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ABSTRACT

To determine whether contact with computer-assisted instruction (CAI) leads to feelings of "depersonalization" and "dehumanization" a review was conducted of investigations to explore attitudes toward various modes of computer-based instruction before, during, or after exposure. Evaluation of pertinent factors which influenced attitudes was made through assessment of relevant literature and personal communication with experts associated with CAI projects. Results of studies are compared in table form and recommendations made for future acceptance and implementation of computer-based systems. It is concluded that computer-based instruction is not a threat to humanization, and that it can provide opportunities for increasing effectiveness and personalization of the instructor-student relationship. (SK)

AFHRL-TR-75-4

AIR FORCE HUMAN RESOURCES LABORATORY

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IMPACT OF COMPUTER-BASED INSTRUCTION ON ATTITUDES OF STUDENTS AND INSTRUCTORS: A REVIEW

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May 1975

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This technical report has been reviewed and is approved.

MARTY R. ROCKWAY, Technical Director
Technical Training Division

Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
Commander

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This review examines the evidence which bears on the issue of whether contact with computer-based instruction leads to feelings of "depersonalization" or "dehumanization." The approach is to document investigations which employ the larger construct of "attitudes" toward various modes of computer-based instruction which are found to be held by students and instructors before, during, or after exposure to computer-based instruction. Evaluation of pertinent factors which influence attitudes was made through an assessment of relevant literature and personal communication with experts associated with several CAI and CMI projects in the United States.

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SUMMARY

Problem

This review examines the evidence which bears on the issue of whether contact with computer-based instruction leads to feelings of "depersonalization" or "dehumanization."

Approach

The approach is to document investigations which employ the larger construct of "attitudes" toward various modes of computer-based instruction which are found to be held by students and instructors before, during, or after exposure to computer-based instruction. Evaluation of pertinent factors which influence attitudes was made through an assessment of relevant literature and personal communication with experts associated with several computer-assisted instruction and computer-managed instruction projects in the United States.

Results

This report contains displays, in the form of tables, of appropriate studies grouped according to the duration of computer-based instruction provided and identifies student and instructor variables. Recommendations which have potential impact on the acceptance and implementation of computer-based systems are also discussed.

Conclusions

The evidence indicates that computer-based instruction is not a threat to humanization. In fact, with proper utilization it can provide opportunities for increasing the effectiveness and personalization of the instructor-student relationship. Since students' initial attitudes toward computer-based instruction are apt to be positive, the focus of any computer-based instructional system should be to sustain and enhance this positiveness. Instructors appear to have initially less favorable attitudes toward computer-based instruction, and any growing enthusiasm seems to be directly proportional to the amount of administrative burdens relieved by the computer and how much time it saves the instructor.

PREFACE

This study was performed in the Technical Training Division, Air Force Human Resources Laboratory (AFSC), under project 1121, Technical Training Development; task 112102, Application of Computers in Air Force Educational and Training Systems. Ms. Anne Truscott King was the project scientist.

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*Each of these individuals contributed through personal communication. The asterisks indicate that the information obtained was utilized within the context of this report.

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I. INTRODUCTION

As with any new technology, the rationale for developing an adaptive computer-based instructional system can be the subject of intensive questioning regarding feasibility, effectiveness, efficiency, and cost. Computer applications have been steadily growing—especially within DOD—and computer-based instruction (CBI), which includes both computer-assisted instruction (CAI) and computer-managed instruction (CMI), currently is being examined for use in the administration and management of large scale individualized instructi. :. One of the concerns which is expressed by observers and investigators of CBI is whether contact with computer-based instruction leads to feelings of depersonalization or dehumanization. This consideration is of particular interest to the Air Force because of its investment in the Advanced Instructional System (AIS).[1] Therefore, it is anticipated that by identifying specific variables which have potential for impacting on student or instructor reactions toward CBI, the managers of such computer-based systems as the AIS will be able to maximize the positive components and alleviate any negative factors.

The opinion that students and instructors are negative to CBI is widely held and frequently expressed by training managers at all levels. This reaction appears to stem initially from the literature on programmed instruction (PI)[2] as exemplified by Roth (1963), Nelson (1967), and Frey, Shimabukuro, and Woodruff (1967), which indicates that, when compared to traditional instruction, PI often elicits feelings of boredom and mechanization (Table 1). The problems with PI may be summarized by noting that low quality courseware development has been identified as the most probable culprit (Mathis, Smith, & Hansen, 1970). In substantiating the fact that it is not the PI *format* which illicits negative attitudes, some literature (e.g., Nelson, 1967) indicates that PI materials have been preferred to conventional ones when courseware is prepared which is interesting, not too repetitious, and does not insult the intelligence of students. At any rate, it appears that the popular media have focused on the negative affect toward PI as testimony to support the thesis that technology in general, and computer-based technology in particular, is "dehumanizing" and "depersonalizing" (Oettinger, 1969). The purpose of this report is to examine the evidence, both pro and con, which bears on this thesis.

II. APPROACH

Documentation is compiled from investigations which employ the larger construct of "attitudes" toward various modes of computer-based instruction which are found to be held by students and instructors before, during, or after exposure to CBI. Assessment of relevant factors which influence attitudes was made through a review of extant literature and personal communication with experts associated with various CAI and CMI projects in the United States.

In systematically investigating the educational, psychological, technological, and computer literature for this review, it became apparent that there were a number of methodological issues which cloud the picture. In addition to a lack of operationally defined measures of student affect toward instructional modes, administering attitudinal measures has not been a part of the traditional experimental design (scarcely 10% of the studies examined reported such measures). Each of the main centers for exploring CAI or CMI has been pursuing its own particular research interest (e.g., Florida State University—trait and state

[1] AIS – The AIS is a prototype computer-based multimedia system for the administration and management of individualized technical training on a large scale. Individualization is achieved through the Adaptive Model—a set of computer algorithms which match student characteristics with available instructional strategies and resources. (cf. Rockway & Yasutake, 1974).

[2] PI (Programmed Instruction) – A student centered method of instruction which achieves criterion-based objectives through planned incremental learning steps; these steps typically followed by self-test situations requiring the student to respond to the instructional presentation. The instructional information may be presented in a printed text format or an audio visual/workbook format. Other modes of presentation are utilized, but, for the purposes of this discussion, only paper and pencil formats are considered under PI.

