although there was a consistent 2% difference between the levels of each of the main effects, the analysis of variance (see Appendix A) showed no significant main effects for the form of the response, the response demand frequency, or provision of confirmation.

There was a tendency for the effects of RDF, confirmation and RDF x confirmation interaction to be significant which was probably produced by the superior mean (4%) for the high RDF - no confirmation condition. There was a significant response by confirmation interaction reflecting the fact that confirmation had no effect with overt responding, but confirmation was inferior with covert responding.

There was a significant difference in terms of difficulty of the content across the four units in this experiment. This type of finding is rather consistent in all of the following experiments as well.

Discussion

The findings with respect to response demand frequency although not significant are consistent with those found during the first implementation with high RDF showing slightly better performance. With respect to the form of the response, again although not significant, shows the overt RD condition to be slightly superior particularly with high RDF.

It does appear that if high RDF is employed it is probably best to demand overt responding, and that in this case the lack of confirmation may not make much of a difference.

VI. EXPERIMENT II

Introduction

This experiment was concerned with the effects of response demand frequency (RDF) and form of response demand (RD) on learning in the persistent medium of linear programed text. The hypothesis tested was that high RDF would be more effective than low RDF whether overt-selected, overt-underline, or covert RD was involved.

Literature relating to effects of RDF was discussed in relation to Experiment I. It was pointed out that a number of studies using the persistent narrative text medium have demonstrated both general and specific attentional effects of overt responding. However, experiments using linear programed text are not so clear as to the effects of conditions of responding. As summarized by Anderson (1967), the large majority of studies show that students required to make overt constructed responses do not learn any more than students who "think" the answers, or read the program with the responses filled in. It should be noted that the comparison of constructed response and "thinking" represents a comparison of overt and covert RD conditions according to the Tosti-Ball (1969) model.

It is not certain whether programs with responses filled in should be considered high or low RDF conditions. It may be that a rhetorical question with the answer provided is nevertheless functionally equivalent to the same question with no answer. This might especially be expected to be the case with well-programed linear text with low error rates. Low RDF conditions are perhaps better represented by programs in which the questions are rephrased into direct statements. This form of low RDF condition is investigated in the present experiment.

The present experiment compares overt-selected and covert RD conditions, together with an overt-underline condition which had not been investigated previously. The main purpose of the RD variable in this study is to provide an assessment of RDF-RD interactions. While no effects of RD conditions are expected by themselves, the effects of RDF may possibly be found to depend on the RD condition. Furthermore, certain types of students may do better using one RD form rather than another.

Method

Design and Analysis. The basic plan of the experimental design is shown in Table 8. The students were randomly divided into six groups, each group receiving a particular sequence of 3 RD conditions in CPT 4, 6, and 10. Groups 1, 2, and 3 are trained using high RDF materials in all CPT units while groups 4, 5, and 6 use low RDF materials.

Table 8

Plan of Experiment II

Group	Response Demand Frequency	Cumulative Posttest Unit		
		4	6	10
1	High	Overt-selected	Overt-underline	Covert
2	High	Overt-underline	Covert	Overt-selected
3	High	Covert	Overt-selected	Overt-underline
4	Low	Overt-selected	Overt-underline	Covert
5	Low	Overt-underline	Covert	Overt-selected
6	Low	Covert	Overt-selected	Overt-underline

It should be pointed out that the sequences for the first three groups are arranged to form a 3 x 3 Latin square, and the sequences for the second three groups involved the same arrangement. Since the RDF conditions are assigned to independent groups, this variable is evaluated on a between-group basis.

The use of two Latin squares, each with a particular level of RDF, permits the examination of the interaction with RDF of each within-student variable forming the Latin square. In particular, the RD and RDF x RD effects of interest in the present experiment are both within-student effects. Since effects of RDF are predicted, the evaluation of this effect with lesser precision as a between-student variable was regarded as conservative.

It may also be noted that the present design permits the examination of interactions between units and the variables of primary interest. Failure of the unit interaction to appear as significant would tend to support the generality of the effects of the primary variables across unit and content. In addition, such results would indicate that effects of the sequence of RD conditions were negligible.

Materials and Procedures. The segments involved in this experiment were 4.1 - 4.3, 5.4 - 5.6, and 8.1 - 8.3, and the medium used was linear text (see Table 2).

Linear programed texts were developed by the RULEG and EGRUL methods of programing (Rule-example; example-rule). These are essentially programing methods of presenting a rule (definition, principle) and having the student identify an example of the rule (from 2, 3, or 4 choices), or presenting an example

and having the student identify the rule or principle which is depicted in the example (Markle, 1964).. Variations of the RULEG-EGRUL method which were used are EG-EG and RUL-RUL.

It is important to note that although confirmation of responses is ordinarily an important part of programed instruction, confirmations were deleted in the first implementation in order to obtain valid data on student frame responses. In this run confirmation was provided in all cases except in Experiment I where its effect was experimentally investigated. The first three modules of linear text were presented in standard format; i.e., there was a question for every information frame. This defined the high response demand frequency (HRDF) dimension. The only difference in presentation among these modules was in the form of response required of the student.

In module 1 (HRDF-written RD), students were instructed to respond to each frame by writing their selection (A, B, C, or D) on the frame answer sheets. In module 2 (HRDF-underline RD), students were instructed to respond to each frame by underlining their selection. In module 3 (HRDF-covert RD), students were instructed to read each frame question and think the answers to themselves.

Modules 4, 5, and 6 of the linear text covered the same material as the first three modules, but the frequency of response demand varied within the presentations.

