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This study examined a sample of 37 Navy and Marine Corps courses purporting some degree of individualization in instructional method. Courses were assigned to three categories for analysis: conventional, mixed, and self-paced instruction. Data were collected from site visits, samples of instructional materials, and questionnaires administered to students, instructors, and supervisors. (continued on reverse)

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(20) Abstract (continued)

Contrasts among categories were made on six measures of instructional quality: prerequisites, cues, participation, reinforcement, feedback, and correctives. The three categories of courses differed significantly on each of the measures.

Although perceptions of questionnaire respondents were generally favorable concerning their courses, it was concluded that ideal individualized instruction rarely occurs in the NAVEDTRACOM. While conventional courses were often found to be higher in measures of quality instruction, their costs were also higher. Recommendations for changing existing training directives are made.

TAEG

TRAINING ANALYSIS AND EVALUATION GROUP

TECHNICAL REPORT 147

SELF-PACED AND CONVENTIONAL INSTRUCTION IN NAVY TRAINING: A COMPARISON ON ELEMENTS OF QUALITY

JULY 1983

FOCUS ON THE TRAINED PERSON

TRAINING ANALYSIS AND EVALUATION GROUP
ORLANDO, FLORIDA 32813

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July 1983

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SECTION I

INTRODUCTION

Self-paced instruction in the Navy is being criticized for producing graduates who have not retained the information taught and who cannot perform on the job.[1] In the face of such criticism, some self-paced courses may be converted back to conventional group-paced instruction.

Unfortunately, there is widespread misconception in the Navy about self-paced instruction. It supposes that the huge differences in student abilities can somehow be accommodated by merely allowing the time for learning to vary. It also supposes that when you call a course "self-paced" it is equivalent to individualized instruction (II). In fact, individualized instruction requires the use of a number of sound instructional elements; self-pacing is only one of these elements.

Self-paced instruction, with some additional individualization of instruction, was implemented in the Navy to provide effective instruction at lower cost. This endeavor has lead to a proliferation of nearly 200 such courses affecting nearly 100,000 students yearly. These attempts to modify strategy have yielded a number of ways in which courses are taught. Some of these attempts have been highly successful; others are criticized as ineffective. Disagreement over the effectiveness of a given method of delivery of instruction may be due to the various meanings attributed to "self-paced" instruction.

Some time ago, The Training Analysis and Evaluation Group (TAEG) pointed out this confusion in terminology and recommended a comprehensive survey to establish the types and extent of II in use in the Navy (Zajkowski, Heidt, Corey, Mew, and Micheli, 1979). Later, Hall and Freda (1982) suggested that there are apparently many meanings to II, and that it is not a unitary concept. Both reports show there is a need to identify and to differentiate the variety of instructional practices now categorized as II in the Naval Education and Training Command (NAVEDTRACOM). Consequently, the Chief of Naval Education and Training (CNET) tasked the TAEG to conduct a study of the variations in this type of instruction.[2]

PURPOSE OF THE STUDY

The purpose of the present study is to identify and document the range of instructional activities present in courses thought to be "individualized" by the NAVEDTRACOM. A model of individualized instruction is developed to provide a basis for qualitative assessment and as a guide for development of courses. Proposed changes to existing directives are provided to guide course designers in creating appropriate, efficient, and effective instruction.

[1]Commander Patrol Wings Pacific ltr ser 70/1065 of 31 August 1982.

[2]CNET Code 022 ltr to CNTT of 5 April 1982.

DEFINITIONS

Three categories of instruction characterize the treatment that will follow. They are: conventional, mixed, and self-paced instruction. Individualized instruction can occur within these categories by degrees.

CONVENTIONAL INSTRUCTION (CI). The central features of CI include group pacing, lectures, students selected with similar academic aptitudes, and a single form of instructional material. Conventional instruction appears to prohibit features that would individualize the instruction; however, many instructors have developed subtle ways of individualizing within the constraints of this seemingly invariant model.

MIXED INSTRUCTION (MIX). The term "mixed instruction" is operationally defined to represent courses reporting between 5 and 90 percent "self-pacing" in the preliminary survey conducted for this study.

SELF-PACED INSTRUCTION (SP). This type of instruction allows students of different aptitudes and previous knowledge to progress through a program at their own rates. While not inherent in the definition, many assume the term "self-paced" instruction includes many of the other characteristics of individualized instruction in addition to releasing the student from time constraints. This study does not make such assumptions.

INDIVIDUALIZED INSTRUCTION (II). This term is defined as instructional activity designed to accommodate individual human differences in background, skill level, aptitudes, and learning styles characterized by (1) releasing of time constraints, (2) choice of instructional media, and (3) adjustment to skill levels and learner characteristics (Zajkowski, et al., 1979). Additionally, those operations in traditional classrooms, self-paced learning centers, and mixed environments that bring about the individualizing of the instruction are identified. These operations are further defined in the following paragraphs.

QUALITY OF INSTRUCTION (QI). Six elements of quality instruction will be used in studying all of the courses selected in the sample used in the present study. They are based on the work of Bloom (1976) and his colleagues who have developed a system of Learning for Mastery (Bloom, 1968). Here, courses are assessed in terms of the extent to which the following six elements (identified by Bloom) are present:

1. **Prerequisites (PRQ).** These are the cognitive entry behaviors that are measured by the Armed Services Vocational Aptitude Battery reading and computational scores, or similar achievement tests. Other achievement tests show the students' readiness for learning a particular lesson or module of instruction. Affective entry behaviors are attitudes reflected in measures of motivation and perseverance. The most adaptive instruction accommodates student variation in both the cognitive and affective entry behaviors in deciding specific instruction for a given student.

2. **Cues (CUE).** These are the signals telling the students what it is they must learn. They are a major part of the instructional materials package, as well as the on-the-block instructor's lecture. Learning objectives, the format of printed materials, the rubrics and headings, graphics, diagrams, mnemonics, demonstrations, topic sentences, and verbal prompts are but some of the cues that bombard a student in the typical classroom, learning center, or laboratory.

3. **Participation (PAR).** This is the extent to which students are given opportunities to practice and rehearse that which they are to learn. It includes exercise materials immediately following a small segment of activity and the distributed practice of this activity over a period of time. To learn something, the student must do something. This "doing" may be either in the form of drill, exercises, or quietly thinking about something related to the module of instruction. Since there is a very high relationship between intensity and time spent with amount of learning on a topic, it is the aim of effective instruction to keep the student's mind engaged in the subject matter. Daydreaming cannot count as study time. Appropriate teaching techniques and appropiate practice materials can elicit the high degree of involvement necessary in students to hasten them along paths of learning. Breaks in the class period can be productive in PAR only if the students talk about that which they have been doing.

4. **Reinforcement (RNF).** Reinforcers strengthen the behavior that precedes them. They should be given after appropriate behavior and withheld after inappropriate behavior. Reinforcers are idiosyncratic to students; however, there are some reinforcers that are generally applicable. These include praise, recognition, special privilege, and, indirectly, feelings of achievement.

5. **Feedback (FBK).** Providing students with information about performance serves not only to reinforce successful behavior, but it also provides guidance on what to study and how much effort to expend in meeting course goals. Tests, quizzes, self tests, critiques, oral and comprehensive examinations all provide the student information as to how they are doing with relation to enabling and terminal learning objectives. Such activities are an important part in the design of instructional materials.

6. **Correctives (COR).** After feedback shows the student that there is a difference between the demonstrated and the required performance or practice, adaptive instruction calls for a prescription to get the student back on track. Correctives are the prescribed alternate forms of presenting that which the student is to learn. The summary, narrative, and programmed instruction mentioned in NAVEDTRA 110A could be used as correctives in certain situations. Correctives are the learning activities that adaptive instruction uses to ensure that all students have repeated opportunities to learn.

PLAN OF THE STUDY

The study was conducted in the following sequence of activities:

- conducted a review of the literature concerning II (presented in appendix E)
- distributed a Course Description survey to a population of 201 courses categorized as individualized instruction
- established categories for assessing the variations in instructional practices
- determined a sample of courses for site visits and detailed analysis of instructional practices and materials used
- site visited 37 courses and administered a structured interview and quality of instruction questionnaire to a sample of students, instructors, and supervisors
- categorized courses as conventional, mixed, or self-paced instruction and examined the degree to which elements of quality instruction in each category were present.

ORGANIZATION OF THE REPORT

In addition to this introduction the report contains four sections and six appendices. Section II provides a detailed description of the approach taken in the study, and also describes the sample and instruments used to gather data. Section III presents the results of the analyses of data. Section IV is a discussion of the results. Section V provides conclusions and recommendations. Appendix A contains the Course Description Form with a tabulation of responses to each item. Appendix B presents the Structured Interview Form with a summary of course data organized by three categories of II. Appendix C contains the Quality of Instruction Questionnaire and the scaled values for each item. Appendix D presents the mean values for each item of the Quality of Instruction Questionnaire as a function of type of II. Appendix E gives a review of literature pertinent to the rationale for using the Quality of Instruction variables in the study. Appendix F synthesizes the literature and study findings with a model of ideal individualized instruction.

SECTION II

TECHNICAL APPROACH

This section describes the sample, the development of the Course Description Form used to obtain information describing the various types of II courses, the procedure for deciding which courses to visit for more detailed information, the development of a quality of instruction questionnaire used to assess instructional practices within the variations of II, an analysis of student time taken to master instruction, a structured interview procedure, and the major data analysis procedures. Throughout this section there are descriptions of salient characteristics of courses falling in each of three categories, or variations of individualized instruction (VARII): conventional, mixed, and self-paced.

DESCRIPTION OF THE SAMPLE

The study began with a survey of courses in the FY 1980 Master Course Reference File of the Navy Integrated Training and Resources Administration System (NITRAS) which were listed as self-paced, computer-managed (CMI), or having a combination of methods of individualizing instruction. This search yielded 199 Course Data Processing (CDP) numbers, of which 69 were instructor-managed instruction, 11 were computer-managed instruction, and 119 were a combination of these two methods. These methods were listed in NITRAS as "P," "C," or "B," respectively.

To select the sample of courses for more detailed analysis, a Course Description Form (CDF) was designed to elicit information concerning instructional practices being used in courses identified in NITRAS as containing some degree of II. The questions generally dealt with time, administration, and philosophies:

1. The use of instructor, student, study, and awaiting instruction time: Specific questions deal with use, recording, and perceptions of these various types of time.

2. Course administration and organization: This category of questions includes such concepts as criterion for mastery, use of feedback, types of reinforcement employed, media and instructional material used, numbers and type of personnel assigned, and relative proportions of instructional type (lecture, lab, self-pacing).

3. Training philosophies: This group of questions assessed beliefs and attitudes about the basic ability of students to learn, the level of achievement to be expected of a cohort of students, and the control over pacing of students.

See appendix A for specific questions dealing with each of these areas.

CDFs were mailed to 83 of the 199 potential target courses. Only one CDF was mailed to courses having identical course identification numbers and

titles but varying CDPs at the same location. An example is the Basic Electricity and Electronics (BE&E) course, which was comprised of 24 CDPs in Orlando, 30 at Great Lakes, 27 at San Diego, and 9 at Memphis. Each location received only one CDF. Table 1 summarizes the number of courses at each location and the number of CDFs sent and used in this study. Included in table 1 are two courses that later became available from the Marine Corps Communication-Electronics School (MCCES). They were: a computer-assisted and an instructor-managed course from MCCES, Twentynine Palms, California. Both were versions of the Communications Center Operator's Course (CCOC) taught by differing methods. Of the 83 CDFs sent, 78 were returned or accounted for--a 94 percent return rate. Based on these returns, 64 courses were suitable for analysis.

TABLE 1. POPULATION OF NITRAS COURSES BY LOCATION

Location	Number of P, C, or B Courses	Number of Course Description Forms Sent	Number of CDFs Included in Study
* SSC Orlando, FL	27	2	2
* NTTC Corry Station, FL	14	13	12
* NATTC Memphis, TN	35	6	6
* SSC Great Lakes, IL	48	16	11
* SSC San Diego, CA	34	8	5
FTC San Diego, CA	7	7	1
* NTTC Meridian, MS	5	5	5
* FTC Charleston, SC	3	3	2
* STC Charleston, SC	2	2	2
NTTC Treasure Island, CA	2	2	2
* FTC Philadelphia, PA	4	4	4
NSS Groton, CT	3	3	3
NATTC Lakehurst, NJ	9	6	6
FTC Norfolk, VA	2	2	0
NAMT Millington, TN	1	1	1
STC PAC Pearl Harbor, HI	3	3	0
**MCCES 29 Palms, CA	2	2	2
Total	201	85	64

* Locations visited.
**Sampled course not in NITRAS.

Table 2 lists the 64 courses from which usable CDFs were obtained. The table gives a sequence number depicting the order the completed questionnaires were returned, the CDP numbers, course short title, location, the estimated percent of the course that was "self-paced" (Question No. 31 on the CDF), and the number of students in annual planned input. In addition, the courses receiving a site visit are indicated by an asterisk.

The CDF was sent to the person "most knowledgeable" of the selected course. A cluster analysis of the responses to the original 62 Navy CDFs did not reveal clear patterns associated with variations in II; however, this information was used to select the widest variety of instructional practices in courses at a given training location. CDF question No. 31, "What percent of this course is 'self-paced'?" had the highest relationship with variations in II (VARII). Thus, this question became the basis for the categories of II used in this study. The percent of self-pacing in each of the 64 courses from which CDFs were used is listed in table 2.

DESCRIPTION OF THE CATEGORIES OF II

Three VARII were identified. There were 7, 10, and 20 courses, respectively, in the three categories. Those courses reporting 0-4 percent self-paced on CDF question 31 were classified as conventional instruction (CI). Those courses 5 to 90 percent self-paced were classified mixed (MIX). Courses with 91 percent or greater were self-paced (SP). The analyses described here and the results reported in section III are based on these categories.

Additional data from the CDF were analyzed to provide a more detailed description of courses in the three VARII. Tabulations were made for the CDF questions eliciting frequency data, and univariate analyses of variance were utilized for the interval- and ratio-scaled data. The following describes some additional characteristics of the three categories of courses. The most individualized courses appear to be more likely to let the student determine when breaks were to occur during the class day. In addition, these courses show more variability in the time taken to finish the course. The three VARII differed in the hours in a typical class day, the learning minutes in a typical class hour, the criterion for mastery on a lesson or module, the amount of lecturing, the amount of self-study, and the use of study materials. Tables 3, 4, and 5 provide summary data for these findings.