Table 1. Synopsis of Literature on Student Attitudes Toward Programmed Instruction (PI)

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	Attitudes End	Comments
Doty & Doty	1964	PI/North Central College Illinois	Psychology	Undergrads males and females	100	ND	2 weeks	ND	+	High positive correlation between GPA and attitude toward PI (r= .71) and between PI achievement and attitude (r= .40) for female Ss; no sig correlations for male Ss.
Eigen	1963	PI	Verbal	High school males	39/72	30 minutes	293 minutes	ND	Mixed	Ss attitudes toward method of learning bore no relationship to how much was learned—thus validity of making administrative decisions on basis of attitudes can be questioned.
Frey, Shimabukuro, Woodruff	1967	PI	General Science	8th graders	74	ND	2 semesters	+	—	Ss favorable during 1st semester, then attitude changed significantly (.01) over 2nd semester. However, no indication as to teachers attitude and part her behavior might have played.
Harding and Fleischman	1967	PI/Navy	Aviation Mechanics	Navy & Marine	347	4 hours	32.5 hours	ND	+	No differences found between 4 aptitude groups in attitudes toward PI. (No aptitude by attitude interaction affect.) Attributed to self-pacing aspect of PI.
Lublin	1965	PI/Penn State	Psych course	Undergrads	219	ND	1 semester	ND	Mixed	3 schedules of reinforcement. Continuous R+ and No R+ groups most unfavorable toward PI text. However, Holland & Skinner's *Analysis of Behavior* text has been described in a study by Banta, 1963, as inferior. No interaction effect between schedules of R+ and aptitude.
Neidt & Sjorgren	1968	PI	Verbal	Undergrads	837, 230, 533	ND	1 semester	+	Neutral	Attitude scale administered 5 times. Constant decline in the mean score from the 1st to 5th administration. May have been Hawthorne effect wearing off.
Nelson	1967	PI	Music	Non-Music majors	300	ND	1 semester	ND	+	Preferred programmed material to conventional ones.
Roth	1963	PI	Verbal	Freshman & grad students	24 26	ND	1 semester	+	—	"tedious and repetitious" "mechanized, non-thought provoking"

NOTE. — ND = No data.
+ = Positive attitude.
— = Negative attitude.

anxiety, State University of New York—individual differences, Pennsylvania State—feedback, etc.) and, therefore, has not consistently examined in detail the issue of attitudes.

Even when attitudinal indices are reported, most studies use experimenter-constructed tests which have unknown or unreported reliabilities. Only one investigator (Brown, 1966) has developed a Likert-type attitude scale with demonstrated test-retest reliability (.89) and several researchers have now begun to utilize what has come to be called the "Brown Scale" (e.g., Mathis *et al.*, 1970; Summerlin, 1971) or modifications thereof (e.g., Smith, Hansen, & Hedl, 1968). Studies which employ various other attitude measures, such as semantic differential, self report, interview, or behavior rating are occasionally reported.

Because of the paucity of controlled experiments found in the literature, the reader is urged to approach any conclusions with caution. He should be warned that many of the results provided by this review may be suggestive of reality only under specific conditions and have limited transferability. That is, the results may be heavily dependent upon such uncontrolled aspects of the educational environment as content of course, instructor's behavior and attitude, general skill of the computer program encountered, and/or responsiveness and reliability of the hardware.

Stability of attitudes, another important methodological consideration, has not been dealt with directly in the literature, but certain summary features can be deduced from the available information. Within those studies which have assessed attitudes prior to any CBI experience as well as after, one group of subjects moved from a negative stance to a positive one (Lahey, Hurlock, & McCann, 1973); four began with positive opinions and did not change (Cerutti, Brubaker, & Littler, 1969; Rothbart & Steinberg, 1971; Smith & Hess, 1972; Sterritt, 1971); two moved from an initially favorable stance to an even increased positive position (Mathis, Smith, & Hansen, 1970; Sherman & Klare, 1970); and no study showed a decrement in attitudes after exposure to CBI.

To fully determine how stable attitudes are, however, measures need to be administered just after the initial exposure to CBI and again, on the same subjects, after considerable experience. Avner, at the University of Illinois (personal communication), indicated that he has taken precisely such measures and that student opinions are well determined after only one hour of exposure to PLATO.[3] An attitude questionnaire was administered before exposure to PLATO, immediately following the first PLATO class, and again after 5 to 12 sessions on PLATO. This questionnaire asked 170 students to rate the effect on education that they thought PLATO would have. No significant differences in overall mean ratings were observed between the three assessments and the high correlation between the averages of the second and final measures ($r = .89$, 8 df., $p = .0001$) attests to attitude stability.

Contained in this report are: (1) a brief summary of findings from the literature and from personal communications with specialists in the fields of CAI and CMI, (2) displays, in the form of tables, of appropriate studies grouped according to the duration of computer-based instruction provided, and (3) identification of student and instructor variables with attending recommendations which have potential impact on acceptance and implementation of CBI systems.

III. STUDENT ATTITUDES

For the purposes of this report, the variables which generate positive and negative affect toward CBI have been classified into two categories: (1) *system variables*, which have to do with hardware and programmable aspects of the CBI-student interaction and (2) *individual difference variables*, which are subject to the vicissitudes of trait and state personality characteristics and which effect student knowledge or feelings of competency. System variables are those factors which, when positive, make the computer seem fairer, clearer, likeable, and inspire confidence in its expertise; but, when negative, produce complaints of inadequate access, excessive down time, slow or erratic response time, etc. Individual difference variables are those factors which have a base of literature of their own and which may have an interactive effect

[3]PLATO stands for Programmed Logic for Automated Teaching Operations. It is a computer-based instructional system which is under development at the University of Illinois. For a detailed description see Green, 1973.

when examined within CBI. Within this category, knowledge or competency variables connote experience factors which, when positive, develop an appreciation of computer products, an understanding of the speed and power of computers, and a sense of triumph over machines; but, when negative, develop complaints of ineffective training, difficulties with CBI interactions, etc. Summaries of student attitudes toward CBI are depicted in Tables 2 through 5.

CBI System Variables

Immediate Feedback and Reinforcement. Although the influence of immediate feedback at times appears in the literature to be a settled issue, it continues to be stressed by investigators as an important contributer to positive feelings toward CBI (e.g., Brown & Gilman, 1969). Feedback helps to maintain the feeling that the student is in an interactive process with the computer as well as being a positive indicator that the student is progressing as expected by giving information about the subject matter and rewarding the student for correct responses (Borman, 1969b). In a study which examined students' attitudes toward CAI instruction as a function of type of feedback used to correct student errors, Gilman (1969) found no significant differences in attitudes between five types of feedback (which included a zero feedback mode). Although it is acknowledged that the issues of feedback and reinforcement are intimately associated and only artificially dealt with discretely, the case for reinforcement is not so clear. In a study of attitudes and reinforcement under PI mode, Lublin (1965) found the continuous reinforcement and no reinforcement groups to be the most unfavorable toward PI, regardless of student aptitude. It is suggested that the issues involving amount and kind of reinforcement continue to be pursued until clarification can be obtained within both the PI and CBI instructional modes.