Instead of asking a question for every frame, questions were asked for every second or third frame. In "no-question" frames, examples or principles, which would be deleted when questions were deleted, were reworded in statement form; e.g., instead of asking, "Which of these situations best exemplified principle X?", the frame was followed by a statement, such as "An example of principle X is..." Module 4, 5, and 6 differed from each other in the form of response demand similar to modules 1, 2, and 3.

Results

Mean student performance as a function of response demand frequency (RDF), and form of the response demand (RD) is given in Table 9.

Table 9

Mean Percent Correct Responses for Conditions of Instruction in Experiment II

	Response Demand Frequency		
Response Demand	High	Low	
Overt underline	69.53	70.51	70.02
Overt selected	72.17	66.39	69.28
Covert	70.45	72.65	71.55
	70.72	69.85	

The analysis of variance on this data (see Appendix A) shows no significant difference between the RDF conditions nor among the RD conditions. Although not significant there was a tendency for a RDF x RD interaction with overt selected better with High RDF (5.5%), covert slightly better with Low RDF (2%) and no difference for the overt underline condition.

As was found in Experiment I there was a significant difference in difficulty level among units.

Discussion

In the first implementation there was a consistent superiority for High RDF that was not replicated in this implementation. With respect to RD the finding of no overall effect is not inconsistent with prior research. When the interaction effects are considered, the overall conclusions are similar to those made in the first implementation as well as other studies. Performance was better when the response form required on the test was the same as that used in the instructional program, regardless of which form was used. Since the test required overt selected responses it is not surprising to find that training with overt-selected responses is somewhat superior particularly with high response demand frequency.

VII. EXPERIMENT III

Introduction

This experiment investigated the effects of response demand frequency (RDF) and management frequency (MF) in two different media. Specifically, the hypothesis tested was that HRDF presentations with either high, medium, or low MF would be superior to a low RDF, low MF presentation. The Computer Assisted Instruction (CAI) and Audiotape-Intrinsically Programed Booklet (AT-IP) media selected for this experiment provided capability for the manipulation of MF, and enabled a test of the generality of the findings concerning RDF and MF.

The results of the first implementation indicated that a high level of performance was obtained where CAI was used. In order to assess whether this high level of performance was due to the medium or the content itself, the CAI and Audiotape segments were also presented in a script version.

It should be noted, however, that the primary purpose of Hypothesis III is not to compare different media. It is rather to assess the optimal conditions for learning within media.

Method

Design and Analysis. The basic plan of the experiment is presented in Table 10. The students were randomly divided into five groups, each group receiving one of four combinations of RDF and MF conditions of instruction in both CPT Units 5 and 13. The AT-IP media was employed for the presentations in Unit 5, and CAI for presentations in Unit 13. As Table 10 indicates, a script version of each medium was prepared as the fifth condition. This arrangement represents a "mixed" design, with RDF-MF conditions as the between-student variable, and unit-media combinations as the repeated measure variable.

Table 10

Plan of Experiment III

Group	Cumulative Posttest Units	
	3 (AT-IP)	5 (CAI)
1	High RDF - High MF	High RDF - High MF
2	High RDF - Medium MF	High RDF - Medium MF
3	High RDF - Low MF	High RDF - Low MF
4	Low RDF - Low MF	Low RDF - Low MF
	(ATS-IP)	(CAIS)
5	High RDF - High MF	High RDF - High MF

Since differences in performance between CPT Units 5 and 13 could be expected from differences in difficulty of content, test items, or quality of programing, in addition to differences between media, the present design does not provide a meaningful direct comparison between media. The design does provide an estimate of the effects of combinations of RDF and MF averaged over both media. In addition, the interaction between RDF-MF conditions and unit-media combinations could be examined to determine if the effects of the presentation variables were comparable in both media.

The analysis of variance followed standard procedures for "mixed" design as modified for an unweighted means analysis (see Winer, p. 374).

Materials and Procedures. The segments involved in this experiment were 4.4 - 4.7 and 12.1 - 12.4. The medium used in segments 4.4 - 4.7 was audiotape with an intrinsically programed booklet, and the audiotape script with the booklet. Computer-Assisted Instruction (CAI) was used in segments 12.1 - 12.4. A script version in intrinsic format was also developed for these four segments.

As originated by Norman A. Crowder, the intrinsic programing technique consisted of routing a student

through a "scrambled" text on the basis of his response. Each response directed him to a different page of the text; thus, the student could not read through directly and sequentially.

Combining the intrinsic programing technique with an audiotape was a WLC innovation. In this teaching mode, the information was presented via the tape. While the student listened to it, he also looked at a summary page in the text which contained the precis of what he was hearing. He then stopped the tape and followed the instructions at the bottom of the summary page, directing him to a page containing a question which tested the information given on the tape and summary. Each response to the test item referred the student to another page which informed him of the accuracy of that response. Thus, the student would select the alternative which he thought was correct, turn to the page indicated for that alternative, and find out if he had made a correct selection. If he had selected the correct response, he was instructed to go on to another summary page, which he read while listening to the next audio portion. If his response was partially correct or incorrect, he was either told the nature of his error and instructed to proceed

as described above, or he was instructed to return to the summary or question page to study the information again and select another alternative. This process of interaction between tape and text continued throughout the segment.