TABLE 2. COURSE POPULATION

Seq No.	CDP(s)	Short Title	Location	%SP (Q31)	Planned Input
* 1.	3665-3698 (3)	TTA	Orlando	100	64
* 2.	604H-6550 (24)	BE/E	Orlando	100	3708
* 3.	303N	CTO TACSOM	Corry	0	140
* 4.	3197	CTT ELINT OP	Corry	75	100
* 5.	6458	CTT WBS OP	Corry	90	100
* 6.	417M	NSG JOOC	Corry	0	70
7.	6059	SK A	Meridian	100	1079
* 8.	6522	AK A	Meridian	90	722
* 9.	6102	PN A	Meridian	100	1263
10.	6057	YN A	Meridian	100	1844
*11.	6061	DK A	Meridian	100	350
*12.	6501	AD A1	Memphis	60	1832
13.	6161	CTM A	Corry	5	405
*14.	6320	CTT SPE	Corry	5	700
15.	6302	CTT A Prep	Corry	0	1325
16.	4376	CTT SNMC/O	Corry	100	50
17.	6319	CTT/ICR/Flex	Corry	0	100
*18.	6380	RM A Sea	San Diego	0	1582
*19.	6381	RM A Shore	San Diego	0	1545
20.	9332	PCO/PXO Rev	San Diego	30	15
21.	281V	Corosion Cont	Millington	100	***
*22.	403V	LC Instr	Great Lakes	100	350
*23.	5382	MSE CODE OP	San Diego	100	400
*24.	601R-6551 (30)	BE/E	Great Lakes	100	4761
*25.	6144	RM A Basic	San Diego	100	3677
*26.	5152	BAS DIG Fund	Charleston	100	295
*27.	5202	GPETE Bas Op	Charleston	100	375
*28.	6269-6549 (27)	BE/E	San Diego	100	5654
29.	6119	HT A-1	Treasure IS	0	1124
30.	2589	FUEL PROBE	Treasure IS	0	85
31.	6301	CTR A	Corry	0	615
32.	6020	CTA A	Corry	0	240
*33.	8511	GAS FREE ENG	Philadelphia	0	75
34.	5340	DC REP PTY LDR	Philadelphia	33	83
*35.	6339	HT A-2	Philadelphia	99	1086
*36.	3218	DC ASST	Philadelphia	80	198
37.	2859	BECTEC	Great Lakes	0	304
38.	6492	MMCLA1200	Great Lakes	85	2250
39.	6493	MMCLA 600	Great Lakes	90	2737
*40.	6486	BT CL A 1200	Great Lakes	90	2250
*41.	6488	BT ADV OPER	Great Lakes	0	600
*42.	6261-8562 (4)	PE	Great Lakes	100	10248
*43.	6487	EN CL A	Great Lakes	65	1861
44.	6280-6284 (4)	AV FUN	Lakehurst	85	1605

TABLE 2. COURSE POPULATION (continued)

Seq No.	CDP(s)	Short Title	Location	%SP (Q31)	Planned Input
45.	6519	PR Bas	Lakehurst	0	579
46.	4509	PR Adv	Lakehurst	0	102
47.	7764	NP/I/	Lakehurst	0	139
48.	7765	NP/II/	Lakehurst	0	2
49.	7766	NP/III/	Lakehurst	0	2
*50.	602D	EW A	Corry	87	912
51.	2694-6046 (3)	IM A	Great Lakes	99	79
*52.	8981	TMA/SSPP	Charleston	50	240
*53.	540J	CIAC	Charleston	0	460
*54.	604J-6243 (6)	AV A	Memphis	100	4600
*55.	601B-6237 (9)	BE/E	Memphis	100	7855
*56.	6210-6229 (17)	AFUN	Memphis	100	16860
57.	6521	TD A1	Memphis	100	361
*58.	402P	LC INSTR	Memphis	100	195
59.	501X	GPETE Bas Op	Groton	100	392
60.	022B	DIESEL Op	Groton	0	218
61.	501C	OX ANAL C CMB MA	Groton	100	16
*62.	6047	OM A	Great Lakes	100	57
*63.	USMC	CCOC (CAI)	29 Palms	100	214**
*64.	USMC	CCOC (IMI)	29 Palms	100	434**

* Course visited.
** FY 82 throughput.
***Course ended 4 Sept 80.

TABLE 3. MEAN CLASS TIME AND CRITERION TO MASTERY FOR THREE VARII (CDF NOS. 3, 4, 14)

ACTIVITY	CI	MIX	SP
Class Day/Hours	7.71	7.40	6.85
Class Hour/Min.	48.14	50.80	54.15
Criterion to Mastery %	73.00	75.40	93.05

(The three VARII differed significantly on all activities.)

TABLE 4. PERCENT ACADEMIC DAY SPENT IN THREE VARII BY SEVEN LEARNING CENTER ACTIVITIES (CDF NO. 23)*

ACTIVITY	CI	MIX	SP
Lecture	54	11	2
Discussion	8	4	3
Demonstration	4	5	3
Self-Study	7	53	53
Tutoring	0	2	3
Film	3	3	1
Laboratories	24	22	32
Other	0	1	3

*Does not add to 100 due to rounding.

TABLE 5. PERCENT CLASSROOM SELF-STUDY TIME IN THREE LEVELS OF INDIVIDUALIZATION BY SIX TYPES OF STUDY MATERIALS (CDF NO. 25)

ACTIVITY	CI	MIX	SP
Student guides	16	9	17
Sum, Nar, P.I.	0	56	51
Other P.I.	0	0	4
Handouts	48	15	13
Equipment Manuals	14	1	7
Other	16	9	5

An important difference in the variations of II is in the ratio of students to instructors and supervisors (table 6). The SP learning centers have over five times as many students, on the average, as do the CI classes, while there are only about twice as many instructors present. The student/instructor ratio (S/I) for SP is about 18 to 1, while in the CI environment it is about 8 to 1.

TABLE 6. MEAN NUMBER OF PERSONNEL IN CLASSROOM OR LEARNING CENTER

VARII	N	SDNTS	AIDES	INST	SUPERV	S/I
CI	7	8.86	0.14	1.14	1.86	7.77
MIX	10	19.50	0.30	2.00	2.60	9.75
SP	20	45.30	0.60	2.50	3.70	18.12
Total	37	31.43	0.46	2.11	3.05	14.90

Of the 64 courses summarized in table 6, 16 (25 percent) had S/I ratios of six or less. These courses break down to nine CI (56 percent), three MIX (19 percent), and four SP (25 percent).

QUALITY OF INSTRUCTION QUESTIONNAIRE

A quality of instruction (QI) questionnaire was developed to assess the extent to which prerequisites (PRQ), cues (CUE), participation (PAR), reinforcement (RNF), feedback (FBK), and correctives (COR) are present in various types of individualized instruction. Items were constructed according to Bloom's (1976) theories of Learning for Mastery and were adapted to military training situations. Each item was examined for content and structure by TAEG staff members. The interim QI was field tested with students from the Orlando BE/E course. In addition, instructors and supervisors were asked to review the questions. The final version of the QI used in the study was based on suggestions from these students, instructors, and supervisors. The resulting questionnaire consisted of 50 items that could be administered in approximately 20 minutes. Appendix C presents this questionnaire with the obtained scale value for each of the variations of II on each item.

The QI questionnaire was administered to 1,090 students, 170 instructors, and 54 supervisors involved with 37 courses at 9 training sites. The combined groups yielded an alpha reliability coefficient of .86 on the instrument. The scoring templates were scaled 1 to 9 for data analysis with the polarity reversed on appropriate scales so that results could be consistently interpreted. The questions were grouped according to the six QI categories (Bloom, 1976) to facilitate the examination of the impact of these variables:

- Prerequisites (Q1-Q5, Q7, Q25)
- Cues (Q8-Q14)
- Participation (Q16, Q18-Q20, Q22, Q23, Q26-Q30)
- Reinforcement (Q31-Q38, Q17, Q21)
- Feedback (Q40-Q44)
- Correctives (Q39, Q45-Q47, Q49, Q50).

Later analyses of questions 6, 15, 24, and 48 found them not as related to the six QI variables as anticipated, although their results are of use to the study.

Table 7 shows the distribution of QI questionnaires to the courses in each category of II and the yearly planned student input for each of these categories. Data obtained from these questionnaires were submitted to detailed analyses of variance of VARII and type of respondent by each of the 50 questions and questions grouped according to the six elements of QI.

TABLE 7. NUMBER OF COURSES, QUESTIONNAIRES ADMINISTERED, AND PLANNED INPUT FOR COURSES VISITED

VARII	(N COURSES)	QI (N RESPONDENTS)	PLANNED INPUT	% PLANNED INPUT
CI	7	146	4,472	6
MIX	10	210	8,915	12
SP	20	958	62,489	82
TOTAL	37	1,314	75,876	100

TIME TO MASTERY ANALYSIS

The literature of Learning for Mastery predicts that the time required for learning in a diverse group of students will become more homogeneous the longer they participate in efficient instruction (Bloom, 1976; Anderson, 1976). This is contrary to the traditional notion that student achievement becomes more heterogeneous the longer they stay in school. One aspect of the present study was to search for an index of such homogeneity in time required for learning as a measure of instructional efficiency. The coefficient of variability ($v = s/m$) was chosen as the index; where, v = variability, s = standard deviation of student time to mastery on a given module, and m = mean student time to mastery on the module. If students requiring longer time for learning begin an individualized course of

study and become more and more like the faster learners, then the standard deviation should decrease for a given cohort as they progress from module to module. Unfortunately, these modules are not of the same length or difficulty, so this makes it possible for the variability of the longer modules to increase. The coefficient of variability tends to correct such effects. This procedure was applied to a selected sample of courses for which there were time to mastery raw data available.

STRUCTURED INTERVIEW

In addition to the quality of instruction questionnaire, a structured interview was developed to specifically assess the degree to which Bloom's elements of quality instruction were present in the instructional materials. Consequently, the structured interview had six major sections, each dealing with an element of QI (see appendix B). The structured interviews were administered to the person deemed "most knowledgeable" of the course by one of the two principal investigators. Analyses of the responses are based on a total of 37 interviews, one for each of the courses sampled.

In conjunction with these interviews, instructional materials for each of the courses were physically examined and assessed for the degree to which elements of QI were present. Finally, samples of reading materials were subjected to a Computer Readability Editing System (CRES) analysis (Kincaid, Aagard, and O'Hara, 1980). Data from the interviews were analyzed by cross tabulating the VARII with each question and the six QI groups of questions.

EVALUATION OF NAVEDTRA 110 (SERIES) GUIDELINES

A separate analysis was conducted of NAVEDTRA 110 (series) guidance with respect to Quality of Instruction elements. For the purposes of this analysis, each question of the structured interview was considered to be an aspect of the QI elements for which guidance could be prepared. Aspects of each element of QI were assessed for their correspondence to sections of the draft NAVEDTRA 110B, the proposed revision to NAVEDTRA 110A, which is the current instruction guiding the development of instructional materials in the NAVEDTRACOM. Based on the discrepancies observed, recommendations for modifications to the NAVEDTRA 110 (series) instruction and for its use were developed.

SECTION III

RESULTS

This section summarizes the results of the QI questionnaire analyses, time and costs analyses, the examination of course materials with the structured interview, and on-site observations.

QUALITY OF INSTRUCTION

The mean score for respondents in each VARII on 45 of the 50 items on the QI questionnaire was above average. This indicates generally favorable opinions toward almost every aspect of instruction measured by this questionnaire. The five unfavorable exceptions (Q7, 20, 23, 26, 45), cut across categories of QI and deal with highly specific aspects of instruction as opposed to generalized trends; the most notable of these is the relative ease with which students can daydream in self-paced instruction (Q23). The most favorable responses showed that instructors were highly regarded as subject matter experts (Q11) and showed agreement in the usefulness of practice activities for students (Q29). The reader is referred to appendix C for the mean scaled responses on each item for the three VARII.

The QI items were combined to obtain information concerning the six elements of quality instruction, as mentioned previously in this section. These six QI (PRQ, CUE, PAR, RNF, FBK, COR) became the dependent measures for 3 X 3 ANOVAs. The independent variables were 3 VARII (CI, MIX, SP) X 3 respondent categories (student, instructor, supervisor).

Figure 1 shows QI scores as a function of VARII. Analysis of the data indicates CI to be judged by respondents as providing the highest degrees of CUE, PAR, and RNF relative to MIX and SP. MIX courses were rated higher than CI and SP in PRQ and COR. SP was estimated to be superior to CI and MIX only in feedback. A more detailed analysis of this main effect is presented in the following paragraphs. Appendix C gives a breakdown by questionnaire item and appendix D gives the mean values and ANOVA results for the VARII main effect.

PREREQUISITES. The mean response to the seven questions comprising PRQ on the QI, shown in figure 1, differed significantly among the three VARII, with the MIX and SP groups rated highest. This was probably due to the respondents in these courses finding the reading levels of student materials easier (Q2), perceiving that more of the students are high in background for success in the course (Q5), and students being far more likely to progress through the course at a rate of speed commensurate with their prerequisites for the task (Q25). This is in spite of the fact that the CI students have better attitudes about school learning going into their courses (Q4).

CUES. The seven CUE questions combined to show the CI courses highest, as shown in figure 1. Here, there was the perception among respondents that the learning objectives were more specific (Q9), there was far more instructor assistance in holding the students' attention to the instructional materials (Q10), and there was a greater proportion of the CI instructor's day being spent in giving cues to students (Q14).

PARTICIPATION. The 11 PAR questions taken together showed the CI group highest overall in this attribute of quality instruction (figure 1). Here, the CI respondents perceived students to spend significantly more time beyond the scheduled academic work day on their courses (Q20), perceived the teaching methods in their courses to be more appropriate (Q22), felt it was more difficult to daydream in class (Q23), detected a greater degree of instructor participation in determining the rate of student progress (Q26), saw more time spent practicing what students learn (Q27), and generally found more realistic practice activities (Q28 to Q30). The SP courses were most skillful in cutting the time between presentation and practice (Q16) and cutting the time awaiting start of their courses (Q19).

REINFORCEMENT. The third, and last of the QI variables on which the CI group scored highest, are the 10 RNF questions (figure 1). In the CI courses, the instructors were perceived as more enthusiastic (Q31), and more likely to believe that all students can and will learn (Q33, Q34). Graduates of the courses were more likely to see the importance of the course for their military career (Q37), and more likely to recommend the CI courses to others (Q38). The lesson materials were more likely to explain the importance of learning their contents (Q17), and were perceived to hold interest longer (Q21).

FEEDBACK. The SP and MIX courses scored higher than CI on the five combined FBK questions (figure 1). These courses were perceived as allowing more tests and retakes of examinations (Q41 and Q42), even though there seems to be less instructor involvement following a test (Q44).

CORRECTIVES. The combined responses to the six COR questions shown in figure 1, find the SP group lowest. This appears to be an anomaly since the theories providing the foundations for Mastery Learning emphasize the importance of corrective activity. The anomaly is probably due to the SP respondents' feeling that the time allowed for relearning after a failed examination is too short (Q45), that there is less availability of instructors for helping students (Q46), and the perception of less availability of practice and restudy materials (Q49).