Computer Acceptance of Alternative Correct Responses. It is a source of identifiable frustration when the student makes a trivial mistake at the console while typing a short constructed response (such as leaving out a blank space between words, typing a period, comma, or other punctuation in the wrong place) and the computer assesses the answer as wrong (Borman, 1969a, 1969b; Sedlak, Borman, & Cartwright, 1972; Wodtke, Mitzel, & Brown, 1965). It is suggested that great flexibility in recognizing correct responses, including misspellings and partial answers, be programmed into any computer-based system. Keeping a running log of all answers deemed incorrect by the computer will facilitate examination by the instructor at regular intervals so that the list of acceptable alternative responses can be updated as new variations appear.

Response Time. This is an interactive variable with two distinct aspects of enormous significance to the formation of student attitudes. The first aspect is how rapidly the computer responds—that is, how fast does it answer a single query and how rapidly does it fill the screen with textual or graphics material? Mitzel and Wodtke (1965) indicate that students tend to become confused if the computer does not respond immediately. This is confirmed by phenomenological evidence from Avner (personal communication), which indicates that any perceived lags or distortions in the time it takes for specific interactions will be found to be irritating and that students adapt to a long response time by displaying distracting behavior. They do not follow the text line by line as it emerges on the screen, but let the whole appear before examining it. This avoidance of looking at the text until it "settles down" is true with both CRT and teletype. It may prove useful within CBI to monitor just what the student does during such times (e.g., does the student choose to time-share himself by switching to another task, becoming distracted, reviewing material, just waiting, etc.)

The other aspect of computer response time is the amount of time given the student to respond to a particular question. Hedl, O'Neil, & Hansen (1971) found that some students indicate that they are not allowed enough time to type certain responses and other investigators (e.g., Wodtke, Mitzel, & Brown, 1965) suggest that perhaps the computer responds too rapidly after a student response, so that consolidation of the newly acquired material does not have time to take place. As Wodtke, Mitzel, and Brown (1965) state, "Although the system is in theory student paced, the immediate presentation of the next question following a correct answer (actually) paces the student." It may be that computer-based systems could profitably distinguish between these two kinds of activities and investigate varying the time parameter. In examining this variable, it should be noted that unpredictable response times have been found to be particularly disturbing (Carbonell, Elkind, & Nickerson, 1968) and users seem to prefer a constant delay to a possibly shorter, but variable one.

Downtime. It is understandable that one of the most pervasive of all problems with CBI, equipment failure or "downtime," can be a salient source of discontent. The most commonly expressed reaction to

Table 2. Synopsis of Literature on Student Attitudes Toward Computer-Based Technology: Short Term Studies (One Session)

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	Attitudes End	Comments
Brown & Gilman	1969	CAI/Penn State Univ	Quantitative	9th, 10th graders	66	ND	1 session	ND	+	Brown scale-Attitudes toward CAI higher than for programmed texts. No sig differences on test performance.
Conord	1970	CAI/Naval Academy	Use of oscilloscope	Naval Academy	70/100	1 hour & 50 minutes	1 session	ND	+	The slower student benefited most. He had no one peeking over his shoulder and felt more relaxed.
Gilman	1969	CAI/Indiana State U	Science	Undergrads	75	ND	1 session	ND	ND	Investigated students' attitude toward instruction as function of type of feedback used to correct errors. No sig. differences in attitudes were found for the five feedback modes.
Hedl, O'Neil Hansen	1971	CAI/FSU	Intro Psych	Undergrads	48	50 minutes	1 session	ND	Mixed	As anxiety state scores increased, student attitudes toward computer testing experience decreased.
Mathis, Smith, Hansen	1970	CAI/FSU	Verbal	Intro Psych	42/64	45 minutes	1 session	+	+	"Futurized" modification of Brown Attitude Scale, Ss generally positive, but CAI experienced Ss were more positive. Ss who made many errors were less positive.
Sheldon	1970	CAI/FSU	Math	Undergrads	29	90 minutes	1 session	ND	+	"Interesting and effective" Some expressed apprehension concerning machine grading.
Sherman & Klare	1970	CAI/Harvard	Verbal	Adult Basic Educ	40	15 minutes	1 session	+	+	"Experience appears to reduce uncertainty and made Ss more positive."
Wodtke, Mitzel, Brown	1965	CAI/Penn State	Quantitative	Undergrads	47	Attitudes assessed after one session	ND	ND	Mixed	Semantic differential given after first session with CAI (N=31). Ss found experience "interesting, good, fair, valuable, and active . . . reported being relatively tense as opposed to relaxed, finding the program inflexible, and missing opportunities for discussion."

NOTE. – ND = No data.
+ = Positive attitude.
– = Negative attitude.

Table 3. Synopsis of Literature on Attitudes of Students Toward Computer-Based Technology: Intermediate Length of Study

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	End	Comments
Bruha	1970	CAI/AFATC Intelligence	CONADAF File System	ND	2 hours	ND	5 days-30 hours	ND	83% positive	Successful use of CAI in an On-the-Job Training program within an operational environment using existing second generation computer equipment.
Cerutti, Brubaker, Littler	1969	BASIC/Cabrillo School Dist, California	Verbal & quanitative	High school	ND	ND	5 weeks	+	+	Computer proved to be motivator for students who were underachievers and potential dropouts.
Hurlock & Hurlock	1973	CAI/NPTRL	Electronics	Navy	75	5-1/2 hrs per day	5 days	ND	73% positive	"Students who trained with a Partner tended to rate CAI lower ($\overline{X}$ = 3.6) than students who trained alone ($\overline{X}$ = 4.2)" (out of 5 points).
Lahey, Hurlock, McCann	1973	CAI/NPTRL	Electronics	Navy	108	ND	11 lessons approx 10 hours	–	79% positive	Initially negative-concerned they would get behind classmates. "Students chose student controlled over program controlled training by a ratio of 4:1; independent of how they rated CAI."
Long, Murphy, Wengert	1968	CAI/IBM	Theories of Data Processing	High school & college	138	50-100 min.	ND	ND	85% positive 9% negative	"seemed to work faster"
Longo	1972	CAI/Army Signal Center	Electronics	Army	142	ND	4 weeks 102 hours	ND	+	22 Likert items. Persistent pro-CAI attitude maintained by the CAI students despite a shift in training methods from CAI to conventional instruction.
McCann, Lahey, Hurlock	1973	CAI/NPTRL	Basic Electronics	Navy	96	ND	11 lessons approx 10 hours	ND	+	"Students who selected their own training maintained a sig. more favorable attitude."
McCombs, et al	1973	Media-managed	Weather	Undergrad pilots	26	ND	16-22 hours	ND	+	Attitudes toward course higher for media adjunct program than for traditional instruction. Do not feel isolated or alone.
Reid, Palmer, Whitlock & Jones	1973	CAI/Austin Texas	Math	College	182	ND	80 minutes computer time	+	ND	Subjects worked in pairs. Pre & post attitude toward CAI measured with Sutter's (1967) CAI-Math Attitudes Survey. Prior attitudes just above neutral point, indicating slightly positive stance. Post attitude scores not reported.