The tape, which contained the content of the segment, remained the same throughout the four modules. The text differed as follows: In module 1 a question was asked for each informational frame (HRDF). Based on his response, the student was always branched to a page where his answer was discussed and confirmed or rejected (high management frequency). In module 2 a question was asked for each frame (HRDF), but the student was branched on the basis of his response for only 50% of his responses (medium management frequency). In module 3 a question was asked for each frame (HRDF), but the student was never given feedback nor confirmed; i.e., he was never branched as a result of his selection. He simply went on to the next question (low management frequency). In module 4 only three or four questions were asked throughout the programed sequence (LRDF), and the student was not branched on the basis of his responses to the three or four questions (low management frequency). Module 5 employed the same text as module 1 but the script was used in place of the tape.

All of the three components of the CAI 1500 system (CRT, audio, and image projector) were utilized in the implementation of the four modules. The first four modules exactly paralleled the first four modules used in the audiotape-IPB segments. Module 5 was similar in that a script version of the High RDF - High MF condition was developed. The following pattern was followed in developing the CAI materials. The informational frames were presented on the CRT screen and image projector. The questions, which were often situations in which the student had to decide the best course of action, were presented: 1) on the audio, where the situation was described; 2) on the image projector, where pictures of the situation were presented along with the audio; 3) on the CRT screen, where the student was asked to select an answer from 3 to 5 choices. The student's selection, accompanied by feedback, was displayed on either the CRT screen or the audiotape, and occasionally on the image projector. This feedback consisted of the reason(s) why the selected answer was correct or incorrect.

Results

Mean student performance as a function of response demand frequency (RDF), and management frequency (MF) conditions is given in Table 11.

Table 11

Mean Percent Correct Responses for Conditions of Instruction in Experiment III

Conditions	Mean
(Audiotape/CAI Versions)	
High RDF - High MF	72.15
High RDF - Medium MF	68.98
High RDF - Low MF	68.18
Low RDF - Low MF	69.26
(Script Versions)	
High RDF - High MF	73.02

As can be seen in Table 11, the high RDF - high MF conditions whether script or tape/CAI are superior to the other conditions. The analysis of variance (see Appendix A) however, showed no significant differences among the five conditions. As usual, there was a significant difference among the unit-media combinations.

Discussion

In the last implementation the findings in this experiment were somewhat counter intuitive in that the high RDF-high MF condition was expected to be equal to or better than the other conditions; however, it was actually worse in most cases. It was noted that where management was not provided, no confirmation was given, however, confirmation was always in the high-high condition. Confirmation was added in cases where it was missing in order to control any possible mediating effects. The findings in this implementation appear to be more consistent, although no significant differences were found among the five conditions in the analysis of variance (see Appendix A). It is interesting to note the lack of a significant difference between the script versions and the hardware bound versions, particularly considering the differences in the costs of development and production.

VIII. EXPERIMENT IV

Introduction

One major goal of the preceding three hypotheses was to demonstrate that students will generally perform better on presentations with high RDF. Numerous exceptions to this principle, however, have been a source of many criticisms recently leveled at linear programed instruction, which has high RDF as an elemental, identifying characteristic.

Although PI has been "the only media group which has made some effort to back up its claims with sound data" (Tosti and Ball, 1969), and although a number of studies indicate that "small-step" programs are generally more effective than low RDF presentations, there has been an embarrassing number of cases in which students do not like, and do not perform well on, linear programed instruction.

One of the chief complaints has been that some students are able to comprehend relatively large units of content material, and are thus bored by frame sequences in which responses to small pieces of information are required at frequent intervals. If it is true that individual students vary in their ability and preference for differing RDF presentations, then criticism of PI for failure to consider individual differences along the RDF dimension is well taken.

Csanyi (1965, 1961) has suggested a procedure by which this apparent RDF limitation might be effectively dealt with. He has extended the format on the basic linear program so that students who do not require a frame sequence of instruction do not have to go through it. In this "syndactic text" program, the student first receives, and is tested on, a relatively large unit of information presented in textual form. If the student passes the test on the summary statement, he proceeds directly to the next summary statement. However, if the student does not pass this test, he is immediately branched to a frame sequence covering the same material. Csanyi has reported that this technique produces superior performance in many different types of students.

Experiment IV is a direct test of the effectiveness of the syndactic-text procedure. It is hypothesized that students unable to achieve satisfactory levels of performance after practice on a low RDF presentation, will show superior levels of performance if remediated on a high RDF presentation, as opposed to an additional low RDF presentation or no remediation. If results support this hypothesis, one means of adapting the Tosti-Ball (1969) model to individual differences in instructional needs is suggested which may have

considerable generality. For example, a low RDF audiotape presentation may be found ineffective for some portion of the students, who might then be remediated on high RDF linear text. The entire instructional sequence might prove more efficient than either audiotape or linear text would be if used alone.

Method

Design and Analysis. The plan of this experiment is shown in Table 12. The students were randomly divided into six groups, each group receiving a different sequence of three experimental methods in CPT Units 3, 8, and 12. In all conditions, the students received the same syndactic-text summaries; the indicated methods of instruction refer to the type of supplementary material used when an inadequate level of performance was achieved on the quiz following a summary.

Table 12

Plan of Experiment IV

Group	Cumulative Posttest Unit		
	2	8	12
1	High RDF	Low RDF	None
2	Low RDF	None	High RDF
3	None	High RDF	Low RDF
4	High RDF	None	Low RDF
5	Low RDF	High RDF	None
6	None	Low RDF	High RDF

It may be noted that all six possible sequences of three conditions are used in this design. The sequences are arranged to form two different 3 X 3

Latin Squares, one square involving Groups 1, 2, and 3, and the second square involving Groups 4, 5, and 6. The difference between these squares may be seen in the reversed sequence of conditions in Units 8 and 12. The consequence of this reversal of sequence is that different components of the Method X Unit interaction are confounded with group differences in each square. Since the groups are randomized, significant differences among groups may legitimately be interpreted as arising from the confounded Method X Unit interactons. However, the remaining components of this interaction are independently estimable from the residual variation in each square, after removal of Unit, Method, Group variation. Thus a second, and more precise, test of the Method X Unit interaction is obtained on a within-student basis.