Figure 2 shows the relationships of the three types of respondent (student, instructor, supervisor) and the six QI variables summed across VARII. There were significant differences among respondents in four of the six QI categories. The supervisors generally perceived the greatest degree of PRQ, RNF, FBK, and COR present in their courses, the instructors were highest in the PAR present, and there were no significant differences among the groups on the CUE and RNF questions. Finally, there were no significant interactions on any of the six dependent variables undergoing analyses of variance.

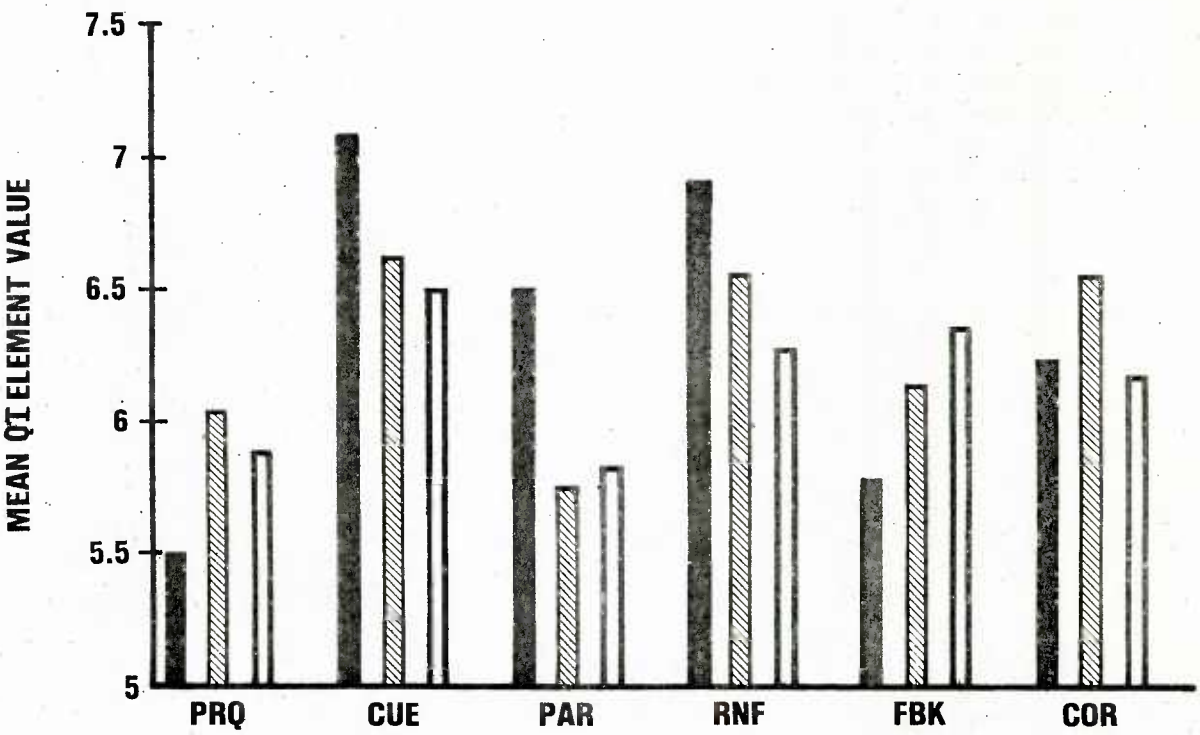

Figure 1. Three VAR II by Six QI

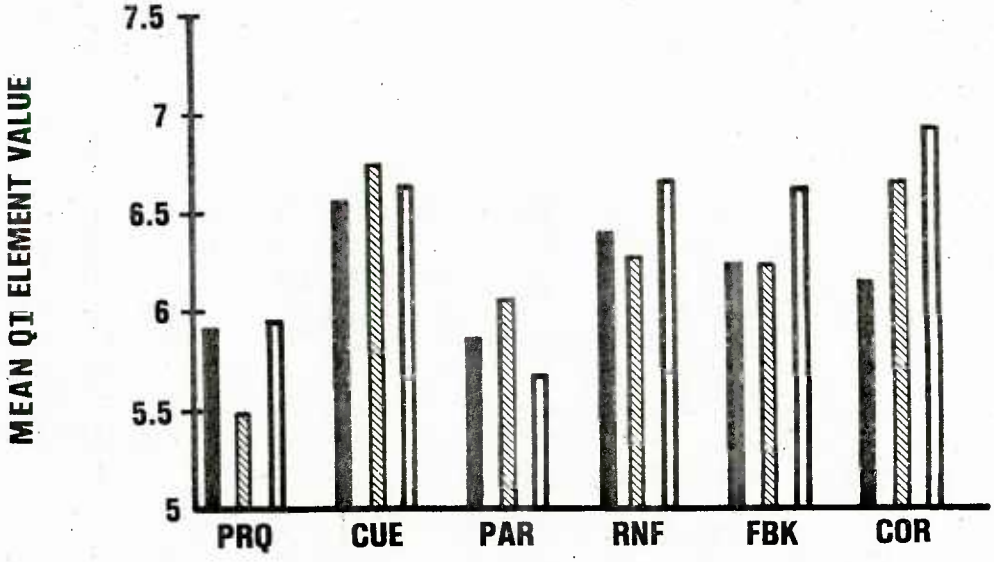

Figure 2. Profiles of 1,083 Students, 164 Instructors, and 52 Supervisors on Six QI Variables

TIME TO MASTERY ANALYSIS

Time to Mastery (TTM) data were collected from three sources: (1) all Phase I Basic Electricity/Electronics students during calendar year 1981 (N= 22704), (2) a sample from Propulsion Engineering Basics (N=62), and (3) a sample from Opticalman A School (N=19). These sources represent 14, 15, and 22 modules, respectively. All data were transformed to coefficients of variability. Figure 3 shows a plot of these coefficients across the number of modules representing each course. A fourth source was taken from BE/E data presented in Federico and Landis (1979) and is also plotted (FL) in figure 3. The general trend of each of the lines suggests the decreasing variability of TTM that Bloom mentions, but the rate of decrease in coefficient of variability is unclear.

COST ANALYSIS

The results of the foregoing analyses prompted collection of cost data. This was already available in the TAEG Incremental Costing Model, and a breakdown by three levels of VARII is shown in table 8 (Dickinson and Swope, 1981). The three costs compared here are: (1) Total cost per course hour, (2) Direct costs per course hour (not including overhead), and (3) Non-student direct costs per course hour (this subtracts student salaries). In all three comparisons the SP costs were lower than the MIX and CI groups. This is coincident with the changing supervisor ratio reported in table 6; i.e., fewer instructors equal lower costs.

TABLE 8. PER CAPITA COST DATA FROM 1981 TAEG INCREMENTAL COSTING MODEL

VARII	Total Cost/ Course Hour	Direct Cost/ Course Hour	Non-Student Direct Costs/ Course Hour
CI	$111.79	$82.70	$27.06
MIX	96.64	71.33	33.20
SP	64.48	47.66	9.67

The direct costs shown on table 8 are not as heavily affected by student throughput as are total costs, although there may be some influence of throughput on these costs. A comparison of the average throughput of the CDPs in the present study shows little difference among the CI, MIX, and SP categories. This may be due to some of the larger courses in the study having between 3 and 30 CDPs per course location (see table 2). The multiple CDPs per large course tend to bring the throughput per CI, MIX, and SP category toward equality. A further association of courses with these cost findings was beyond the scope of the present tasking.

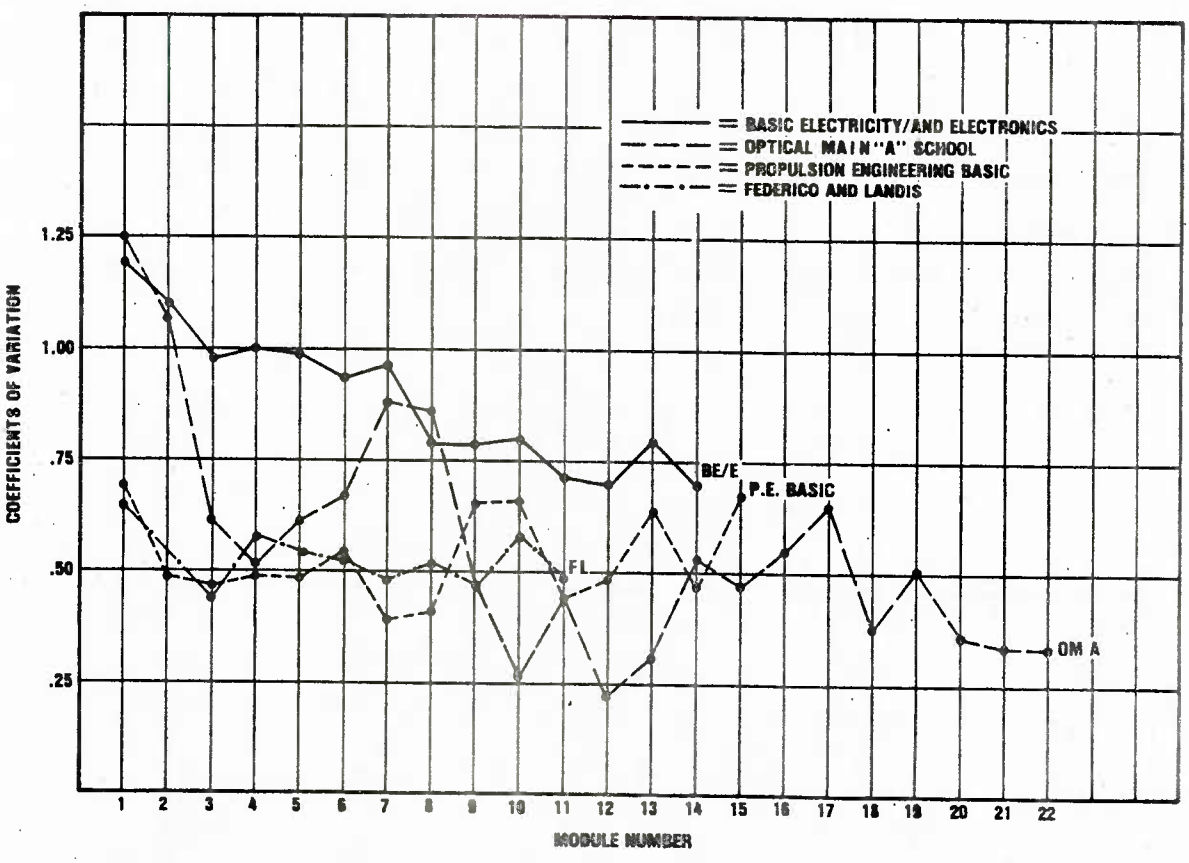

Figure 3. Coefficients of Variation in Module Time to Mastery in Four Self-paced Courses.

STRUCTURED INTERVIEW

Table 9 contains a summary of responses to the structured interview data (appendix B), showing the extent six elements of QI are present in instructional materials taken from the 37 courses in the study. The data in the table represent percent of respondents indicating the instructional element was present in their course. Two types of values appear in table 9. The top number in each cell is the mean percent of the pertinent questionnaire items answered "yes," and the lower numbers show the range in percent of "yes" scores for course. The structured interview form and the percent responses by VARII category are shown in appendix B.

TABLE 9. PERCENT STRUCTURED INTERVIEW RESPONSES OF THREE VARII BY QI VARIABLES

VARII		CONDITIONS OF QUALITY INSTRUCTION					
		PRQ	CUE	PAR	RNF	FBK	COR
CI	Mean	20	38	38	36	42	52
	Range	0-50	14-62	0-88	0-100	25-67	33-100
MIXED	Mean	30	51	71	50	58	70
	Range	0-50	24-86	13-100	0-100	42-83	0-100
SP	Mean	48	47	63	45	60	63
	Range	13-75	19-86	0-100	0-100	33-92	0-100

PREREQUISITES. Observations made while collecting these data illustrate how Navy schools attempt to deal with the prerequisite issue of assessing skills. For instance, pretests are being used in 50 percent of the visited self-paced courses to determine if entering students have the required math or typing skills. Pretesting is a useful way to identify those who require special training before entering the main part of a course. Some courses allow students to "test out" of sections of the course without further study, if students can convince instructors they have previously mastered the skills being taught. However, students rarely take advantage of this offer.

It was learned that as much as 50 percent of the content of lessons is isolated information not applied in follow-on lessons. Comments from course specialists frequently included statements such as "...the lessons could be taught in any order," or "...the content of a lesson is needed in a follow-on school, but would not be used again in the current course." This suggests that many courses are structured so as to exclude distributed practice in the application of newly acquired skills, and could account for low retention and transfer of learned skills to follow-on courses and to the job.

An inspection of materials revealed that self-paced materials appear to be better-written than materials for conventional instruction. None of the conventional materials passed a comprehensibility check while 63 percent of the self-paced materials passed this check. Long sentences and high reading grade levels were the major types of problems found.

CUES. The data in table 9 suggest that many of the opportunities to present cues in instructional materials are not being used. This is true for conventional and mixed as well as self-paced instruction (appendix B). In the materials used, opportunities to provide various types of cues were used only 38 percent of the time. The use rate varied from 14 to 62 percent for individual courses. While the skilled instructor could be compensating for these deficiencies, the instructional materials did not support these functions. However, within self-paced instruction which is almost entirely dependent upon the instructional materials to present new information, an average use of 47 percent of the possible cue functions were used. For individual courses the range varied from 19 to 86 percent of these types of cue functions.

Observations made while collecting these data provided insight into the way these cue functions are being carried out. For instance, courses vary widely on how much printed information a student is given to provide an overview of the course. While 43 percent of the conventional instruction courses provided students with course outlines, schedules, student profiles, lists of training objectives or other documents that summarize what will be learned in the course, only 10 percent of the self-paced courses provided these types of materials to students.

The instructional materials in these courses made wide use of both words and illustrations. However, there were important instances where there is a mismatch between content and instructional material. The most significant of these mismatches is in the teaching of procedures. Although performing procedures on equipment requires locating instruments and controls, and repositioning of controls based on visual cues (all tasks requiring extensive processing of visual information), procedures were generally taught by having students read written steps. Consequently, materials to teach procedures for hands-on equipment operation and maintenance were judged to be the least effective of the training materials reviewed.

In general:

- locations and identification cues were presented by words
- procedural steps were frequently unclear
- safety practices were often not explicit

- demonstrations of procedures were not included in self-paced materials
- group-paced demonstrations were difficult to follow.

Other types of cues can be used to make it easier for students to learn and recall information. Included are the use of mnemonics (memory aids), dividing information into easily recallable chunks, the use of memorable graphics, and highlighting key words to emphasize those words that when recalled will aid students in remembering related material. The analysis of instructional materials in this study indicated these techniques are infrequently used in Navy training materials.