Table 3. (Continued)

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	End	Comments
Rosenberg Reznikoff, Stroebel & Ericson	1967	ND	Automated note taking	Nurses	26/54	ND	3 Months	+	+	More favorable after *actual contact* with computer.
Scanland	1970	CAI/FSU	Verbal	Rural Negro adults	22/67	1 hour per week	6 weeks	ND	+	Enthusiastic, complete involvement, after initial timidity, no one missed a class "continuous paper feed , . . proved to be especially appealing device . . . not only for purposes of review and record, but as 'evidence' of their involvement . . ."
Smith	1973	Remedial CAI/SCRDT	Math	Junior high low SES	115/240	10 minutes 3 hours	11 weeks	ND	+	Suppes' program for remedial drill & practice. Instruments pre- and post-tested: Sears Self-Concept Inventory, Coopersmith Self-Esteem Inventory, Crandall Locus of Control Instrument. CAI seems to facilitate realistic student attitudes and avoids fear of failure. Study contradicts thesis of dehumanizing influence of computer technology as no decreases in student attitudes on above instruments from pretest to posttest were observed.
Summerlin	1971	CAI/FSU	Chemistry	High school	ND	45 min up to 3-4 hours	2 weeks	ND	+	Brown Attitude questionnaire—"even though they felt that CAI was superior to traditional instruction, most students indicated that they would *prefer* traditional instruction . . . teacher has a *personality* . . ."

Note. — ND = No data.
+ = Positive attitude.
— = Negative attitude.

Table 4. Synopsis of Literature on Attitudes of Students Toward Computer-Based Technology: Long Term Studies (at least one semester)

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	Attitudes End	Comments
Cieri	1970	CAI/Army Signal Center	Electronics	Army	278	ND	78 Hours of course matter	ND	+	Favorable attitudes persist even after prolonged interaction with CAI and after return to conventional instruction. "You are given more individual attention . . ."
Cupl & Castleberry	1971	CAI/Texas U	Organic chemistry	Undergrads	55/110	30-45 min	1 semester	ND	+	"CAI group consistently indicated greater positive opinion for CAI-type assistance over teaching assistance."
Ford, Slough, Hurlock	1972	CAI/NPTRL	Electronics	Navy	760 (50 long term CAI)	ND	10,197 terminal hours	ND	+ $\overline{X}$=4.4 on a 5 pt. scale	Students would prefer to have about 70-80% of their instruction via CAI. Long term CAI produced an even greater increase in preference for CAI.
Halley	1972	CMI/State Univ of NY	Statistics	Undergrads	141	ND	1 semester	ND	62% positive 35% negative	Negative reaction may be function of course content. On a 5-point scale from "very personal" to "very impersonal" the responses were evenly distributed across all 5 categories.
Hess & Tanezakis	1973	CAI/SCRDT	Drill & practice arith-metic	Junior High low SES	50/189	ND	1-2 years	ND	+	Semantic differential—terms favorable toward CAI selected by both CAI and Non-CAI experience groups (e.g., fairer, easier, clearer, better). Term, "computer" seemed to inspire confidence about its general expertise.
Judd, Bunderson, & Bessent	1970	CAI/Austin Texas	Quantitative	Freshmen	58	1-2 hours	1 semester	ND	+	"Students working on CRT terminals were more favorable . . .than those working on typewriter." Although the rate or presentation was identical Ss perceived the typewriter terminals as slower.
Sachman	1973a	CAI/AF Academy	Computer Science	AF Cadets	415	15 minutes	1 semester	ND	+	Time-sharing consistently preferred ("greater challenge . . .heightened creativity . . .debugging") Batch mode viewed as easier to learn, better for coding.
Smith & Hess	1972	CAI/SCRDT	Drill & practice math	Junior high school low SES	159/320	ND	2 years	+	+	CAI promoted realistic attitudes toward math. Did not prove dehumanizing.

Table 4. (Continued)

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	Attitudes End	Comments
Suiter & Reid	1969	CAI/Austin, Texas	Math problem solving	Undergrads males	82/100	2 hours	2 semesters	ND	Mixed	Attitude measures taken before and after exposure to CAI, but before measures were not reported. High anxiety Ss were negative. High dominant Ss were negative when working in pairs. High submissives were positive. High dominant were positive when working alone.

Note. – ND = No data.
+ = Positive attitude.

Table 5. Synopsis of Literature on Attitudes of Students Toward Computer-Based Technology: Length of Study Undetermined

Author	Year	Type of Program or Language/ Institution	Type of Content	Type of Subjects	Number of Subjects CAI/Total	Average Length of Exposure per Session	Length of Study	Attitudes Beginning	End	Comments
Boblick	1971	CAI/FSU	Physics	High school	ND	ND	ND	ND	77% positive 5% negative	Positive attitude attributed to program requiring student to be active participant.
Borman	1970	CAI/Penn State	Inservice Math course	Elementary school teachers	89,63,89	ND	ND	ND	+	Low correlation between attitude and achievement scores (r= .08) and between attitude and time to complete the CAI course (r= –.02) Therefore, both high and low achievers expressed favorable opinions.
Hagerty	1970	CMI/FSU	Verbal	Graduates	59	ND	ND	ND	+	"Students who chose their own sequence tended to perform better than the set-sequence group . . .also had higher attitude scores toward CMI and took less time . . ."
Rothbart . & Steinberg	1971	PLATO/ Illinois	Drill & practice verbal & quanti-	K-6th grades	ND	Up to 45 min.	ND	+	+	Child reacted to "no" or "wrong" on the CBT screen by erasing it, therefore ignoring the further comments on how to correct his mistakes. Program was changed to writing "you goofed" and Ss stayed with screen to receive further instructions.
Sedlak, Borman, Cartwright	1972	CAI/Penn State	Special Education course	Inservice Teachers	317	ND	ND	ND	+	Open ended comments could be made to each item of Brown Scale-used to help pinpoint areas to be improved. Major negative aspects identified and later corrected included: malfunctioning of equipment, scheduling problems, and lack of alternative correct responses.
Sterritt	1971	CAI/Mc-Clellan Learning Inst	Drill practice math & spelling	1st & 5th grades	80	15 minutes	ND	+	+	Makes access to CAI a reward for learning: instant feedback seems to influence Ss to be more accurate. " . . .the computer has in no way depersonalized our teaching or weakened our relationships with students. Instead it has given us more time to spend helping each student individually."

Note. – ND = No data.
+ = Positive attitude.

such interruptions is disappointment when the prevailing attitude is positive (Smith, 1973) and intense annoyance when the general attitude is negative (Sackman, 1973b). Stolurow (personal communication) and Mitzel (personal communication) both identify downtime as a system variable which is clearly responsible for generating negative attitudes toward the system. However, both Mitzel and Hansen (personal communication) indicated that despite complaints about trouble with the terminal, students come back for another course. As Hansen put it, CBI system users are incredibly resilient—even with as much as fifty percent downtime, students return for more. It may be that users assess the computer as helpful where it really counts; e.g., in contributing to successful problem solving (Sackman, 1973a) and that, if highly efficient manual backup procedures are available, the negative aspects of any interruption can be mitigated.