The present design also permits the examination of Square X Unit and Square X Method interactions, which in this case must be interpreted as arising from effects of the sequence of methods.

The analyses were conducted according to the procedure described by Winer (1962, p. 549) as modified for an unweighted means analysis.

Materials and Procedures. The segments involved in this experiment were 2.6 - 2.8, 6.1 - 6.3, and 11.1 - 11.3, and the medium used was syndactic text (see Table 2).

A syndactic text is essentially a series of linear programed frames each preceded by a brief but complete summary of the information presented in the frames. Students work through the syndactic text by reading the first summary statement and taking a summary quiz of 5 to 8 questions. If the student answers all summary quiz questions correctly, he reads the second summary, takes summary quiz 2, etc.

The student who incorrectly answers one or more questions of a summary quiz is required to study the linear programed sequence which is identical to the linear text. It was developed by the RULEG or EGRUL method of presenting small bits of information accompanied by examples of the concepts being taught. At the end of the programed sequence, the student retakes the summary quiz. Regardless of his performance when he retakes the summary quiz, he goes on to the next summary statement and repeats the procedure. Non-research segments of syndactic text were implemented according to the procedure given above.

In the first implementation approximately 70% of the students scored 100% on the summary quizzes and therefore, the effects of the two programed sequences

(HRDF vs LRDF) could not be assessed. In this run the students proceeded through the sequences regardless of their quiz score.

The first module of these research segments of syndactic texts was presented in the same manner as non-research segments, except that the students proceeded through the linear sequence (HRDF) regardless of his quiz score.

The second module of syndactic text was identical to module 1 except that it was characterized by a low response demand (LRDF) program. Instead of having RULEG question frames, examples were simply given in statement form. This sequence of statements was referred to as a "detailed summary statement." There were no questions asked in the detailed summary statement.

The third module in these nine segments was represented by summary statements alone (no remediation, no RDF). The student read a summary statement, took the summary quiz, re-read the summary and then proceeded to the next summary statement regardless of his score on the summary quiz.

Results

Mean student performance as a function of the three remediation conditions is given in Table 13.

Table 13

Mean Percent Correct Responses for Remediation Conditions in Experiment IV

	Remediation Condition		
	Linear Sequence (High RDF)	Detailed Sequence (No RDF)	Re-read Summary
CPT Score	69.70	74.39	70.97

Although there is a 4% difference in favor of the detailed summary as opposed to the linear sequence and a repeat of the summary, the analysis of variance (see Appendix A). indicates a significant difference only for units which is expected.

Discussion

As was found in the first implementation a high percentage of students (approximately 70%) did not (according to their summary quiz performance) need the remediation. It would appear that the syndactic text summaries are rather effective. Indeed, it is the case that the students reported a high degree of approval for this type of instruction. It would appear that any of the three forms of remediation would be equally effective.

IX. EXPERIMENT V

Introduction

This experiment investigated the effects of advance organizers as used within the medium of syndactic text. Although Programed Instruction (PI) has been "the only media group which has made some effort to back up its claims with sound data" (Tosti and Ball, 1969), and although a number of studies indicate that "small-step" programs are generally more effective than low RDF presentations, there has been an embarrassing number of cases in which students do not like, and do not perform well on, linear programed instruction.

One of the chief complaints has been that some students are able to comprehend relatively large units of content material, and are thus bored by frame sequences in which responses to small pieces of information are required at frequent intervals. In going through the small steps, a student may lose track of where the specific bit of information fits in the overall unit of instruction. Ausubel (1965) has stated that the advantage of deliberately constructing special organizers for each new unit of instruction is that the learner can enjoy the advantages of a subsumer in which the new material

can be related to stable elements already in his cognitive structure which both (a) gives him a general overview of the more detailed material in advance of his actual confrontation with it, and (b) also provides organizing elements that are inclusive of and take into account most relevantly and efficiently the particular content contained in the material. Any existing subsumer in the learner's cognitive structure, which he could independently employ for this purpose, self-evidently lacks particularized relevance and inclusiveness for the new material and would hardly be available in advance of initial contact with it. Although students might be able to improvise a suitable subsumer for future learning efforts after they become familiar with the material, it is unlikely that they would be able to do so as efficiently as a person sophisticated in both subject matter content and pedagogy. A "content map" showing the relationships of all topics in a graphic display was used as the format for the advance organizer.

Method

Design and Analysis. The plan of Experiment V is given in Table 14.

Table 14

Plan of Experiment V

	Cumulative Posttest Unit	
Group	14	11
1	Content map	Content map
2	No content map	No content map

The students were randomly assigned to one of the two groups resulting in a repeated measures analysis of variance design.

Materials and Procedures. The segments involved in this experiment were 5.1 - 5.3 and 8.4 - 8.6 and the medium used was syndactic text.

A syndactic text is essentially a series of linear programed frames each preceded by a brief but complete summary of the information presented in the frames. Students worked through the syndactic text by reading the first summary statement and taking a summary quiz of 5 to 8 questions. If the student answered all summary quiz questions correctly, he read the second summary, took summary quiz 2, etc.