PARTICIPATION. Instructional materials were also examined for conformance to eight different characteristics of good practice materials (see appendix B). Within conventional instruction only 38 percent of the recommended exercise techniques were used in the typical courses. The mixed courses averaged using 71 percent of the types of exercise characteristics while the self-paced courses used 63 percent. Individual courses ranged from 0 to 88 percent for conventional instruction, 13 to 100 percent for the mixed, and 0 to 100 percent for the self-paced.

Observations of good practice and notes on how to improve practice were made during the interviews. Perhaps the most useful practice technique observed was the simulated job shop used at the conclusion of several of the courses. These shops provide opportunities for students to practice performing the job they will be assigned on arriving at their new duty station. In the simulated job shop students have the time and resources to perform representative tasks, and to continue to do this until certified in this performance.

Distributed practice contributes to retention and the ability to employ the school-learned skills on the job. In some courses distributed practice occurred without being planned or supported with special materials. Courses sampled rarely contained special materials for distributed practice.

REINFORCEMENT. The instructional materials for conventional instruction used 36 percent of the types of opportunities to employ reinforcing functions, while the materials for the mixed courses used 50 percent and the self-paced used 45 percent of these opportunities. Individual courses in all three types of instruction varied from zero to 100 percent employment of these functions. The primary observation concerning reinforcement is that little attention is given to its design and scheduling in Navy training materials.

FEEDBACK. Scored tests are an important form of feedback to students on their performance in a course. The extent of feedback provided to students in a course can be estimated by the types and the frequency of tests in the course. In terms of the present study, a comprehensive testing program would score 100 percent on the use of feedback opportunities. The actual

scores were 42 percent for conventional instruction, 58 percent for mixed, and 60 percent for self-paced instruction. Individual course scores varied over a broad range. For instance, individual self-paced courses scored as low as 33 percent and as high as 92 percent.

CORRECTIVES. Printed directions on what to study to overcome deficiencies discovered through testing did not vary greatly across the three types of training programs. Conventional instruction used 52 percent of the types of opportunities, while mixed and self-paced instruction used 70 and 63 percent respectively.

EVALUATION OF DRAFT NAVEDTRA 110B GUIDELINES

In general, conformance to current guidelines in draft NAVEDTRA 110B would correct many of the course deficiencies identified in this study. However, certain elements of quality instruction call for guidance not dealt with adequately in this draft instruction. This part of the report documents an analysis of the draft NAVEDTRA 110B directive for the purpose of identifying areas where additional guidance is needed.

With the help of CNET personnel who prepared the draft 110B, the contents of the instruction were compared with the elements of quality instruction on the structured interview for evaluating instructional materials. In this manner a series of deficiencies in draft 110B were identified.

PREREQUISITES. The instruction does not provide the necessary requirement or guidance for designers to properly match materials to student prior learning. It does not require that:

- pretests be used to determine if prerequisites are known
- prerequisites for a lesson be taught in a previous lesson
- a specified reading grade level or comprehensibility level be maintained
- advanced organizers be used to relate previous learning to a new learning task.

CUES. While many of the CUE-oriented requirements are spelled out in the proposed instruction, there are areas that need to be expanded. The instruction does not require:

- course overview documents be given so that students understand the content and flow of the course and can track progress through the course
- appropriate communication channels be used; i.e., verbal information with words and visual information with graphics

- demonstrations be used where needed and standardized through the use of instructor guides.

PARTICIPATION. Practice of newly formed skills is necessary for their retention and usefulness on the job. While the instruction calls for practice, the requirement for practice and its support needs to be improved. The proposed instruction does not require:

- students to distribute practice over time with materials designed to support distributed practice.

REINFORCEMENT. It is necessary to reinforce the acts of studying and acquiring skilled performance. Although reinforcement is essential to learning, it is not addressed in the proposed instruction. Specifically, the proposed instruction does not require:

- instructional materials to contain statements or events generally known to be reinforcing at appropriate points in the instruction

- instructors to learn skills in developing reinforcement menus for individual students assigned to a learning center with clear instructions on how to shift reinforcers, withdraw the use of external reinforcers, and avoid satiation of effective reinforcers.

FEEDBACK. In addition to using tests to determine if prerequisites are present in students beginning an instructional module or course, the draft 110B does not require:

- curriculum designers to consider alternative methods of providing formative evaluation to learners, such as oral examination and discussion with aides or advanced students

- course managers to maintain reliability and content validity data on formative and summative examinations.

CORRECTIVES. The draft 110B does not describe procedures to be followed when a student is unsuccessful in either formative or summative examination. The implication is that such students go back and restudy the same materials using the same methods that lead to failure the first time. While the Narrative, Summary, and Programmed Instruction hint at alternative learning, they do not provide for a new approach to teaching the subject, with new examples. There are no provisions for alternative ways of attaining the same objectives.

SECTION IV

DISCUSSION

This section discusses the findings of the study. First, an apparent contradiction in the data regarding the relative effectiveness of conventional versus self-paced instruction is analyzed. Next, a summary of findings related to elements of quality instruction and variation of individualized instruction is presented. Cost data are then discussed in terms of their usefulness in assessing the efficiency of self-paced instruction.

The intent of this study was to examine the variations in instructional practices in the courses classified in NITRAS as individualized instruction. The data in section III show that there are indeed differences in courses but there are few distinct patterns attributable to instructional strategy; i.e., conventional versus self-paced. The differences in these courses are primarily accounted for by instructional practices which can be for the most part employed irrespective of strategy; that is, the degree to which they use good learning principles. As defined in this section, II has three essential ingredients; (1) releasing of time constraints, (2) choosing instructional media, and (3) adjustment to skill levels and learner characteristics. The NITRAS categories of self-paced instruction (P), computer-managed instruction (C) and a combination of the two (B), depend on self-pacing to determine if a course is individualized. This can lead to errors in assessing the effectiveness of truly individualized instruction.

The data in section III also show an apparent discrepancy in findings resulting from the use of the quality of instruction questionnaire and the structured interview. The results from QI generally show that conventional instruction is superior to SP in the provision of cues, participation, and reinforcement. Conversely, the structured interview data show that SP is superior to CI in all six elements of QI. Part of this discrepancy may be due to the fact that these time measures ask for different information. The QI asks for perceptions and judgments about instructional practices while the structured interview is designed to assess instructional materials. Examination of table 9 indicates that on a relative basis SP is superior to CI. On an absolute basis, however, average presence of QI elements reported for material is far from what could be considered acceptable in any of the VARII. CI measures ranged from 20 to 52 percent, the MIX range was 30 to 71 percent, and the SP range was 45 to 63 percent. One interpretation of the superiority of CI over SP in the QI questionnaire is that in a conventional environment, instructors have more opportunity and appear to compensate for deficiencies in instructional materials. This interpretation is strengthened by the results of the Johnson and Graham (1982) study which showed learning center instructors spend most of their time in short and routine transactions with students thus precluding their opportunity to provide other cues, participation and reinforcement. The explanation that instructors will compensate for curricular deficiencies is further supported by the data in table 5. These data show that CI courses in

the present study had lower S/I ratios, therefore, providing the chance to compensate for deficiencies in materials.

Additional findings of interest are discussed in the following paragraphs. They are organized by the six elements of quality instruction so that they conform to the approach and analyses of this study.

PREREQUISITES

Questionnaire respondents in all variations of II perceived their courses as doing an adequate job adapting to individual differences in prior learning, intelligence, and attitudes about school. Students in CI classes had the best attitudes about school learning at the start of their courses and are perceived as performing at a higher level than their abilities would allow. Students in the mixed and self-paced classes felt their study habits were most improved. Although students, instructors, and managers gave their courses relatively high grades, there were still instructional material problems. The single largest cause for poor performance in all instructional settings is the mismatch between the skills, knowledge, aptitudes, and attitudes a student brings to the task and what the designer of the training materials assumes the student brings.

CUES

Questionnaire respondents felt their materials were well presented with clear objectives and maps of what the students are to do. Instructors are perceived as expert, with those in CI courses lecturing more, better holding the students' attention, and spending more time helping individual students than in other courses. Analysis of the structured interviews revealed instructional materials need more clear directions, variety in presentation, high-quality graphics, and guidelines to instructors on their proper use.

PARTICIPATION

Questionnaire respondents in all levels of II feel that students spend much of their day in constructive activity. Those in conventional classes most easily see the importance of that which they are to learn, however, and are most likely to put in time beyond the scheduled workday. Those in CI courses also feel the lesson materials and instructors are more likely to hold student interest, keep them from daydreaming, manifest appropriate teaching methods, and elicit more practice than do those in other courses. The time between presentation and practice was seen as shortest in the SP courses. The instructional materials are weak in distributed practice and in providing students opportunity to practice newly-acquired job skills in a simulated or model work environment.

REINFORCEMENT

Questionnaire respondents in CI courses are seen as more enthusiastic, receiving more recognition for their efforts, and more likely to work with and for students than do those in SP courses. Students in CI courses are

most likely to see the importance of their learning for a military career, and are most likely to recommend their courses to other students. Instructional materials were found to have little built-in reinforcement. This could be due to the absence of the topic from NAVEDTRA 110A and previous guides.

FEEDBACK

Questionnaire respondents feel that there is more testing occurring in the SP courses than CI and MIX, but that there is more instructor availability for feedback following testing in the CI courses. Instructional materials were adequate in providing feedback; however, reliability and validity of the feedback mechanism was not available for study.

CORRECTIVES

Questionnaire respondents feel that SP and MIX students are more likely to take corrective activity within the classroom or learning center and less likely to be set back to a later class than those in CI. The availability of restudy materials following failure of an examination is perceived as being high in all levels of II, but highest in the mixed II courses. Instructional materials generally build corrective procedures into classroom and learning center practice, but data from the interviews revealed little use of peer tutoring or instructor aides in this phase of instruction.

COST OF INSTRUCTION

The study results indicate that the direct costs of self-paced courses are approximately one-third to one-half the costs of conventional instruction depending on the manner in which costs are calculated. This, however, does not include curriculum development costs. An earlier report found the cost of graduates higher in SP than in CI (Dickinson and Swope, 1981). If both sets of data are to be believed, they carry different implications for CNET policy. If average cost per graduate is indeed higher for SP then this should certainly affect decisions about undertaking the conversion of existing CI or new instruction to self-pacing. If, however, the direct cost of delivery is lower for courses already individualized then decisions can be made relative to the continuance of such courses. In both these instances equal effectiveness under CI or SP is assumed. Unfortunately, these and similar analyses were peripheral issues to the main objectives of the studies in which they were embedded. If these results can be validated through more detailed analysis of existing cost data, they would provide the basis for policy regarding the use of instructional strategies.

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions regarding differences in instructional practices in self-paced, computer-managed, mixed and conventional courses as defined in NITRAS are provided here, together with recommendations for improving the management and conduct of those courses and for modifying NAVEDTRA 110 (series) and related instructions.

CONCLUSIONS

1. Individualized instruction, defined as including (1) release of time constraints, (2) choice of instructional media, and (3) adjustment to skill levels of the learners, rarely occurs in the NAVEDTRACOM. Most courses categorized as "B," "P," or "C" in NITRAS contain some II, primarily release of time constraints (self-pacing). Other aspects of II are present in these courses in varying, but in insufficient degrees, to correctly categorize the courses as "individualized instruction."

2. In the courses examined, quality of instruction elements (cues, participation, reinforcement) were perceived by questionnaire respondents to occur with more frequency in CI than in MIX or SP courses. This may be due to the lower student/instructor ratios in CI courses allowing greater opportunity for instructors to compensate for curricular deficiencies. In no form of instruction examined, however, were any of the elements present in the degree necessary to qualify as II. Although the attitudes and perceptions of students, instructors, and supervisors were positive toward all aspects of instruction, regardless of method, examination of materials and visits to classrooms and learning centers failed to validate this optimistic outlook.

3. Both student and nonstudent direct costs for the SP courses in this study were 36-58 percent of those required for the CI courses.

4. Self-paced instruction is heavily dependent on written instructional materials. Consequently, the proper design and use of these materials is even more crucial than for CI courses. Self-paced materials examined in this study were superior to those in CI and MIX courses; however, on an absolute scale of adequacy, instructional materials were found to be deficient in all three types of courses. Primary areas of deficiency in SP materials include orientation to the course, teaching of procedures, use of memory-aiding techniques, inadequate opportunities for distributed practice, and limited use of performance testing.

5. Despite the mutually exclusive labels applied to the courses in this study ("P," "C," and "B") most courses employed a mix of instructional strategies to meet objectives; i.e., aspects of both II and CI were used in most courses. This approach appears to represent a pragmatic philosophy within these courses of using instructional practices which match learning tasks and that a single instructional strategy will probably not be suitable for all tasks within a given course.

6. Instructional strategy (II vs CI) is not the determining factor in overall course effectiveness of current Navy courses. Rather, effectiveness is mediated by the extent to which good instructional practices are used within the courses and ultimately determined by the degree to which proper instructional objectives have been defined and met. Good instructional practices can be employed within various instructional strategies. Since it is possible for properly executed II and CI to be equally effective, a choice of strategy should rest primarily on the relative cost efficiencies of the two approaches.

RECOMMENDATIONS

1. Revise NAVEDTRA 110 (series) and related directives to include the following guidance:

a. Use pretests to determine if a student meets the entering requirements and to diagnose specific deficiencies.

(1) Expand paragraph 2.2.4.1, Pretests, to include the use of pretests to determine that students have required entry behavior; i.e., math skills, typing speed and accuracy, before allowing them to enter the main body of the course.

b. Use appropriately-designed training materials to remediate those students who do not meet criterion on pretested entry skills.

(1) Expand the Student Remediation Guide for Use by Learning Center Instructors, adding corrective procedures for remediating required entry skills.

(2) Create entry skills corrective modules for student use. These modules should teach the math skills and other specific entry level skills required but not taught in the main course. Use variations on the corrective math module of the BE&E school as a model.

c. Direct authors to write module booklets according to guidelines on readability and comprehensibility, with the goal of making it easier for targeted students to understand the text that they read.

(1) Expand paragraph 3.6.2.1 to include guidelines for writers to: (a) use controlled vocabulary (both common and technical specialized words) which can be based on carefully developed lists (see Kincaid, et al., 1980), (b) avoid words and phrases designated as awkward, (c) avoid awkward or difficult sentences, and (d) write at a readability grade level matched to students' reading ability.

(2) Ensure that the checks are automatically made by using the Computer Readability Editing System (Kincaid, et al., 1980). The development and use of readability and comprehensibility guidelines is required by OPNAVINST 1510.11, Enlisted Fundamental Skills Training, of 19 August 1982.

d. Provide students with a clear description of what they will be able to do at the completion of the course and how the course is organized to help him achieve this goal. (This is being accomplished within conventional group-paced courses, but not in the self-paced courses.)