Variables Subject to Individual Differences

Individual Performance in Relation to Peer Performance. Summerlin (1971) reports that a majority of the students (87%) in her study were concerned that they might not be understanding the course material as well as their peers understood it, even though preliminary checks indicated that they were doing quite well on an absolute scale. Hansen (1969) reported similar results with a computer-based sequential testing program in science in which 77% of the students felt uncertain about their performance relative to the performance of others. It seems that, traditionally, the entire classroom atmosphere provides the student with the barometer he uses to gauge his success or failure, and it is possible that the student taking computer-based courses becomes frustrated when he cannot estimate his usual position in the classroom pecking order. Since the literature offered few insights into this phenomenon, contacts were made with several investigators in major CAI projects. The question asked of these researchers was, "Is it necessary for students to know how they are performing in relation to their classmates and, if so, what is the best way to present this information?"

Hansen (personal communication) responded by indicating that as long as a computer-based system is operating in a mastery oriented framework, where the objective is mastery of material as evidenced by passing tests, the problem of peer hierarchy is not as acute as it might be in a civilian atmosphere where a large component of classroom behavior is "psyching out the teacher" and establishing a pecking order. Hansen suggests that sufficient information can be given to the student through "reality oriented feedback." This information indicates whether or not the student is "on track," "on time," and "passing" and, in the CAI systems with which Hansen has worked, seems to obviate any desire of the students to find out where they are in relation to other students. Bunderson (personal communication) stated that, if the CBI system is courteous and efficient, and the interactions such that the individual student feels successful, is achieving, and progressing as expected, student attitudes will be positive. His solution to keeping the student informed is to have a "status display" of information, which is pertinent to the students' goals, available at all times. Bunderson further suggests that not everyone needs group information in order to be comfortable with his own progress, such that individual differences in personality can be observed. More importantly, if complete group information is made available even anonymously (e.g., listings of test scores without further identifying information), how will this information effect the bottom student? Even if individual success is legislated, someone will be on the bottom of some contiuum (e.g., on a time scale), and Bunderson feels that "it's important not to build up counter-productive social mores,"—especially when they are not necessary within the CBI framework.

Learner Control. Several studies have found that favorable attitudes are maintained by students who select their own training (e.g., McCann, Lahey, & Hurlock, 1973) and that, independent of attitude toward instructional mode, students will choose learner control over program control by a ratio of 4:1 (Lahey, Hurlock, & McCann, 1973). However, empirical studies have failed to confirm that students under learner control exhibit significantly better performance (cf., Judd, O'Neil, & Spelt, 1974); so that, in some circles, the question of learner control is moot. Even with respect to expressed attitudes toward tasks under learner control or program control, Judd, Bunderson, and Bessent (1970) and Olivier (1971) have found no significant differences. The issue of learner control is further confounded because the literature indicates little consensus even as to a proper empirical definition—to some investigators, having learner control provides a choice in virtually every instructional decision to be made; whereas, to others, learner control may mean simply having access to additional examples or practice items. Since the system overhead costs for program control are substantial, learner control continues to be an attractive alternative—but it has yet to be proven to be significantly influential on attitudes or performance.

Recent literature suggests that individual differences may be an important consideration in the effectiveness of learner control on performance measures. Fry (1971) found that, as a main effect, his learner control group demonstrated poorer performance on the post-test than did the linear or randomly sequenced groups. However, an examination of possible interaction effects indicated that students who scored high on the aptitude and inquisitiveness scales had significantly higher post-test scores ($p < .05$) under the learner control conditions. Training or experience also seems to maximize any positive effect of learner control. For example, subjects who have had previous experience with learner control are more likely to choose learner control when given an option (Pascal, 1971). In a military setting, this variable may not be of paramount concern, since student expectations probably would not be violated by lack of learner control. However, it may be beneficial to examine this issue since it may prove highly motivating to students to experience a sense of autonomy in an otherwise rather unyielding environment.

Anxiety. Satisfaction with any CBI system implies that the user (student or instructor) manifests a positive attitude toward the instructional mode and has a low level of anxiety toward the mechanized properties of the mode. A conceptual distinction has been made in the literature between *trait* anxiety and *state* anxiety (McCombs *et al.*, 1974; O'Neil, Spielberger, & Hansen, 1969; Speilberger, 1970). *State* anxiety refers to a transitory state or condition that is characterized by feelings of tension and apprehension; whereas, *trait* anxiety implies an individual difference of anxiety proneness; i.e., the disposition to respond with elevated state anxiety under conditions which might be characterized by some threat to self-esteem. Studies which have examined state anxiety report results which confirm what would be expected intuitively: O'Neil, Spielberger, and Hansen (1969) found that students whose state anxiety was high during the presentation of learning materials via a CAI system made more errors in the difficult portion of the task than the less anxious students, but did just as well in the easier portions of the task; Hedl, O'Neil, and Hansen (1971) in a comparison of anxiety and attitude reactions to computer-based administration of an intelligence test found that state anxiety scores were significantly higher in the computer testing situation, but decreased across three testing sessions. Generally, researchers support the finding of these two studies that a direct relationship exists between state anxiety scores and attitudes—as state anxiety scores increase, attitudes toward the computer experience decrease. Such consistent reports in the literature indicate that, in any CBI setting, anxiety should be monitored and a concerted program should be instituted to alleviate potentially stressful aspects of the environment.

In addition to measurable aspects of anxiety, some investigators note that some students express a *need for* an *instructor* to explain and discuss course material with them (Borman, 1969b; Summerlin, 1971; Wodtke, Mitzel, & Brown, 1965). Perhaps, as has been suggested by Schwartz and Long (1967), the desire for assistance from an instructor is analagous to a "fire escape"—the instructor may not be needed very frequently or for long periods, but when he is needed, students feel acutely that it is important that he be available immediately. This need for human assistance, when course material problems are encountered, may be counterbalanced, however, by other feelings which have been expressed by seemingly anxious and tranquil students alike—that avoiding subjective evaluations (Hess & Tenezakis, 1973) and not having instructor-student interactions within a traditional classroom setting (Smith, 1973) can help to allay the fear of failure and can be one of the particular advantages of CBI.

Of course, *experience with CBI* should prove to be a major component in reducing anxiety and contributing to a positive stance toward the CBI experience. Though few in number, those studies which report attitudinal indices taken before and after experience with CBI show that students are initially neutral to slightly positive (e.g., Cerutti, Brubaker, & Littler, 1969; Smith & Hess, 1972) and that actual experience makes attitudes even more positive (e.g., Mathis, Smith, & Hansen, 1970; Rosenberg *et al.*, 1967; Sherman & Klare, 1970). Any initial negativity (e.g., Lahey, Hurlock, & McCann, 1973) is directly related to specific apprehensions, such as concern about performance (Rosenberg *et al.*, 1967) which can be assessed and mitigated through an orientation process or dissipated through actual experience with the system.