The student who incorrectly answered one or more questions of a summary quiz was required to study the linear programed sequence which was identical to the linear text discussed previously. It was developed by the RULEG or EGRUL method of presenting small bits of information accompanied by examples of the concepts being taught. At the end of the programed sequence, the student retook the summary quiz. Regardless of his performance when he retook the summary quiz, he went on to the next summary statement and repeated the procedure.

Figure 2 provides a sample of the content maps that were used as advance organizers. At the beginning of each of the six experiments in this experiment, the students in group one were given the following instructions in regard to the use of the content maps.

> Before reading the text, study the enclosed "content map." This chart outlines the subject matter taught in this segment. It indicates both the order in which the various topics are discussed and the intended relationships among the various topics. Read the content map starting from the bottom. The number in the bottom right corner of each box indicates the order in which each item is taught. Parallel paths indicate relationships among slightly diverse topics. The number in the upper left corner of certain boxes indicates that these are higher order topics which incorporate the topics discussed in the boxes below it. These are usually major points in each of the summaries.

Studying the content map before reading the text will help you to recognize clearly the relationships among the ideas taught. You should find it helpful to refer back to the content map as you study each of the summaries.

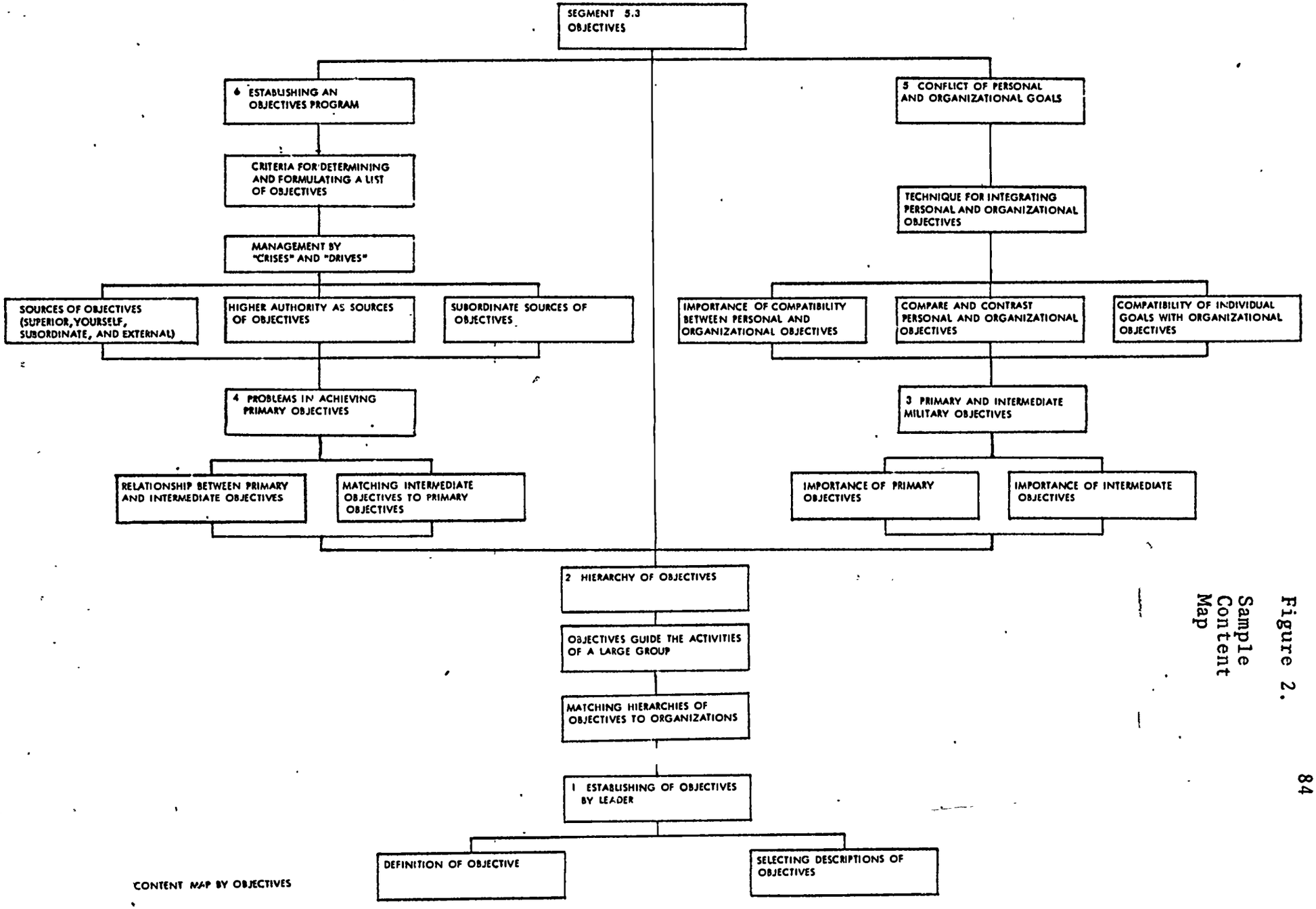

Figure 2. Sample Content Map

Results

Mean student performance as a function of content map usage is given in Table 15.

Table 15

Mean Percent Correct Responses

for Conditions of Instruction in Experiment V

Group	Mean Percent Correct
Content Maps	74.41
No Content Maps	77.35

It can be noted that there is a 3% difference in favor of no content maps. However, the analysis of variance (see Appendix A) showed no significant difference with respect to the maps.

There was no significant unit effect nor any interaction between units and maps.