(1) Provide each student with a course schedule containing a sequence of lesson titles, tests, and laboratory sessions, with an estimated completion time (range) for each entry.

(2) Provide students with a copy of the Student Profile, describing in simple terms the skills they will have at the end of the course.

e. Provide directions within NAVEDTRA 110 (series) instructions for:

(1) guiding training systems designers in identifying learning tasks best accomplished by group instruction

(2) incorporating Outline of Instruction/Instructor Activity pages in the Learning Center Instructor Guide to support instructor led lectures, discussions, and demonstrations for selected topics

(3) including information in the Learning Center Instructors Guide on how to schedule students who advance to appropriate zones in the curriculum to take part in group-paced activities

(4) guiding training systems designers in the layout of classrooms supporting both self-paced and group-paced instruction, and incorporating these layouts in the Instructional Management Plan.

f. Use text-graphics pages to convey visual information that cannot be efficiently presented with words. These highly illustrated pages are especially useful in aiding the student in locating components on a piece of equipment, placing switches and levers in a prescribed position, and recognizing signals or system responses.

(1) Make use of text-graphics pages in teaching procedures or in presenting procedures to be followed in laboratory exercises involving the operation or maintenance of equipment. Use the TAEG format model for procedure learning (Braby, Hamel, and Smode, 1982).

g. Provide guidelines to instructors on how and when to conduct demonstrations. Improperly handled, demonstrations waste time and introduce confusion in students' minds. Demonstrations are an important mode of training in group-paced and "mixed" instruction and should be handled skillfully.

(1) Give directions on how to conduct a demonstration within that section providing guidance to instructional systems designers on creating Instructor Guides.

(2) Require that an Outline of Instruction/Instructor Activity Page be created for each major demonstration. In the Instructor Activities column of this page spell out exactly what the instructor is to do in this specific demonstration.

h. Provide detailed guidelines to instructional systems designers on how to identify when distributed practice is needed, and how to create materials to support distributed practice.

(1) Direct instructional systems designers to build distributed practice exercises for that subject matter not normally used in lessons subsequent to its initial presentation and add this guidance to NAVEDTRA 110 (series) under the heading "reduce forgetting by providing periodic opportunity to recall and practice infrequently used material."

i. Direct instructional systems designers to provide each student with the opportunity to practice the newly acquired job skills in a simulated or model work environment. This should be the final phase of job training, and students should not be allowed to leave until certified that they can perform the work described in the student profile.

(1) Modify section 3.6.2, Instructional Materials for Self-paced Courses, and section 3.6.3, Learning Center Instructor (LCI) Guide, of NAVEDTRA 110 (series) to include directions for designing exercises in simulated work environments, and guidelines to instructors and students for carrying out these exercises. Sample materials should be included.

(2) Modify paragraph 3.6.4.5, Final Comprehensive Test, of NAVEDTRA 110 (series) to specifically state which part of the comprehensive test will, when possible, be a job-like performance test in a simulated or model work environment, and that students not be certified until they pass this performance test.

j. More alternative methods and materials need to be developed for LCIs to prescribe for students failing to show mastery under the primary method of instruction in a course. Such "correctives" should include sound/slide packages, books, and articles keyed to particular areas of student difficulty in the course, microcomputer-based CAI diskettes, counseling by subject-matter experts, assignment of advanced students as tutors, and a longer school day.

k. Provide instructors and supervisors in prerequisite courses with information concerning former students' performance in upper-level courses.

l. Introduce more instructor accountability for students' academic success into the training system. Make instructors' names a permanent part of every student's record.

2. Compare the effectiveness/efficiency of the 35 Navy "P," "C," and "B" courses examined in this study using course specific data from the TAEG incremental costing model and the CNET training appraisal system. Identify

and correct course deficiencies in accordance with NAVEDTRA 110 (series) and revisions as suggested in recommendation 1.

3. Conduct a controlled study of the relative effectiveness and efficiency of the conventional and individualized instruction formats. Select a moderate throughput course with suitable curriculum for the development of an idealized program of instruction under either of the formats. Ensure that other aspects of course management are suitable for the assessment of efficiencies. Use study outcomes to assist with the development of policy regarding the use of CI and II in NAVEDTRACOM courses.

4. Use the projected life-cycle cost as a major factor in choosing the main instructional strategy (CI vs II) for a new course. When choosing whether to change the instructional strategy of an ongoing course, use incremental costing techniques.

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APPENDIX A

COURSE DESCRIPTION FORM WITH SUMMARY STATISTICS

This is the questionnaire sent to course managers in the initial part of the study. The response categories are filled in with summary statistics from the 62 courses shown in table 2. All numbers are frequencies, except where labelled as mean (M) or standard deviations (SD).

COURSE DESCRIPTION FORM

The Training Analysis and Evaluation Group (TAEG) is continuing its study of variations in individualized instruction for the Chief of Naval Education and Training (CNET). In the present phase of the project, it is necessary to obtain a description of current practices. Accurate responses to the questions that follow will be useful in understanding and improving the learning environment of future Navy men and women.

Please have the persons most familiar with your course fill out the questionnaire. Describe the course as it presently is being taught, regardless of your plans to revise or change it. Try to be as objective and factual as possible in your answers, even when the question seems to require a subjective judgment. It shouldn't take much more than a half-hour. Completed forms should be returned to:

Director
Training Analysis and Evaluation Group
Department of the Navy
Orlando, FL 32813

If there are any questions concerning the project, please contact:

Richard M. Evans
Training Analysis and Evaluation Group
Autovon 791-5673

_____
(Title of course)

_____ _____
(Catalog number) (Location)

_____ _____ _____
(CDP number) (CIN) (Type)

_____ _____
(Name and rank of person responding) (Autovon number)

_____
(Job title of person responding)

1. Do you record contact hours as well as calendar days to completion for individual students? (Circle). . . . . yes no (34 28)

   If Yes, where are these data maintained?

   (6) Students' self-records.
   (13) Master record files in the training office.
   (6) Hard cards in each classroom.
   (15) In a student academic record book.
   (10) In the computer memory.
   (4) Other (please list):

   (44-1)
   (10-2)

2. Is this course in shifts? If yes, how many per day ?. . . (5-3)

3. How many hours in a typical class day in this course?. . . (M=7.38) (SD=.82)

4. How many learning minutes are there in a typical class hour?. . . . . (M=51.31) (SD=5.85)

5. Is break time included in your recorded class hours? . . . yes no (39 21)

6. Can individual students determine when breaks will occur?. yes no (49 13)

7. Does remediation time add to the recorded class hours if it occurs over and above normal class time? . . . yes no (23 38)

8. What is the average number of working days to completion of this course? . . . . . .(M=34.89) (SD=29.90)

9. How many average working days do your faster students take to complete?. . . . . .(M=26.56) (SD=24.43)

10. How many average working days do your slower students take to finish?. . . . . .(M=36.49) SD=30.07

11. How many modules (or lessons) are there in this course?. .(M=19.00) (SD=19.20)

12. How many days do students generally spend until attaining mastery on each module?. . . . . .(M=2.31) (SD=2.14)

13. After how many failed examinations would a student in this course be (list the number of failures next to any action):

   (M=1.00) Given within-class remediation or corrective activity.
   (M=1.00) Given outside-class remediation or corrective activity.
   (M=2.13) Sent to an academic review board.
   (M=0.53) Other (please list):

14. What is the criterion for mastery in each lesson or module? . . . . . (M=80.66) percent (SD=21.48)

15. About how many students achieve criterion on the first attempt in most modules or lessons?. . . . (M=72.65) percent (SD=32.61)

16. In general, do you feel that the recommendations made by instructors to academic review boards, with regard to dropping or setting back students, are followed? . . . . . Agree (45) Disagree (4)

17. What is your estimate of the percent of students sent to academic review boards who are set back?. . . . . (M=26.82) percent (SD=37.35)

18. Estimate of the percent of students sent to academic review boards who are dropped from school . . . . . (M=24.58) percent (SD=33.49)

19. Does this course require a comprehensive end-of-course examination?. . . . . yes (40) no (21)

20. Can students fail their course because of a low comprehensive exam score? . . . . . yes (32) no (23)

21. For the following instructional management functions in the classroom or learning center, indicate (by a check) how it is performed:

	Instructor	Computer	Both
. Assignment of learning material	(46	4	8)
. Composing exams	(48	5	2)
. Administering exams	(48	3	5)
. Scoring exams	(42	10	4)
. Prescribing remediation or correctives	(46	2	10)
. Record keeping	(45	0	13)

22. For the following instructional management functions in the laboratory, indicate (by a check) how it is performed:

	Instructor	Computer	Both
. Assignment of learning material	(43	4	4)
. Composing exams	(43	1	4)
. Administering exams	(44	2	4)
. Scoring exams	(44	2	4)
. Prescribing remediation or correctives	(45	1	4)
. Record keeping	(40	2	9)

23. Estimate the percent time that each of the below is present in this course (must add up to 100):

(M=16.03;SD=21.84) Lecture.
(6.00; 11.18) Discussion.
(5.82; 10.14) Classroom demonstration.
(35.76; 34.96) Self-study of reading materials in the classroom.
(2.44; 5.74) Tutoring.
(2.21; 4.21) Films or television tapes.
(29.90; 24.82) Laboratory exercises or demonstrations.
(1.31; 3.73) Other (please list):

24. List the different ways this course has to teach the same objectives (such as the summary, programmed instruction, and narrative mentioned in NAVEDTRA 110)? . . . . . _____

(M=2.08; SD=1.41)

25. Estimate the percent time spent in classroom self-study that is devoted to reading the following types of materials (must add up to 100):

(M=14.35; SD=25.27) Student guides.
(36.61; 31.88) Modules with summary, narrative, and programmed instruction (such as per NAVEDTRA 110).
(2.60; 12.92) Other programmed instruction.
(15.48; 24.41) Handouts prepared by school.
(8.79; 19.38) Equipment technical manuals prepared by contractors.
(6.26; 17.53) Other (please list):

26. How many instructors are assigned to your average classroom or learning center? . . . . . (M=1.92) (SD=1.63)

27. How many students are assigned to your average classroom or learning center? . . . . . (M=26.50; 50=38.25)

28. How many aides, plowbacks, or proctors are assigned per room above? . . . . . (M=0.35; SD=0.70)

29. How many full-time managers and administrators are assigned to this course?. . . . . (M=2.65; SD=2.66)

30. What percent of the instructor's day is spent in training of general military subjects or discipline? . . (M=3.89; SD=6.02)

31. What percent of this course is "self-paced"? . . . . . (M=57.61; SD=45.13)

32. What percent of this course is "lock-step" instruction?. (M=42.87; SD=45.51)

33. Do you use ASVAB scores or GCT in order to get a predicted completion time for your students in this course? . . . . . yes no
(16 46)

34. Are students assigned to special course materials based on some sort of aptitude score? . . . . . yes no
(3 59)

35. What is the average number of working days holding time for students awaiting instruction in this course? . . . . (M=1.18; SD=2.77)
(46 Omit)

36. Estimate the percent of working time spent in each of the following activities for personnel awaiting instruction (must add to 100):

____ General preparatory skills, such as math or reading.
____ Course-related activity.
____ Military training.
____ Guard, mess duty, etc.
____ Other (please list):

37. How do students here learn how well or poorly they are doing?

("Mechanically, from tests" n=25)
("From a personal instructor" n=10)
("From any instructor" n= 7)
(Combination of Above n=15)

38. List in order of importance the major incentives students have for doing well this course:
(Extrinsic incentives n=39)
(Intrinsic incentives n=20)
(Combination of the two n= 1)

39. List actions available here for dealing with unmotivated students.

(A "punishment-type" response n=18)
("Counsel and Help" n=21)
("Special study group" n= 1)
(Combination of above n=17)

40. List in the order of importance the incentives an instructor has for teaching well here:

(Extrinsic Incentives 14)
(Intrinsic Incentives 41)

41. Does every student have one instructor who is responsible for his or her total success in the training program?. . . . . yes (25) no (34)

42. Which one of the following ideas best describes this course?

(29) The time for learning is pretty well fixed, with students varying in the degree of their mastery of the course goals.

(33) The students vary in the working days to finish the course, but the level of their mastery is pretty much the same.

43. Which one of the following best describes the distribution of student achievement in this course?

(34) A few students below average, many about average, and a few above average.

(24) More above average than below average students.

(4) More below average than above average students.

44. Check the one statement that is closest to the philosophy of instructors concerning student achievement here:

(9) If we do a good job in giving the students what they need there will always be 10-30 percent of the students who just cannot get a solid grasp of the subject.

(52) If we do a good job in giving the students what they need, we can get almost all students to learn almost anything this course has to teach.

45. Which one of the following best describes the pacing in this course?

(17) All students progress through the subject matter at the same speed--that of an "average" student.

(21) Students pretty much determine their own individual pace in learning here.

(24) The instructors generally require students to maintain a pace determined by estimates of student abilities and the difficulty of the subject matter.

46. Which one of the following best describes a typical instructor's action in this course?

(38) They go to the student and ask questions individually, when the student appears to be "stumped."

(23) They wait for students to request the help they may need.

47. CNETINST 3920.1B, "Policy on Automation," endorses automation of all education and training functions. Here, we would like to know how this course has used small microcomputers in this regard. (Omit, if you do not use microcomputers.)

Instructional Use	Model or Type	Number
Management	(Microcomputers)	(6)
Delivery		(1)
Testing		(3)
Administration		(3)
Other		(3)

48. How many of the permanent personnel in this course are owners of personal microcomputers? (Number M=3.43 Type Mode = Microcomputers) (7 Courses)

49. Please indicate the number of personnel teaching or supervising this course who can write programs in such microcomputer languages as BASIC or Pascal.

	Introductory	Intermediate	Advanced
Number at each level of programming	(M=4.33 (9 Courses	M=2.50 8 Courses	M=1.17) 6 Courses)

50. Please list any special uses of microcomputers in this course that might be useful in other Navy courses:

Thank you

APPENDIX B

STRUCTURED INTERVIEW FOR EVALUATING INSTRUCTIONAL MATERIALS

The percent "yes" responses among the 7 CI, 10 MIX, and 20 SP courses are in parentheses in the left margin as follows:

(CI-MIX-SP)

STRUCTURED INTERVIEW FOR EVALUATING INSTRUCTIONAL MATERIALS

I. PREREQUISITES

Are materials matched to student's prior learning?