Most studies which have administered attitude measures have done so after experience with CBI and the aggregate of this evidence is unequivocal: students enjoy interactions with computers. The flavor of this enjoyment can be observed in these two representative statements:

> "Many tried to slip back into class . . .tried to go through the CAI program for a second time . . .most students elected to review, when they were given an option to review or continue . . .even gave incorrect answers occasionally, in order to receive the supplementary material . . .would repeat graphics as many as 10 or 15 times . . ."
>
> Summerlin (1971)

"...overwhelming enthusiasm for the CAI program on the part of beginning as well as second-year participants...welcomed the change from the classroom routine, were prompt in attendance..."

Smith and Hess (1972)

Antithetical to such feelings of enthusiasm would be feelings of isolation or boredom. Specific examinations of the hypothesis that interactions with CBI might instill sensations of isolation, boredom, or depersonalization (e.g., Mathis, Smith, & Hansen, 1970; McCombs *et al.*, 1973; Smith & Hess, 1972; Sterritt, 1971) provide substantial evidence to refute such a contention. Skeptics may question that this evidence may be confounded by the effect that amount of CBI experience or the amount learned may have.

The first variable, *length of experience*, seems to have little consequence on attitudes, since examination of long term use of CBI (cf., Cieri, 1970; Ford, Slough, & Hurlock, 1972, in Table 4) found sustained, positive attitudes among students. Further evidence that positive attitudes are not a function of the newness of the CBI experience, comes from a study by Linder and Whitehurst (1973) who assessed "novelty effect" by examining the relationship between the number of personalized courses elected to be taken concurrently and attitudes toward personalized courses. The investigators found, with an N of 713 college students, that the data did not support the novelty effect hypothesis, since the number of personalized courses taken concurrently was not predictive of student attitudes.

The answer to the question of whether the *amount learned* influences student attitudes is also clearly, "no." Doty and Doty (1964), and Eigen (1963) found that achievement with PI modes bore no relationship to attitudes toward mode of instruction. Within CAI, Borman (1970) corroborates this evidence by finding a non-significant and very low correlation (.08) between attitude and achievement and, for that matter, between attitude and time to completion ($r = -.02$). Interestingly, none of the articles examined indicated a significant aptitude by attitude interaction, although only one study (Harding & Fleishman, 1967) addressed this issue specifically.

Level of Performance. Level of performance is closely related to the variable which has just been discussed, amount learned. However, these two factors may be distinguished as the micro and macro aspects of the measurement of learning continuum: level of performance is measured by the item to item progress of the student; whereas, the amount learned is measured by his level of mastery at the end of the course. Attitudes toward CBI seem to be related directly to personal performance (Mitzel & Wodtke, 1965), such that those who perform well are more favorable toward CBI than those who perform poorly. Throughout the literature, indications are that those students who make the fewest errors show the greatest increase in positiveness (e.g., Mathis, Smith, & Hansen, 1970). Further, Mitzel (personal communication) and Conord (1970) suggest that disadvantaged or slower students like CBI best—perhaps because they are achieving consistent success for the first time after a history of failure. Bunderson (personal communication) reiterates that success, achievement, and progress are the most important features of CBI and positive attitudes will follow. The recommendation which emerges from this assessment is one which any computer-based system needs to implement: legislate success, especially at the beginning of the student's experience with CBI, through adaptive models and sensitive testing procedures which identify an optimal level for entry and progression.

Volunteerism versus Non-Volunteerism. Judd at the University of Texas, Austin, (personal communication) indicated that studies he has conducted, which looked at the effect of being a volunteer or non-volunteer for working with CAI, found that volunteers are highly positive at the beginning, but decrease in positiveness over time. Judd attributes this decrease to ceiling effects, since the initial assessment of attitudes is 9 plus on a 10 point scale, there is no place to go but downward. Non-volunteers, however, have quite stationary attitudes which remain slightly positive. The implication for any computer-based system is that assignment of students to specific instructional systems can be made without having to consider whether being a non-volunteer will have an increasingly negative impact on a student's opinion of the mode.

Orientation and Initial Contact. Most of the researchers who address the issue suggest that systematic orientation to CBI is the most feasible way to elicit initially positive attitudes, since the first contact is deemed to be critical in forming opinions (Longo, personal communication) and initial attitudes are difficult to change (e.g., Sackman, 1973b reported that 26% of the Air Force cadets held unfavorable attitudes toward computers in general as a result of an introductory course in CAI). Wodtke, Mitzel, and Brown (1965) used a semantic differential to determine that students report feeling relatively tense as opposed to relaxed and attributed this finding to the fact that some students feel that they may do something wrong or break the machine.

An orientation program should help to overcome such feelings of "machine shyness." In support of contentions that even a short orientation is important to establishing initially positive feelings, Sherman and Klare (1970) note that attitude scores for students who received a 15-minute introduction to the terminal were significantly higher (beyond .01 level) than for those who did not receive any orientation. However, among others, Judd (personal communication) suggests that proponents of CBI should be careful not to oversell the system because students may enter into the system with high expectations and reality may prove disappointing. In addition to introducing the student to the general features of CBI, a formal orientation program may also mitigate feelings of apprehension or anxiety by directly addressing these issues.

IV. INSTRUCTOR CONSIDERATIONS

The opening sentence of an often cited article by Feldhusen and Szabo (1969) states, "If the teacher is the heart of the classroom, then surely Professors Suppes and Atkinson have performed one of the first transplants in the field of education." There is a danger in passing over this type of metaphor without assessing the inherent implication—the assumption that the teacher will be (or is being) replaced as some kind of useless appendage as soon as CBI becomes widely available. If instructor morale and motivation is to be maintained at an acceptable level, this sentiment cannot be fostered, either through administrative edict or through instructor misinformation. Of course, instructional roles or functions will be changed by CBI; but just as the widespread availability of inexpensive books did not make instructors obsolete, so the advent of even extensive use of CBI will not supersede all instructional skills. However, the task of determining just which teaching behaviors will change, and how many and what kind of skills will be altered, is only beginning to be addressed. Some suggestions about what can be anticipated are made in the literature, but hard data are not yet available. For the purpose of this discussion, the term "roles" can be assumed to mean and to include the specific teaching behaviors, constellation of behaviors, or subfunctions which constitute the daily regime of a teacher or instructor.