Discussion

The finding of no significant difference for the effect of maps, it should be pointed out, is not an indictment against advance organizers, but it may indicate that if advance organizers are generally effective, the content maps as used here were not. However, this finding may relate to the fact, as Ausubel (1965) has reported, that the facilitating effect of organizers occurs more readily for students with relatively poor verbal ability who tend to structure material less effectively. Considering the relatively high ability level of the general USNA population it is perhaps not surprising to find no significant differences.

This finding is consistent with the results of the subsidiary analyses relating to the use of maps as reported in Chapter X.

X. SUBSIDIARY ANALYSES

Introduction

The cumulative posttest units were the fundamental units of instruction for the research conducted in Experiments I through V. Performance on the cumulative posttests (CPT's) was the dependent measure used in each of the experiments. The CPT's were norm-referenced rather than criterion referenced tests. In the previous run of the course, the statistical analyses in each of the experiments were conducted using performance on the criterion-referenced progress checks as the dependent measure in addition to the CPT's. No great dissimilarities were found in the results using these two different measures, although the CPT results did perhaps provide better precision.

The following subsidiary analyses were developed shortly before the course was implemented the second time (fall 1970) and the progress checks alone were used as the dependent measure. Basically the three subsidiary questions to be discussed in this chapter were replications of variables investigated in the previous experiments. The variables manipulated were the use of the (1) content maps, (2) script versions of various audiotape segments, and (3) special answer forms for the syndactic text summary quizzes.

Subsidiary Analysis I

The use of the content maps and special answer forms was investigated in segments 2.1, 2.9, 3.5 and 6.5. The medium used was syndactic text as discussed in Chapter IX. The content maps used as advance organizers was also discussed in Chapter IX. The special answer sheets were used by the students in answering the summary quizzes in these segments. The student used a special crayon in marking his answer on the sheet and in a few seconds after marking his answer, the correct answer would appear. The question of using this type of revealed answer form arose when it was discovered after the first run that very few students had to go through the programed sequences. Going through the programed sequences naturally added considerable time compared to just reading the summaries, and it was felt that with the correct answers available to the student in the text, the temptation, to ensure that going through the remedial sequences was not necessary, was very real. If the students could achieve an acceptable level of the progress checks it really didn't matter whether they went through the linear sequences, re-read the summary or just went on to the next summary. The point was however, that it would be difficult to determine which procedure would be most effective if

it could not be positively stated that the correct procedures were followed.

The basic design of this analysis is shown in Table 16. The students were randomly assigned to groups.

Table 16

Plan for Subsidiary Question I

	Segment			
Group	2.1	2.9	3.5	6.4
1	Map-RAF *	No Map-RAF	Map-No RAF	No Map-No RAF
2	No Map-RAF	No Map-No RAF	Map-RAF	Map-No RAF
3	Map-No RAF	Map-RAF	No Map-No RAF	No Map-RAF
4	No map-No RAF	Map-No RAF	No map-RAF	Map-RAF

* RAF = Revealed answer form

Results. The mean student performance for the four conditions is given in Table 17.

Table 17

Mean Percent Correct on Progress Checks for the Conditions of Instruction in Question I

	Answer Sheet	No Answer Sheet	
Map	91.46	90.85	91.15
No Map	88.31	89.61	88.96
	89.88	90.23	

The analysis of variance of this data (see Appendix B) indicates no significant differences with respect to the use of the maps or the special answer sheets. As has been seen with most of the analyses a significant difference was found across the segments, but there was no interaction between segments and either of the two variables.

The finding of no differences with the maps is consistent with that found in Experiment V where the dependent measure was the norm-referenced cumulative posttest. A few of the students report that the special answer sheets did tend to remove the temptation of looking at the quiz answers before responding, but the forms were so unreliable that the students became

irritated at their use. The correct answer sometimes took several minutes to appear. In addition, the additional cost of these forms did not warrant their continued use. The fact was that the students learned equally well whether controlled by the special answer sheet or not.

Sub-idiary Analysis II

The use of the content maps as advance organizers was investigated again in segment 7.5 which was originally programed in the medium of audiotape/panel book. The use of the tape script in place of the audiotape was also investigated in this segment. The plan of this analysis is shown in Table 18. The students were randomly assigned to a group.

Table 18

Plan for Subsidiary Question II

	Segment
Group	7.5
1	Audiotape/PB-Map
2	Audiotape/PB-No Map
3	Audiotape Script/PB-Map
4	Audiotape Script/PB-No Map

Results. The mean student performance for the four conditions is given in Table 19.

Table 19

Mean Percent Correct on Progress Checks for the Conditions of Instruction in Question II

	Map	No Map	
Audiotape	83.00	83.64	83.32
Tape-Script	86.00	82.00	81.00
	84.50	82.82	

The analysis of variance of this data (see Appendix B) showed no significant differences due to the media (script vs tape), the use of the content map, nor was there a significant interaction between these variables.

Again, the findings in relation to the maps was consistent with the previous analyses. The finding of a lack of difference between the use of the scripts of the tapes in conjunction with the panel book as opposed to the tapes themselves is an important finding. It gives the instructional system and student an option in the use of the materials without apparently jeopardizing his performance. This is consistent with the lack of difference found in Experiment III between

scripts and the hardware bound (audiotapes and CAI) versions of the materials. A similar finding will be noted in the last subsidiary analysis on the following pages.

Subsidiary Analysis III

The use of the content maps and the script version of the audiotape with panel book and the intrinsically programed booklet was experimentally manipulated across segments 9.1, 9.2, 10.1 and 10.2. The basic design of this analysis is shown in Table 20. The students were randomly assigned to the groups.