	Y	N		
(0-20-50)	0	0	1.	Pretest to determine if prerequisites are known.
(14-10-20)	0	0	2.	Pretest to determine if student already has mastered lesson materials.
(29-40-45)	0	0	3.	Prerequisites for a lesson are taught in previous lessons.
(14-40-55)	0	0	4.	Alternate forms of material exist to accommodate variations in student aptitude.
(14-30-55)	0	0	5.	Remedial material prescribed for missed test questions in pretest (for prerequisite knowledge), progress checks, and formal tests.
(0-40-63)	0	0	6.	Material is comprehensible to the typical student; i.e., it passes the comprehensibility check.
(0-10-30)	0	0	7.	Material shows how lesson is related to prior learning (advanced organizing).
(88-70-65)	0	0	8.	Material states how student will use this information on the job, to ensure the student knows why he is studying.

II. CUES

Management documents help form student expectations for the course.

(71-90-80)	0	0	9.	Terminal and Enabling Objectives for the lesson are provided to the student.
(43-30-10)	0	0	10.	The student copy of the course outline clearly shows lessons and how they relate to each other.
(43-40-65)	0	0	11.	The student is given a clear description of how the course will be conducted.

Management statements in lesson give clear directions on how to study the materials.

(57-80-80)	0	0	12.	Overview describes what lesson is about.
(29-80-85)	0	0	13.	Each lesson presents clear directions to the student on how to use the material.
(29-40-60)	0	0	14.	The student has a means to record his progress.

Training objectives are clear and technically complete.

	Y	N		
(88-60-85)	0	0	15.	The describe what the student is expected to be able to do, and give conditions and standards.

Information is organized and formatted for ease of use.

Knowledge Objectives:

	Y	N		
(43-70-90)	0	0	16.	All information needed for objective is concisely stated in one place.
(57-60-85)	0	0	17.	All non-essential information is excluded.
(43-70-70)	0	0	18.	Information is displayed in blocks. Blocks have names or headings.
(57-80-70)	0	0	19.	Verbal information is presented with words; visual information is presented with graphics.

Performance Objectives:

(43-70-40)	0	0	20.	Steps and describe in order.
(0-10-30)	0	0	21.	Rules are presented to guide performance.
(29-30-35)	0	0	22.	Explicit safety precautions are presented.
(71-90-25)	0	0	23.	Demonstrations are given.
(43-50-15)	0	0	24.	Demonstrations cover range of applications.
(43-80-20)	0	0	25.	Medium for demonstration allows students to stop, start, repeat, and skip forward and backward.

Memory aiding presentation techniques are used.

(0-10-10)	0	0	26.	Mnemonics.
(0-0-20)	0	0	27.	Chunking.
(0-10-30)	0	0	28.	Memorable graphics.
(14-20-40)	0	0	29.	Emboldened key words.

III PARTICIPATION

(57-70-75)	0	0	30.	Students are directed to practice.
(29-80-80)	0	0	31.	Materials are provided for practice.
(14-80-75)	0	0	32.	Only information found in lesson presentation is needed in practice.

	Y	N		
(57-80-75)	0	0	33.	Practice problems are consistent with objective, test items and lesson presentation.
(43-70-50)	0	0	34.	Skills presented and practiced in one lesson are called up and practiced in a series of subsequent lessons.
(29-40-35)	0	0	35.	Materials are provided for distributed practice.
(43-80-65)	0	0	36.	Practice exercises provide knowledge of results.
(29-70-45)	0	0	37.	Practice exercises guide remediation.
	IV	REINFORCEMENT		
(14-20-30)	0	0	38.	The material contains reinforcing statements to be displayed to the student after he has successfully completed a block of instruction.
(57-60-60)	0	0	39.	Students get 75 percent or more of the progress check and test items correct.
	0	0		(Mark here if item 35 is checked: "Practice exercises provide knowledge of results."
	V	FEEDBACK		
	Types of Tests.			
	Progress Checks:			
(29-70-90)	0	0	40.	Written.
(29-60-60)	0	0	41.	Performance.
	Module Progress Tests:			
(71-80-90)	0	0	42.	Written.
(29-90-70)	0	0	43.	Performance.
	Comprehensive within Course Tests:			
(14-10-40)	0	0	44.	Written.
(14-20-35)	0	0	45.	Performance.
	Final Comprehensive Test:			
(88-40-65)	0	0	46.	Written.
(14-60-30)	0	0	47.	Performance.

Scope of Tests.

	Y	N		
(71-90-85)	0	0	48.	Test items exist to measure achievement of each objective.

Structure of Test Items/Answers.

(71-80-85)	0	0	49.	Test items are consistent with learning objectives.
(71-90-70)	0	0	50.	Correct answers to missed items are presented to students.
(No data)	0	0	51.	Test items pass the comprehensibility check.

VI. CORRECTIVES

(43-50-60)	0	0	52.	Directions on how to study material on missed items are provided.
(43-80-55)	0	0		(Mark here if item 36 is checked: "Practice exercises guide remediation.")
(71-80-75)	0	0		(Mark here if item 49 is checked: "Correct answers to missed items are presented to students.")

COMPREHENSIBILITY CHECK

A. From each set of instructional materials, randomly select 3 narrative passages of about 500 words each, and conduct a CRES analysis on these passages.

Y	N	
0	0	Less than 05% awkward or undesirable words.
0	0	Less than 10% long sentences.
0	0	No lists in long sentences.
0	0	Not higher than 10th reading grade level (12th for highly technical material).

B. From the exercise and test items in the instructional materials, randomly select 20 questions (10 multiple choice; 10 T/F, if possible) and analyze them using a modified CRES routine.

1. In multiple choice questions:

Y	N	
0	0	Not more than 25% of the correct answers are the longest answers.
0	0	No questions flagged as having inappropriate answers.
0	0	No repetitive words and phrases in answers.
0	0	Double negatives are not used.
0	0	Not more than 15% of test item alternatives are more than 22 words.
0	0	Reading grade level of test items does not exceed the 10th grade (12th for highly technical material).

2. In true/false questions:

0	0	Not more than 15% of questions are more than 22 words.
0	0	No negative wording in questions.
0	0	No complex questions (i.e., "either...or," "neither...nor," and "or").
0	0	Reading grade level of test items does not exceed the 10th grade (12th highly technical material).

APPENDIX C

QUALITY OF INSTRUCTION QUESTIONNAIRE

Data are recorded from 37 courses in final sample:

Group 1: 7 Conventional instruction courses (CI) n=146
Group 2: 10 Mixed (5 - 90%) Courses (MIX) n=210
Group 3: 20 Self-Paced (SP) n=958

Questionnaires scored 1 to 9. Group mean is indicated on the scale with alpha probabilities from oneway ANOVA. Number total = 1,314 cases from 37 courses at 9 locations.

This questionnaire was designed by the Training Analysis and Evaluation Group to provide a snapshot of feelings concerning current instruction. Your responses to the questions will become part of a pool of responses and will not be traceable to you after they are entered into the computer. No student, instructor, or supervisor decisions related to reward or promotion may be made on the basis of your answers here.

Name of Course Being Rated _____

Location_____

Check one: Student__ Instructor__ Supervisor__

How many lessons (modules) in this course? _____

For students: How many lessons (modules) have you completed? _____

DIRECTIONS: Draw a small vertical line through the point on the two-sided scale that best summarizes your answer to the question. For example, the response to the question:

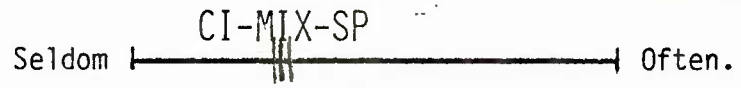
"How do you feel today?"

Bad !————————————/————————! Good

conveys the notion that you feel pretty good. The remaining questions are harder. Please try to answer every question. The summarized information from hundreds of these questionnaires will be a guide for the improvement of Navy instruction.

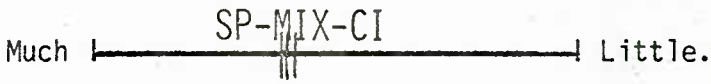
---

1. How often do you find course materials here to be written as if students have certain skills or knowledge that they, in fact, do not have?



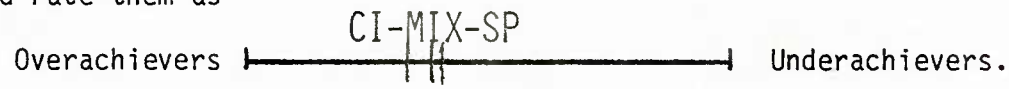
2. For most students, the reading level of lesson materials in this course is

3. To what extent is review of previously-learned material a part of this course?

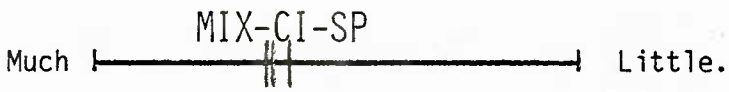


4. Prior to enrolling in this course, most students' attitude about school learning was

5. Based on my knowledge of the average abilities of students here, I would rate them as

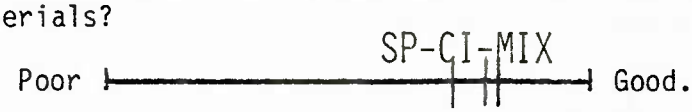


6. Students' study habits are improved by this course



7. Before students can take an examination here, to what degree must they convince their instructor that they are ready for it?

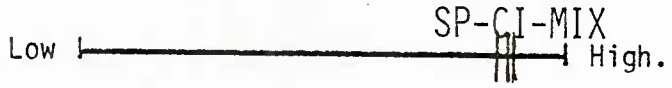
8. How well is the information to be learned in this course presented in the study materials?



9. In this course the learning objectives seem very

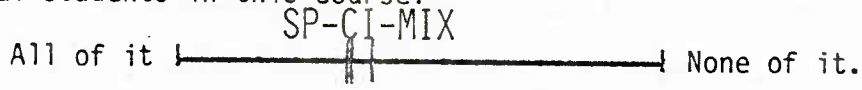
10. To what degree does an instructor assist in getting and holding the student's attention to the instructional materials?

11. To what degree are the instructors in this course expert in the subject?



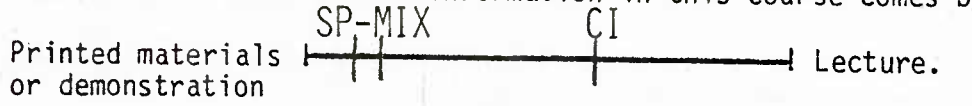
12. The course materials help students know where they are in the course and what they are to do next.

13. What proportion of the instructor's day seems to be spent instructing individual students in this course?

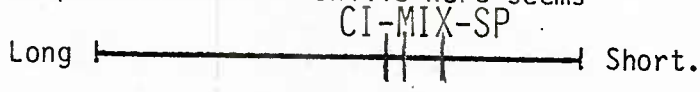


14. What proportion of the instructor's day is seemed to be spent giving directions or information to students?

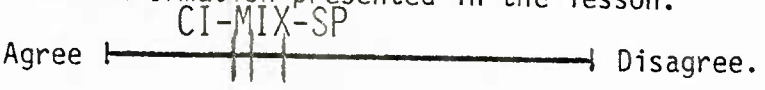
15. It seems as if most of the information in this course comes by



16. Compared to other courses, the amount of time between presentation of a lesson and the practice of its skills here seems



17. The lesson materials clearly describe why it is important that students learn the information presented in the lesson.

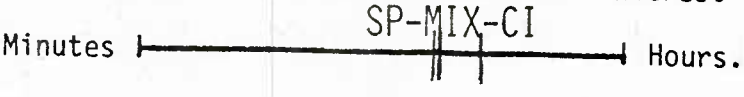


18. In this course what amount of the student's day is spent in constructive use of time in course activity?

19. To what degree is the waiting time between arrival on base and the start of this course used in course-preparatory activity?

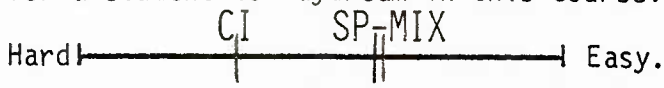
20. How much study time do students usually spend beyond the scheduled academic workday?

21. The course lesson materials here hold students' interest for

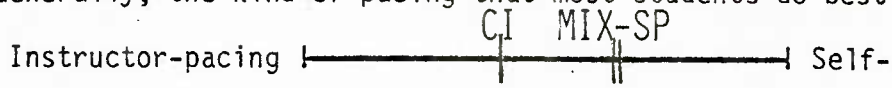


22. To what degree do the teaching methods used in this course seem appropriate?

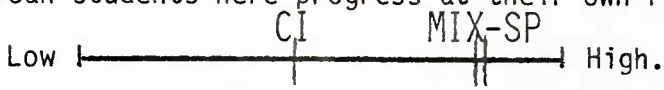
23. How easy is it for a student to daydream in this course?



24. Generally, the kind of pacing that most students do best under is



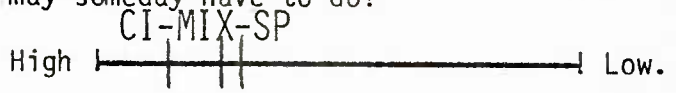
25. To what degree can students here progress at their own rate?



26. To what degree does an instructor determine the rate students progress through this course?

27. Compared to other courses, how much time do students here spend practicing the things they have learned?

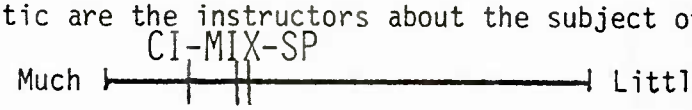
28. To what degree do the practice and lab activities of this course seem like work you may someday have to do?



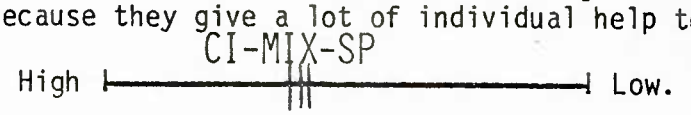
29. Practice activities will help students to remember course material when they get to the job.

30. The lesson materials provide students here with the chance to practice using what they have learned

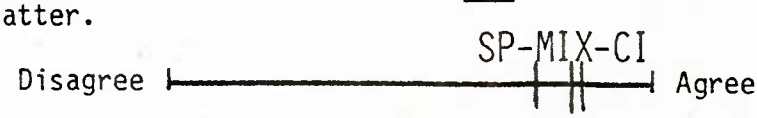
31. How enthusiastic are the instructors about the subject of this course?



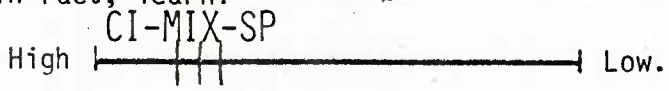
32. To what degree do the instructors seem to be recognized by their supervisors because they give a lot of individual help to students?



33. Instructors here seem to believe that <u>all</u> students can learn the subject matter.

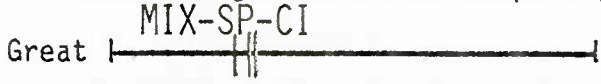


34. To what degree do the instructors here work to ensure that all students do, in fact, learn?



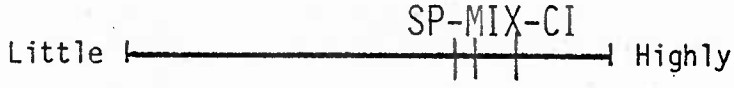
35. Students see the information in this course important for their future civilian career.