Teaching Behaviors

Some investigators maintain that "individualizing instruction is more, not less, demanding than conventional . . ." (Mitzel *et al.*, 1971) and that "the teacher's role is likely to revolve around human relations, instructional strategies, construction of learning materials, and learning research" (Hansen & Harvey, 1970). It may be precipitous to attempt to formalize instructional behaviors while they are still in the process of evolving, but in order to prepare for possible consequences of role change, whatever information is available should be closely inspected and the ramifications of positive and negative affect associated with these changes should be anticipated (Table 6).

Few studies have examined *teaching behaviors* in such specificity as to determine differences between roles appropriate to traditional classrooms and roles appropriate to CBI classrooms. Enough observational data has been generated, however, to indicate that, frequently, the change in roles (and concomitant training) is *ad hoc* and not particularly well integrated (Flynn & Chadwick, 1970). Additionally, some of the roles identified in a civilian atmosphere have little or no transferability to a military environment, where control and structure can be very centrally located and differentiation in skills more pronounced. This section will concentrate on those potentially effected role areas which impact on a military environment, particularly Air Force technical training. Any areas of communality with civilian educational environments will not be highlighted, but assumed.

Two investigations (Flynn & Chadwick, 1970; Hill & Furst, 1969) detail projects which collected descriptive data about the role of the teacher in a CAI classroom as compared to roles in a more traditional setting. Hill and Furst in a high school setting used field observations, interviews, and a 35-item questionnaire in order to obtain data concerning: (1) initiation of questions by students, (2) teacher attention to individual students versus attention to the whole class, (3) amount of time spent in disciplinary actions, and (4) general teacher activity. Flynn and Chadwick used observational techniques and interviews to address similar issues with teachers from grades 1 through 12. Each of these studies gathered corroborative evidence concerning topics which should be of interest to future computer-based instructional systems:

1. Student-teacher interactions. The data from Hill and Furst indicated that students initiate more questions in the CAI classrooms. This was substantiated by the study of Flynn and Chadwick, which

Table 6. Synopsis of Literature on Attitudes of Teachers Toward Computer-Based Technology

Author	Year	Type of Program or Language/ Institution	Type of Subject	Number of Subjects	Length of Study	Attitudes Beginning	End	Comments
Coulson	1971	CMI/SDC	Teachers of first grade	9	2 years	ND	+	Supports Rosenthal's effect of expectancy. Especially liked remedial exercise materials and regular progress reports. "Teacher's enthusiasm . . .was directly proportional to the amount of work done for them by the computer, and inversely related to the amount of new work levied on them."
Hartley	1971	PI	Teachers	ND	Survey	Mixed & Uninter-pretable		Likert scaling-attitudes toward new media. Low internal consistency. (Test-retest r = .67) Number of "Socially desirable" responses high.
Koontz	1970	CAI/Naval Academy	Naval Academy Instructors	ND	15,000 terminal hours 100 courses	ND	+	Faculty – enthusiastic
Robardy	1972	CAI/Michigan State Univ	Teachers & Principals	256	Survey	ND	Mixed	Statistically significant positive relationship between knowledge and attitude.
Tobias	1968	City College NY	Teachers	179	Survey	ND	Mixed	Semantic differential. Teachers found to have significantly less favorable attitudes toward terms which connote automation.
Toggenburger	1973	Classroom Teacher Support System/Los Angeles School District	Teachers	300	ND	ND	+	Teachers rated system highly–state that it saves time & provides quality material.

Note. – ND = No data.
+ = Positive.

showed that students initiated 52% of the interactions with the teacher in an individualized system; whereas in the traditional classroom, the students initiated an average of only 34% of the interactions with the teacher. However, in the Hill and Furst study, student initiated questions tended to be primarily direction oriented, such as "How do I do this, or what do I do next?", rather than subject matter oriented. Under the primary modes of PI and CAI, the substance of student-instructor interactions should be monitored to determine what is, in fact, the ratio of process to content questions and whether the ratio effects how the instructor perceives his role.

2. Teacher attention. As would be expected, both studies support the observation that greater attention was given to individuals in the CAI classroom; whereas the whole class was the primary focus in non CAI interchanges. However, the qualitative components of the kinds of attention shown need to be examined: attention can be concerned with subject matter, with giving directions, or it can be on a more personal or affective plane. Of course, increased attention to individuals is one of the characteristics of CBI which should contribute to feelings of personalization, regardless of its qualitative aspects.

3. Discipline. Teachers perceived the high school CAI class as having fewer discipline problems, yet, observational data indicated no difference in the amount of discipline administered (Hill & Furst, 1969). Flynn and Chadwick (1970) observed significantly less corrective feedback in the on-line classes, but this may be partly a function of having fewer student-teacher interactions. Discipline within the classroom is not a significant problem in military technical training, but one can infer from this information that teachers felt that students were attending to the lesson material rather than engaging in disruptive behaviors. Certainly, increased attention is welcome in any educational setting.

4. Teacher activity. This heading may encompass an extensive set of variables which may be effected by the teacher's conception of his role: whether this role is clearly prescribed by the administration, or is largely one which the teacher himself devises or assumes.

Hill and Furst (1969) found that traditional classes seemed to require more activity from the instructor such as giving home work, grading papers, or lecturing, and that during the time in the CAI classes when no verbal interchanges took place, no clear pattern emerged concerning how the instructors spent their time. Flynn and Chadwick (1970) present a rather disturbing picture of a teacher, freed from traditional instructional tasks, tending to do mundane housekeeping and logistical chores. Of thirteen roles or behaviors identified by Flynn and Chadwick, five can be assessed as only marginally professional (i.e., taking roll, directing students' whereabouts, obtaining supplies and materials, cleaning equipment, and directing students to do logistical tasks such as getting supplies) and some additional behaviors can be appraised as not being particularly instructional (e.g., events coded as: "no observable relevant activity," less time in the management of cognitive activities, and less time asking questions.)

Some of this behavior indicates a lack of role clarity. Instructors seem to be unsure of what is expected of them and, therefore, their behaviors become less instructionally purposive and more "clerical." After interviewing 123 teachers in an individualized instruction system, Steward and Love (1970), concluded that anxiety was created by any unpredictable role change, but that when the role expectations of the instructors were confirmed, then they were comfortable, expressed a high level of satisfaction, felt no loss of status, and, although these teachers reported that extra effort was required in order to get used to the new system, the results seemed to be worth the effort involved.

Thus, it would appear that *role changes* are the most apparent disruption that the instructor faces under a CBI system. It follows that this will be the most obvious area in which new computer-based systems must plan to intervene in order to insure successful conversion to a pro-CBI stance. It is suggested that future systems carefully monitor instructor behaviors during some initial period to determine which aspects are facilitative to the instructional process and which are not. These observations can then be used to help formulate an inservice training program.

Seven major role changes have been noted by Hansen and Harvey (1970). Although their evaluation did not present empirical data to substantiate the inclusion of any particular role, their listing of potential role changes seems to be intuitively comprehensive. This list can be summarized as those roles which will be diminished under a CBI system (e.g., less direct presentation of information and less corrective discipline) and those roles which will be augmented (e.g., designing instructional strategies, guiding individual students, more team effort, and diagnostic, assessment, and prescriptive functions).