Table 20

Plan for Subsidiary Question III

	Segment	
Group	9.1	9.2
1	Audiotape Script/PB Map	Audiotape/PB Map
2	Audiotape/PB Map	Audiotape Script/PB Map
3	Audiotape Script/PB No Map	Audiotape/PB No Map
4	Audiotape/PB No Map	Audiotape Script/PB No Map

	Segment	
Group	10.1	10.2
1	Audiotape/IP No Map	Audiotape Script/IP No Map
2	Audiotape Script/IP No Map	Audiotape/IP No Map
3	Audiotape/IP Map	Audiotape Script/IP Map
4	Audiotape Script/IP Map	Audiotape/IP Map

Results. The mean student performance for the conditions of instruction in Question III is given in Table 21.

Table 21

Mean Percent Correct on Progress Checks for the Conditions of Instruction in Question III

	Segment							
	9.1		9.2		10.1		10.2	
	Tape	Script	Tape	Script	Tape	Script	Tape	Script
Map	92.22	94.55	92.73	92.22	95.00	94.55	92.73	89.00
No Map	89.09	91.00	88.00	91.82	97.27	98.89	94.44	89.09

The analysis of variance of this data revealed no significant differences between media (script vs tape) across Part 9 nor across Part 10 (see Appendix B). There was no significant main effect for the use of the maps across the four segments ($\bar{x}$ for maps = 92.88, $\bar{x}$ for no maps = 92.45). As usual there was a significant difference between the two parts with Part 9 slightly more difficult than Part 10, and a significant difference between the two segments of Part 10 with 10.2 somewhat more difficult. There was also a small segment by media interaction in Part 10 where audiotape was somewhat superior in segment 10.2 but slightly reversed in segment 10.1.

Again it can be noted that these findings are consistent with all of the previous analyses where the use of content maps and scripts were manipulated. Although there were no significant differences, the consistency of the many analyses using both norm- and criterion-referenced measures give some weight to the previous conclusions.

XI. SUMMARY OF SPRING AND FALL RESULTS

This research effort was directed at answering the central question of whether variations of conditions of instruction in the presentation design domains as posited by Tosti and Ball (1969) are of greater importance than variations in the media domain. Tosti and Ball's position has not received strong experimental support from this series of studies. Indeed, in Experiment I of the spring run where the presentation design was held constant, a significant difference was found between media. Although this does not necessarily refute the basic assumptions of the Tosti and Ball model, it does indicate that other variables relating to the production of instruction particularly via transient media (videotapes and audiotapes) should be considered. On the other hand, one can see many cases where no significant differences were found when the medium was constant and the presentation design was varied.

In investigating the question of whether substantial effects of student achievement could be produced by manipulation of presentation variables over large segments of instruction, Experiment II of the spring run provided the most conclusive evidence. It was found that with linear text, the high response demand frequency condition was

consistently superior to the low response demand frequency condition. A facilitative effect does appear to be produced by the insertion of a significant number of questions in the instructional material. Further investigations need to be conducted with respect to this variable as implemented with transient media (see Experiment I spring and fall runs).

Although major differences were not found with respect to the form of response required of the student, the trend in Experiment II of the spring run was that the overt-selected response condition was slightly better than either overt-spoken or covert. This finding is generally in concert with the major body of prior research that indicates that the form of response utilized within the instructional materials should be similar to that required of the student on the tests of achievement on those materials. In Experiments I and II of the fall implementation, no significant differences were found with respect to the main effect of the form of the response demand (RD). However, if one has a high RDF presentation it was felt that the most effective RD might be overt-selected which is in concert with the spring findings.

Perhaps the least conclusive finding related to manipulations of management frequency (MF) in conjunction with variations in response demand frequency (RDF) as indicated in Experiment III of the spring run. It appeared that the most efficient condition was the use of moderate levels of management frequency (MF) in conjunction with high response demand frequency (RDF). However, an intervening variable may have been the fact that knowledge of results was not provided in those cases where management was not manipulated. This may have produced variations in the experimental conditions that were not due to the major variables investigated. In the fall run, with confirmation added, the results showed no significant differences among the combinations of RDF and MF nor between a script version of the high RDF-high MF condition and the automated (tape or CAI) version.

In Experiment IV of both the spring and fall runs the type of remediation provided after the syndactic text summaries had no effect on the students performance. They performed equally well. Indeed it was the case that the students generally performed so well on the syndactic text summaries that a precise test of the remediation conditions in this medium was difficult to obtain.

Indeed the preponderance of findings were "no significant differences"! In Experiment V (fall run) no significant differences were found with respect to the use of "content maps" as advance organizers. This was replicated in the subsidiary analyses of the fall run using progress checks as the dependent measure. In these same subsidiary analyses performance was almost identical where scripts of tapes were compared with the use of the tapes themselves. With respect to both media and presentation variables, there were no consistently significant differences with respect to the type of learning or task required of the student as seen in the first implementation. That is, the findings with relation to norm-referenced CPT performance were generally consistent with the findings in relation to progress check performance.

Comparison among media with the same kind of control and precision devoted to comparison of presentation variables in the present studies may well have demonstrated numberous reliable differences among media, as was the finding in Experiment I of the spring run. However, these results do support the general conclusion that differences among media, if they exist, are no more substantial nor important than variation in difficulty among

units in the same media, resulting from variation in content programing skill, or test items. Thus it would seem that the problem of media selection should deserve no more attention from the educational technologist than he is willing to devote to these other sources of variation in student achievement.