36. The incentives for finishing this course as quickly as possible seem

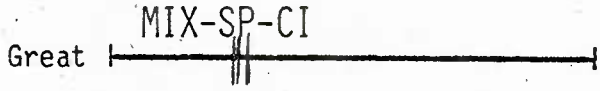


37. Graduates see this course as important to their military career.

38. How highly would you expect students to recommend this course to others?



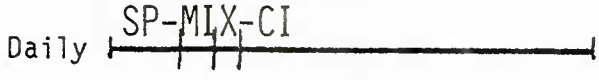
39. When students do poorly on a test, to what degree is corrective work allowed?



40. The amount of testing in this course seems to be too

41. How often can students retake an examination, should they fail?

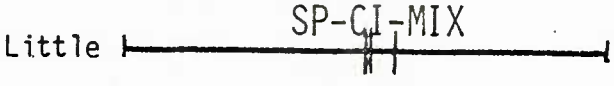
42. Testing in this course occurs almost



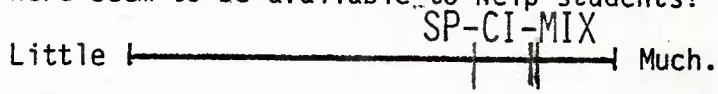
43. The tests here really measure how well students know what the lesson materials teach.

44. To what degree does the instructor become involved with students after they take a test?

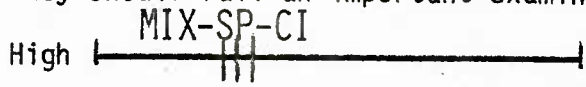
45. It seems to me that the amount of time allotted for relearning after failure to pass an examination is too



46. Compared to other courses, civilian or military, how much do the instructors here seem to be available to help students?

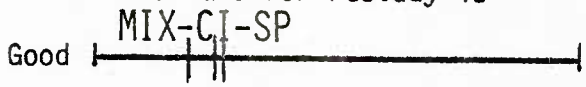


47. To what degree do students take individual corrective activity in this classroom, if they should fail an important examination?

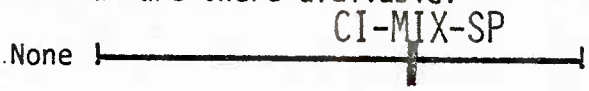


48. In this course, students who fall behind are set back to a later class.

49. When students miss terms in practice exercises and tests, the availability of the materials for restudy is



50. Following failure of an examination, how many different ways of learning the material are there available?



Thank you.

APPENDIX D

MEAN VALUES AND SIGNIFICANCE (Total df = 1313) OF THREE VARII ON QUALITY OF INSTRUCTION QUESTIONNAIRE

(These are the numerical values for the scales plotted in appendix C.)

TABLE D-1. MEAN VALUES AND SIGNIFICANCE OF THREE VARIATIONS OF II ACROSS 50 QI QUESTIONS

Question	CI	MIX	SP	ANOVA p
1	6.38	6.28	6.10	n.s.*
2	6.36	7.16	6.57	.01
3	5.36	5.59	5.64	n.s.
4	6.06	5.52	5.57	.05
5	6.01	5.64	5.43	.01
6	5.81	5.88	5.45	.05
7	4.24	4.75	4.48	n.s.
8	6.99	7.18	6.38	.01
9	7.67	7.17	6.83	.01
10	7.51	6.35	5.99	.01
11	7.82	7.83	7.58	n.s.
12	6.76	7.19	6.84	n.s.
13	5.85	5.34	5.89	.01
14	6.86	5.52	5.89	.01
15	3.84	7.79	8.06	.01
16	5.37	5.74	6.39	.01
17	6.88	6.42	5.93	.01
18	6.92	7.24	6.99	n.s.
19	6.08	6.05	6.64	.01
20	5.08	3.99	3.98	.01
21	6.21	5.51	5.40	.01
22	7.00	6.23	6.04	.01
23	6.14	3.41	3.51	.01
24	3.62	5.78	5.83	.01
25	3.99	7.20	7.34	.01
26	6.64	5.10	4.64	.01
27	5.92	5.19	5.35	.05
28	7.73	6.94	6.46	.01
29	8.16	7.92	7.50	.01
30	6.26	5.80	6.33	.05
31	7.55	6.72	6.48	.01
32	5.64	5.43	5.18	n.s.
33	7.44	7.54	6.78	.01
34	7.58	7.14	6.79	.01
35	6.32	6.04	6.72	.01
36	6.31	6.76	6.46	n.s.
37	7.89	7.30	6.88	.01
38	7.12	6.49	6.09	.01
39	6.51	6.74	6.73	n.s.
40	5.38	5.43	5.59	n.s.
41	3.20	5.34	6.14	.01
42	6.78	7.16	7.83	.01
43	7.01	7.08	6.75	n.s.

*n.s.=not significant

TABLE D-1. MEAN VALUES AND SIGNIFICANCE OF THREE VARIABLES II ACROSS 50 QI QUESTIONS (continued)

Question	CI	MIX	SP	ANOVA p
44	6.49	5.49	5.47	.01
45	4.60	5.03	4.59	.01
46	7.35	7.38	6.37	.01
47	6.12	6.77	6.54	.05
48	4.23	6.03	7.28	.01
49	6.95	7.36	6.84	.01
50	5.92	5.92	5.95	n.s.

APPENDIX E

REVIEW OF THE LITERATURE

REVIEW OF THE LITERATURE

HISTORICAL

The conversion of Navy instruction to the individualized learning center activity that is the subject of this report has antecedents in the beginning of recorded history. Brubacher's A History of the Problems of Education (1947) gives a number of precedents for modern training methods, among them: the sorting of students who were to become the philosophers, warriors, or artisans based on individual differences in mental talent, described by Plato; the advocacy of different teaching methods for differing student natures by Quintillian; and more recently, the 1919 Dalton, Massachusetts, plan allowing students to progress at their own rate, and Carleton Washburn's individualized "Winnetka Plan" in Illinois also in 1919.

The efficiencies sought today by accounting for individual human differences in learning were foreseen by Terman over 50 years ago:

> If the differences are found due in the main to controllable factors of environment and training, then, theoretically, they can be wiped out by appropriate education procedures--procedures which it would then be our duty to provide. On the other hand, if they are primarily due to differences in original endowment, then the duty of the school is clearly to provide for differentiated training which will take these native differences into account (Terman, 1928).

THEORETICAL

This was the thought that was particularly attractive to trainers in the 1960s who found the need to teach a widely divergent group of individuals to successfully pursue highly convergent learning objectives. Prior to this time researchers dealt with individual differences as the within-group variance in their experiments. This variance was the "error term" in their F and t ratios. Good experimental design sought to maximize the group variation under study, control the extraneous sources of variance, and minimize the error variance (due to individual differences in the subjects or learners) (Kerlinger, 1973). But such experimentation confounded the differential effects of individual differences. Strategies of schooling based on this research made matters worse by emphasizing the very differences that were such a problem for the group-based methods in use.

The untangling of the relationships between methods of instruction and ways of learning has more recently occurred in investigations of "ability-treatment interactions" (Bracht, 1970; Berliner and Cahen, 1973). Theoretically, the more we know about how various individuals learn various kinds of things to be learned the better the learning environment can be controlled and the less the "error" term in a teaching or learning experiment. The more treatments an instructional system has available to teach a given task, the more likely it will have an efficient and effective

method to reach an individual of a given ability. To extend this logic, if we had enough ways of adapting our methods of instruction to a given ability student, the variation of human achievement should approach zero--that is, almost anyone should be able to learn most anything.

Fundamentals of such learning were first described by Miller and Dollard (1941) in an early theory of teaching. Their identification of drive, cues, response, and reward was a forerunner to much of the later identification of the behavioral characteristics of teaching--most importantly used by Carroll (1963) and then Bloom (1968). Most of the current efforts in individualized instruction have philosophical roots in Carroll's "A Model of School Learning" (1963), which asserts,

$$\text{Degree of Learning} = f\left(\frac{\text{Time Spent}}{\text{Time Needed.}}\right)$$

"Time spent" is further differentiated with "time allowed for learning" and "time the learner is willing to spend," or perseverance. The "time needed" is also broken down to that required because of the students' aptitude, "ability to understand instruction," and "quality of instruction" (QI). Thus, this model finally becomes,

$$\text{Degree of Learning} = f\left(\frac{\text{Time Allowed X Time willing to spend}}{\text{Time req'd X Abil Understand X QI.}}\right)$$

The development of these formulas is expanded in Block and Burns (1977).

Benjamin Bloom (1968) reasoned that by optimum presence of the variables under the school's control it would be possible for almost all students to attain levels of achievement heretofore attained by only a few. The application of this reasoning was called "Learning for Mastery." This notion was well suited for a military training environment--if under fixed-time instruction students varied in the degree of mastery, and if achievement variance around a given criterion for mastery is undesirable or costly, then Bloom's system fixed the level of mastery allowing students to vary in the time taken to learn. This idea became a philosophical basis for much of the so-called "self-paced" course development introduced in military instruction during the 1970s.

Bloom (1974) has further reasoned that the apparent variation in human intelligence, aptitude, and achievement is based on norms reflecting the elapsed time individuals have lived, or elapsed time exposed to schooling, or elapsed time students have studied particular subjects. Such variation is difficult to examine in absolute terms. It is more useful to relate it to a fixed criterion of attainment or achievement. Bloom approximates this variation as a ratio of 5 to 1 in student time to mastery under a variety of learning conditions--said another way, the learning time required by slow learners at the beginning of a course is about five times that of the faster learners. Furthermore, when you eliminate the wasted time and consider elapsed time on task, this ratio is reduced to 3 to 1. Finally, Bloom has observed that students nearing completion of a course taught by mastery learning methods differ only about 1.5 to 1.

Anderson (1976) investigated the magnitude and stability of the individual differences in elapsed time and time on task and time to criterion. He found that rate of learning defined in both ways was alterable, much as Bloom (1976) later hypothesized in a fully developed theory of school learning (see figure E-1). Prominent in this model is "rate of learning" as a dependent variable, in keeping with the earlier assertion that in a given subject taught with Mastery Learning strategies, the ratio of TTM between "slow" and "fast" learners should diminish.

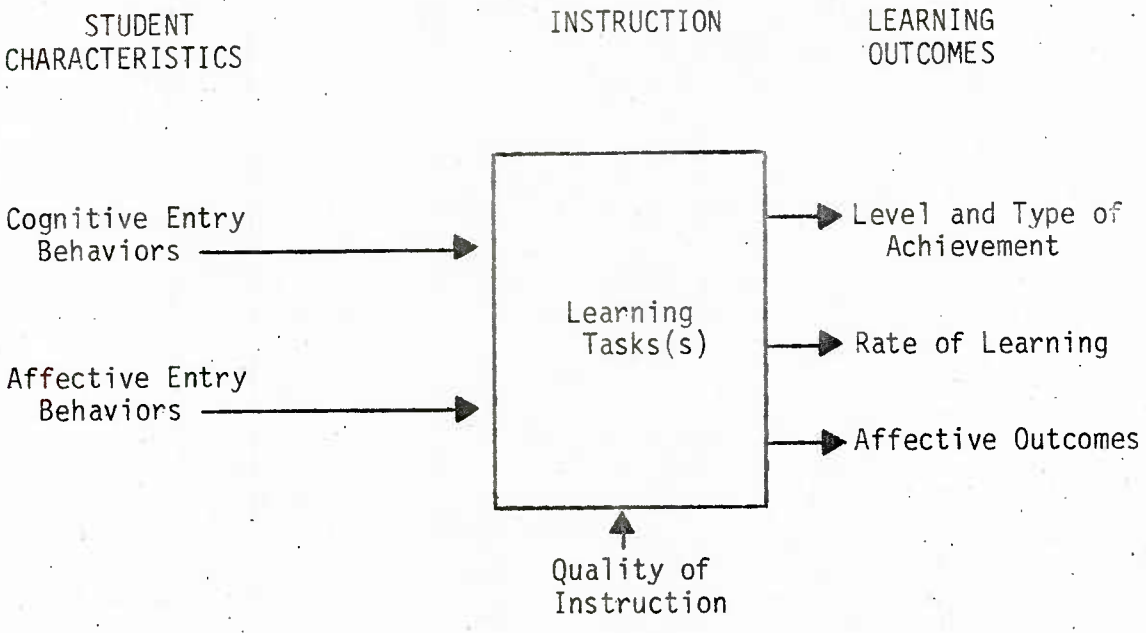


Figure E-1. Major Variables in the Theory of School Learning (after Bloom, 1976)

Taken separately, Bloom asserts that Cognitive Entry Behaviors (intelligence and experience) account for 50 percent of the variation in school achievement, Affective Entry Behaviors (attitudes about learning) account for 25 percent, and Quality of Instruction accounts for 25 percent of this variation. The interactive combination of these three major variables accounts for about 90 percent of school achievement. Since cognitive and affective entry behaviors are nearly inalterable during the length of most courses in the Navy, we will deal primarily with those elements that are. Bloom's theory describes six elements that are present in quality instruction. They were explained in the definitions section of this paper as prerequisites, cues, participation, reinforcement, feedback, and correctives.

These elements of quality instruction were discerned by looking at the ideal teaching and learning situation--the tutorial. The tutorial is perhaps the easiest situation to provide for the foregoing six elements of quality instruction. The task of Navy instructional developers is to try to

design these ideals of the one-to-one student/instructor situation into the many-to-one situation.

QI VARIABLES

The kind of individualizing that takes place in a given instructional context depends on the number and kinds of tools that are available in the instructor's kit. Matlick, et al. (1980) conducted an extensive review of the literature on the subject and postulated eight such controlling factors: (1) time available, (2) instructional personnel, (3) facilities, (4) management, (5) student population characteristics, (6) course content/task types, (7) instructional methods, and (8) media/materials/devices. From these, they proposed a four-dimensional model for classifying and describing models of II. The basic dimensions were objectives, time, proficiency, and instructional treatment--each of which could be fixed or variable. Supposedly, courses could then be assigned to one of the 16 categories of this 2x2x2x2 model for comparison. Salient conclusions from their literature review were: that II is not a precise term that there are many approaches to II, and that there are few fundamental differences among current approaches to individualizing.

A study of the effects of cues, participation, and corrective feedback in instruction looked at 54 studies involving 700 classes (Lysakowski and Walberg, 1982). The characteristics of over 14,000 students of these classes suggested large and consistent effects of instructional cues, participation, and corrective feedback for learning in natural settings, such as in a typical classroom. The authors concluded that their analysis strongly confirms the Dollard-Miller-Carroll-Bloom theory that has evolved during the past four decades.

Several studies deal with the instructor/student (I/S) ratio and its effect on achievement. Glass and Smith (1979) conducted a meta-analysis of 80 studies of class size with achievement, finding an inverse relationship, and concluded that few resources at the command of educators will reliably produce effects of the size found. Glass and Smith suggest, for example, that a student who might score at the 63rd percentile when taught individually, would score at about the 37th percentile in a class of 40 students. Van Matre, et al. (1981) compared 237 Navy BE/E students undergoing instruction with a 1/18 I/S ratio and 1/30 I/S ratio. They found that the larger class size may have detrimental effects on student time to mastery, and it also may have an effect on instructor administrative behavior. Cohen, Kulik, and Kulik (1982) conducted a meta-analysis of 65 school tutoring programs. Here, the tutored students scored higher on examinations and had more positive attitudes toward subject matter. Another recent study by Kulik and Kulik (1982) looked at ability grouping as a way to individualize within a conventional instructional environment. This was a meta-analysis of 52 studies on the subject, finding a small effect size, but an effect large enough to move a given student from the 50th to the 54th percentile in achievement.

The meta-analysis procedure itself was investigated for its rigor in making conclusions about class size (Hedges and Stock, 1983). Using their

own model of efffect size, in reanalysis, however, did not suggest any substantial changes in the conclusions of Glass and Smith. The authors concluded that there is higher achievement expectation in smaller classes and that class size accounts for substantial amounts of variation in student achievement.

The importance of the effect of I/S ratio found by Van Matre, et al. (1981), is supported by a more recent NPRDC study. Johnson and Graham (1982) kept records of BE/E and AFUN instructors in the CMI environment to determine the kinds of activity present, initiating factors, and time devoted to each episode of the activity. They found that while jobs differed greatly between and within courses, the demands on the learning center instructors depended on the length and difficulty of the learning module and that tradeoffs between training effectiveness and the demands on the instructor have not always been made. The most striking observation was that in these computerized courses most instructors spend their time in routine transactions with the student.

In a survey of 255 students and 100 instructors using the CMI system at San Diego and Memphis, Robinson, et al. (1981) found that trainees' attitudes were generally favorable toward the CMI system while instructors' attitudes were not favorable. They also noted that the longer the trainees stayed in the Navy, the more their attitudes became negative.

Morris, Surber, and Bijou (1978) investigated the effect of procrastination in 75 college students in an individualized course with 74 in the equivalent of an IMI course. They found that even though the "self-paced" students procrastinated in the course activities while those in the instructor-paced course did not, both groups scored as well in achievement, retention, and attitude measures. They concluded that although students procrastinate when free to do so, they proceed evenly through the course material when given incentives to do so. Finally, the authors remind us that "...students do not self-pace; they pace according to the conditions that control pacing behavior" (p. 228).

A correlational study of 385 freshman biology students who were under individualized and conventional instruction found some individual differences in learners important. Latta, Dolphin, and Grabe (1978) found low-ability, high test-anxious students do best under II--especially females. They also found perseverance, measured by extra lecture attendance and extra reported study hours, positively related to performance in mastery learning strategies; but in traditional instruction, this was only true for males.

Time is central to the Carroll model. Centra and Potter (1980) developed a model depicting their notion of the variables contributing most to student learning. One of their variables, Time on Task, was often cited in their review of the literature. They note that it may be overly simplistic to conclude that achievement increases merely due to length of time in school, as many researchers have found. But Centra and Potter warn that this is not enough--concern must also exist for the quality of time spent in the learning environment. Walberg (1982) synthesized three National studies of educational effectiveness. Although many studies show

no significant difference between groups, a "Box Score" of a percentage of studies favorable to the relationship between time and learning is 95 percent positive. To make his point, Walberg suggests that doubling the time students actually concentrate on study might double the amount of learning.

Block and Tierney (1974) compared two corrective procedures in a Mastery Learning instructional strategy: correction by redirected study and correction in the Bloom method, which was high in feedback and formative evaluation. The redirected study correction procedure had no effect on the knowledge outcomes of the upper division historiography course, but the Bloom-type increased the application scores.

A recent review of 13 studies sponsored by the Army Research Institute was concerned with the retention of tasks performed within the operational military environment (Hagman and Rose, 1983). It concluded that retention was improved by repetition, distibuted practice, and training tailored for specific environments. It also concluded there were no detrimental effects in the use of equipment variety in training when equipment is similar and repetitions are spaced, and that the use of mnemonics are not universally useful.

Thompson (1980) compared an individualized mastery system of teaching calculus with a conventional lecture-discussion-recitation strategy among 840 Air Force Academy freshmen. He found indistinguishable results in math achievement, and suggests that differences favoring II in the literature may be due to the inferiority of CI, rather than the superiority of II, since the CI courses in his study were thought to be well-taught. Thompson suggests that a less-professional instructor is needed in II, which makes it more cost-effective. He also warns that assignment of CI-conditioned faculty to II courses may result in a loss of job satisfaction among instructors.

COSTS

TAEG Technical Report 105 contrasted the operating costs of CMI, IMI, and CI in a Navy RM A course (Corey, 1981), showing nearly similar annual operating costs, but with 15-year cycle operating costs favoring IMI and CMI. While no generalizations were made beyond the course studied, the report did conclude that the most expensive resource in training is the student population, and that dollars spent in curriculum development show great potential for payback in a short time. The report also recommended that formal economic analysis be a part of every major course development.

Orlansky and String (1979) studied cost-effectiveness of computer-based instruction in all of the military services. They concluded that while achievement in CMI, CAI, and CI are about the same, that computer-based education saves about 30 percent time to mastery over CI. A later study (Orlansky, String, and Chatelier, 1982) looked at examples of flight simulators, computer-based instruction, and maintenance training simulators for cost and effectiveness with nearly the same conclusions. They also cite summary figures giving some indication of the importance of training to the

Department of Defense--a $12.8 billion enterprise in FY 83. The time spent by students, instructors, and others in individual training account for about one-fourth of the military and civilian man-years in DOD. About 20 percent of all military personnel are in schools as students or instructors, and about 76 percent of this effort is initial training for new service members.

SUMMARY

The various versions of individualized instruction have antecedents in the wisdom of recorded history, with solid roots in the learning theory of this half century. From the tutorial to the large group presentation, there are definable attributes of effective instruction that are not present in ineffective instruction. The reconceptualization of school organization possible by accepting learning time as a variable allows the planning of instruction that can hold levels of performance constant. This allows the development of a new philosophy of training that can retain high exit requirements from courses that may not necessarily have control over the ability levels of students entering the programs.

Benjamin Bloom's theory of school learning is seen as the tacit philosophical foundation of most military individualized instruction. Adaptive instruction accounts for the cognitive and affective entry behaviors for a course by designing instruction for known levels of prerequisites. Instructional quality is determined by the presence or absence of cues, participation, reinforcement, feedback, and correctives. When these six attributes are optimum for a given human ability, the philosophy guiding Learning for Mastery can assert that all can learn, and all will learn. The philosophy asserts that it may take more time and effort for some than for others--but they will learn.

APPENDIX F

A MODEL OF INDIVIDUALIZED INSTRUCTION

A MODEL OF INDIVIDUALIZED INSTRUCTION

This appendix attempts to synthesize that which was learned from a review of the literature and that which was obtained from site visits and questionnaires. Figure F-1 is a flow diagram describing ideal individualized instruction. It is consonant with the instructional theories that provide the foundation for mastery learning. It attempts to synthesize what was learned by visiting 37 Navy and Marine Corps learning centers and classrooms. Finally, it assumes that all students who begin the process can and will learn.

In figure F-1 the instructional module is the basic unit of analysis. Such a module should be tailored so that it will require an average student 1 day to master. In this way, oral and printed formative examinations will occur often enough to keep the student's attention and require a high degree of participation. The system is designed to keep the student's mind engaged with the subject matter. Students who already have the skills taught in the module have the ability to challenge the criterion and move on to other instructional modules, if they can demonstrate mastery.

The process portrayed in the model is self-correcting. Students not having either the prerequisites or the mastery of the module following practice do not exit until they have the criterion skills. External intervention may be required when higher authority determines a given student is spending too much time in a course, and that the Navy's training dollars might be more effectively spent on someone else.

The first decision point in the model involves prerequisites. PRQs importance in the model reflects Bloom's (1976) assertion that it accounts for 50 percent of student variation in achievement. The basic decisions concerning the students' possession of PRQ can be made with aptitude and achievement tests and/or oral examination. If students do not have the prerequisite cognitive and affective behaviors and if the instruction itself does not adapt to these deficiencies, they will probably fail to learn their tasks. Thus, the instruction adapts to the individual by (1) branching to a task for which the student does have the prerequisites or (2) the instructional system itself finding the materials, instructor or tutor time, and any other resources necessary to teach these prerequisites.

Next, the cues are presented to enable the students to determine that which they are required to learn. As with other quality of instruction variables CUE does not necessarily have to follow PRQ or come at any particular time. As a first approximation, cues are the terminal learning objectives for the module. Later when information is being presented, cues aid in learning the discriminations necessary to acquire the concepts or other skills involved in the module.

Participation (PAR) is the focus of all activity within the model. Students learn what they do. Thus, PRQ is an attempt to determine the students' readiness for doing something. CUEs let students know what they are to do. FBK gives students information as to how they are doing. RNF is supposed to strengthen that which students were doing. And COR provides alternate ways for students to learn to do the particular learning tasks. All of these elements serve to keep the PAR going.

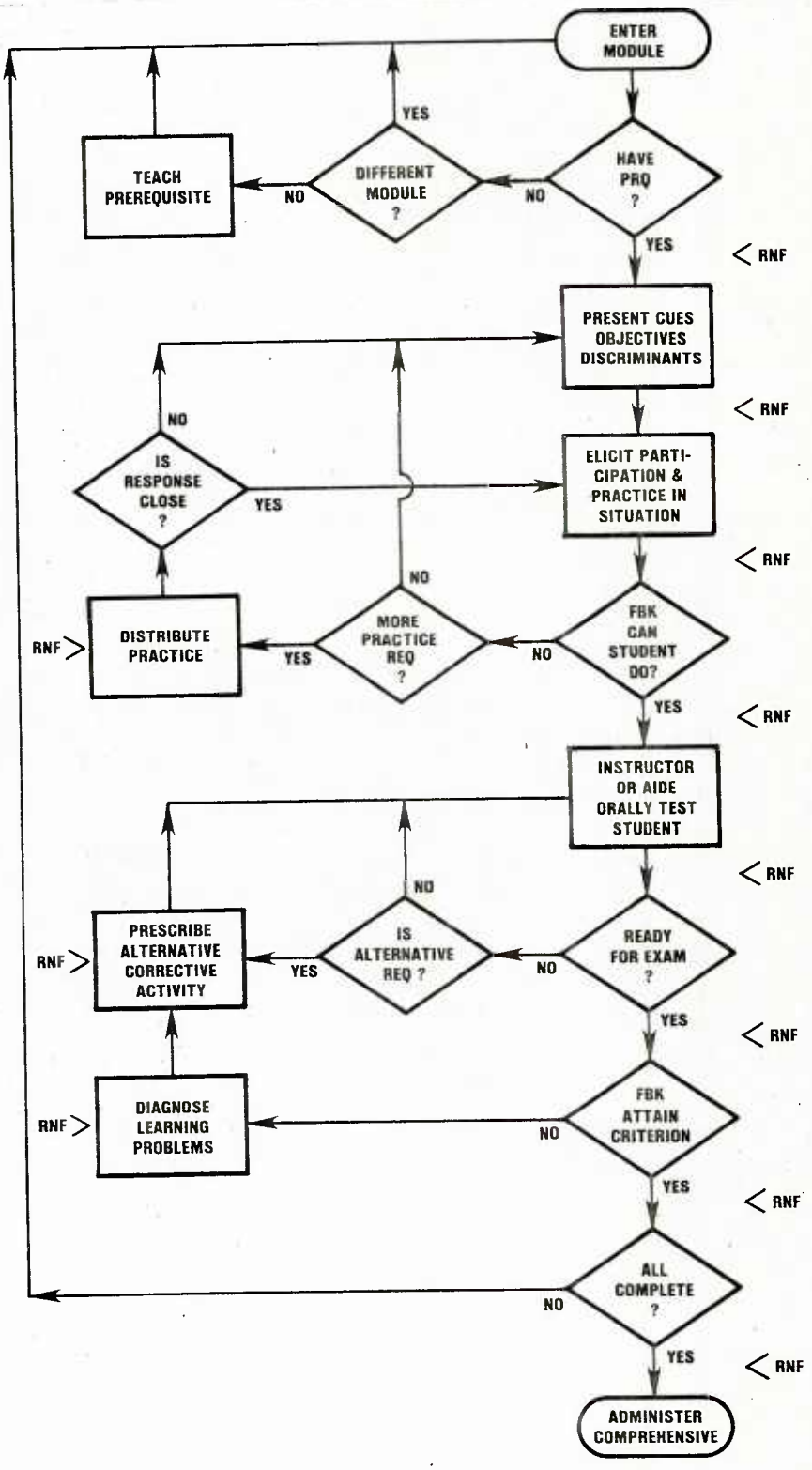


Figure F-1. A Model of Quality Individualized Instruction

After the prerequisites are assured, it is the occurrence of reinforcements that keep the students' attention to the cues, the activity, the many forms of testing, and the correctives. Figure F-1 shows RNF occurring at almost every point. With some students, learning is its own reward. With others, there is a need for profuse administration of "attaboys" or even more material reward. This model of individualized instruction asserts the importance of RNF at a number of key points in the act of instruction.

Feedback can also occur at different stages in the model through different media. Usually, FBK is given by a test, with additional feedback provided by the instructor following the test. A test is defined as any evaluation of a student's performance. Thus, FBK occurs during and after examinations, in discussion with instructors, and in rap sessions with other students concerning aspects of the course.

Correctives (COR) are a form of remedial activity that are essential to ensure that all students will learn. When a student fails to demonstrate mastery after following a particular instructional sequence, it is incumbent on both the instructional materials and the instructor to determine the reason for failure. Once the cause of this failure is diagnosed, alternative materials are prescribed--presumably, these materials will be more appropriate to the student's specific learning style or skills. Such alternatives might be chapters in textbooks or technical manuals, sound/slide presentations, floppy disks containing microcomputer-based CAI, or tutoring by an advanced student.

The model is intended as a description of the essential functions that need to be performed in good instruction. It is not nor is it intended to be a prescription of how these functions are to be carried out within the prerogative of course managers or curriculum developers. Adequate guidance for carrying out these functions can be obtained from the literature and especially NAVEDTRA 110A with the modifications recommended in section V.

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