General Conclusions. With such a large number of analyses showing no significant differences one has the choice of accepting the fact that there is a high probability that no real differences exist or that the experimental designs and analyses are in someway at fault.

Much of the prior research on media and various presentation variables involved instructional materials of a short-term nature which usually covered one main content area, and were frequently conducted in an experimental environment. It should be noted that this research effort involved investigations over a semester's worth of instruction in a required course for a significant portion of the midshipmen at the U. S. Naval Academy. The content of the instructional materials covered topics in many disciplines (see Table 2). In addition, many of the experiments were replicated in a second implementation of the course.

The experimental designs were sound and employed tight control to ensure that the research data could be gathered without hindering the learner's opportunity to learn. The part and segment results indicated significant differences as small as 2.5 to 3.0 percent. Although they were statistically significant they obviously were not educationally significant. Therefore, it was felt that it was unlikely that the lack of findings of effects of the primary experimental variables could be attributed to a lack of precision in the experimental designs and analyses.

The above discussion does not mean however, that it has been established as fact that no real differences exist with respect to media and presentation variables. What it does indicate is that with general prescriptions to the programers (i.e., for high RDF write a question for every frame; for medium MF provide response sensitive feedback every other frame, etc.) and precise guidelines, based on a sytematic approach, for the revision of the instructional materials, almost any medium with almost any presentation design characteristics can be programed so that the learners can reach a pre-set level of acceptable performance. However, certain subject matter programed in some media, with certain presentation

characteristics, will demand more effort and cost to show the desired level of performance. Some may consider cost the most critical factor and opt for slightly less effective student performance. Others may well consider effective student learning to be most critical, at whatever the cost.

The topics for future research that would appear to have high payoff for instructional technology would be the investigation of optimum revision procedures and the delineation of the variables important in developing effective programing skill. Indeed, the programer needs to be an independent variable in future media research just as the teacher and test administrator have been recognized as independent variables in other research. Even when general prescriptions are given to a programer, be it in the development of a film, a tape, or printed materials, a great deal of latitude remains in his hands as to the appearance of the final product in its most minute detail.

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APPENDIX A

Experiment I

Analysis of Variance

Source	df	MS	F
Response (R)	1	20.430	<1
Group (G/R)	2	17.938	<1
Student (S/GR)	37	27.666	--
Units (U)	3	389.832	43.11**
Frequency (F)	1	21.980	2.43
Confirmation (C)	1	21.965	2.43
FC	1	18.551	2.05
RF	1	0.495	<1
RC	1	37.854	4.19*
Residual	4	2.335	<1
S(FMU)/GR	110	9.044	

*p < .05
**p < .01

Experiment II

Analysis of Variance

Frequency (F)	1	1.919	<1
Rows (R)	2	43.471	2.87
FR	2	8.132	<1
Students (S/FR)	35	15.695	--
Units (U)	2	84.763	12.05*
Method (M)	2	4.580	<1
FU	2	3.009	<1
FM	2	15.789	2.25
UM	2	1.377	<1
FUM	2	1.402	<1
S X (UM)/FR	67	7.033	

*p < .01

APPENDIX A

Experiment III

Analysis of Variance

Source	df	MS	F
Methods (M)	4	10.737	<1
Students (S/M)	36	14.417	
Units (U)	1	176.679	32.84*
MU	4	1.528	<1
SU/M	35	5.380	

*p < .01

Experiment IV

Analysis of Variance

Square (Q)	1	19.107	<1
Groups (G/Q)	4	12.437	<1
Students (S/GQ)	35	20.326	--
Units (U)	2	92.752	13.08*
Method (M)	2	20.535	2.89
QU	2	.675	<1
QM	2	10.124	1.43
UM/Q	4	2.697	<1
SUM/GQ	68	7.089	--

*p < .01

Experiment V

Analysis of Variance

Content Map (M)	1	14.854	2.29
Students (S/M)	39	6.476	--
Unit (U)	1	.054	<1
U X M	1	2.784	<1
U X S/M	39	5.551	--

APPENDIX B

Subsidiary Question I

Analysis of Variance

Source	df	MS	F
Sequences	3	24.18	<1
Students	37	95.46	
Segments	3	363.89	5.35*
Sheet (S)	1	4.84	<1
Map (M)	1	193.09	2.84
S X M	1	36.55	<1
Students X Seq	111	67.99	

*p < .01

Subsidiary Question II

Analysis of Variance

Media (M)	1	4.73	<1
Content Map (C)	1	28.88	<1
M X C	1	55.08	<1
Students/MC	37	125.68	

APPENDIX B

Subsidiary Question III

Analysis of Variance

Source	df	MS	F
Sequence (Q)	1	55.266	<1
CP	1	260.128	3.93
QCP	1	0.715	<1
Students	37	66.106	--
Part (P)	1	237.979	4.15*
Content Map (C)	1	7.355	<1
Within Part 9			
Segments (S_9)	1	5.558	<1
Media (M_9)	1	72.535	1.17
S_9 X M_9	1	1.101	<1
CS_9	1	3.057	<1
CM_9	1	19.454	<1
Within Part 10			
Segments (S_{10})	1	532.160	17.99**
Media (M_{10})	1	79.618	2.69
S_{10} X M_{10}	1	133.745	4.52*
CS_{10}	1	29.441	<1
CM_{10}	1	0.258	<1
Students X Part	37	57.327	
Students X S_9	37	62.052	
Students X S_{10}	37	29.588	