In summary, the profile of an instructor under a CBI system may include the following behavior changes:

1. less autonomy in the classroom--not as much unstructured time for diversionary discussions and "old war stories."

2. less platform or lecturing behaviors.

3. perhaps less able to reinforce students for cognitive behaviors—Hess and Tenezakis (1973), note that "the teacher's salience as a rewarding figure in matters of learning may be reduced."

4. increased importance as a central resource person--if truly an expert. However, Hess and Tenezakis (1973), after exploring some of the "socio-affective" aspects of CAI-student interaction, note that, "the computer may come to be regarded as a *source*, not simply a *medium*, of information and instruction."

5. more time for individual students--however, focus may be primarily on slower students, which may impact on how the instructor views his contribution.

The previous discussion indicates that computer-based systems can expect fundamental changes in the nature of instructional roles. Since each of the identified roles may have positive and negative aspects for a particular instructor and no one instructor could be expected to be able to perform all roles with equal effectiveness, it may be that for the CBI training environment, more differentiation in instructional tasks will have to take place. Such differentiation may imply development of a team of experts which would be trained to cover the required spectrum of tasks. Such a team might include: subject matter experts who may have to evidence expertise to a degree which eclipses any former definition (Lamos, 1971), behavior analysts who are able to apply learning principles to obtain specified knowledge and skills (Rogers, 1968), instructional analysts to analyze student progress and changes in the student population (Lamos, 1971), instructional programmers who can convert the descriptions generated by the above experts into appropriate instructional interactions (Rogers, 1968), and program editors who revise and refine instructional sequences after examining performance data (Rogers, 1968).

The major implication from this overview is that any instructor training and orientation to CBI must be carefully structured to directly address the affective nature of any perceived role change. However, before discussing the factors which might be emphasized during CBI instructor training and orientation, this report will address the issue of degree of instructor involvement in the development and implementation phases of CBI.

Amount of Instructor Involvement

At some point in the development of any new computer-based system, a decision has to be made about the extent to which instructors need, desire, or should be required to be involved. Basically, investigators tend to agree with Hansen (personal communication) who noted that attitude is role dependent: if the instructor is an active participant in the development and implementation of a new system, then he becomes its best salesman; but if the instructor assumes or is forced to take a passive position and is not able to contribute to the development, then he will be neutral at best and most probably negative. Bunderson (personal communication) concurs by noting that faculty or instructors are positive toward CBI when they are involved in the formative stages and throughout development and Mitzel (personal communication) suggests that giving the instructor experience at the courseware development level creates a positive set toward a new system. So, the issue is not involvement *per se*, but how much involvement is optimal--for the instructor and for the system? For any new instructional system, it appears that level of involvement has to be mediated by system mode. The temporal and intellectual commitments for a PI mode and for a CAI mode are different. For a PI mode, it may be easier to immerse an instructor in courseware development, since he normally has mechanisms for input to courseware. But for a CAI mode, involvement during development phases might have to be more selective.

To substantiate this point, Avner (personal communication) noted that any CAI system should consider the fact that it takes an average of three months, working half-time, for an instructor to feel comfortable at the terminal with the language. Initially it takes two man-months to produce one hour of evaluated material and even after the instructor is considered to be experienced, it still takes two weeks to produce one hour of evaluated material (this formula is consistent with Rogers, 1968, who assumes a conservative 100-1 hour ratio for developing CAI materials). This is an enormous investment, not only in terms of institutional money and time, but also in terms of the instructors' professional life-span. In the Air

Force environment, duty tours need to be stabilized so that Air Training Command can be certain of sufficient payoff for the necessary additional training and there should be sufficient spin-off applications in terms of jobs into which instructors may progress after their initial instructor tour. It may be that a new instructor specialty should be created which can reward and thereafter place those individuals who have upgraded themselves by learning a computer language at a level which makes them competent as CAI courseware writers or technologists.

Guinti (personal communication) suggests that, from his experience with the Army's computerized training system (CTS) project, it appears to be sufficient for the instructor to know what instructional strategies are available (e.g., branching, looping, prescriptions, etc.) and what the model for the system is. However, a detailed knowledge of the programming language itself is not necessary. In contrast, Avner (personal communication) insists that a simplified language should be made available, otherwise the instructor has to go to a systems level programmer to get even a slight modification. Bunderson (personal communication) agrees and notes that there is some danger in just developing a system and then "laying it on." He notes that there seems to be a threshold for how packaged any system can be while still allowing the instructor to feel useful. He elaborated on this point through the following analogy: Cakemix companies have found that their redi-mix products are significantly more successful if the housewife-user is allowed the creative flourish; i.e., to put in the egg. Within Bunderson's project, *Time-Shared, Interactive, Computer-Controlled, Information Television* (TICCIT), the "creative flourish" is allowed through letting the instructor make instructional modifications by adding material to the program in a modular fashion, while leaving the primary courseware intact by not permitting the instructor to have access to the central courseware workings. Regardless of whether degree of instructor involvement or role changes become issues in a particular computer-based system, some kind of orientation and/or training program should be instituted.

Orientation and/or Inservice Training

Most investigators agree that an extended period of inservice training and orientation is probably the single most important variable to effect instructor attitudes. Some investigators (e.g., Coulson, 1971; Silberman, 1967) feel that, in order to provide for maximum effectiveness and cooperation, such training should continue well beyond the point where the instructor appears to be handling the normal mechanical operations ably. Although Hansen (personal communication) says that the Navy's program remains effective using only on-the-job training, Guinti (personal communication) stated that extensive formal orientation must be conducted. Since, historically, PI often has been "shoved down the throats of instructors," such intense resentment has been created toward PI that some still lingers after many years of exposure. Guinti suggests that converts to a positive philosophy can be made if demonstration programs are available in each instructor's area, so that the instructor can go through it himself. It is just as important, though, that the administrative *staff* have a chance to go through the orientation program since they interface with students and have an opportunity to influence attitudes. Block (personal communication) also prescribes intensive orientation. The fundamental intention of the orientation would be to give the rationale for any change and to describe why it might be better. Block suggests that, in presenting specific facets of the technology, it would be an asset to determine the basis on which the instructor decides whether a resource is useful (i.e., face validity). Several researchers note that it is important not to oversell CBI or PI but to present any new technology as just another tool (Avner. Block, & Judd, personal communications). The consensus is that the main thrust of any orientation program should be to acknowledge that role changes can be expected and to address the affective nature of some of these changes as openly as possible.

The issue of training subsumes the issue of *screening* for potential instructors, which can be another area of possible dissimilarity between military and civilian environments. Of course, many military programs may not have any latitude in selection of instructors—what they see is what they get. In a prototype developmental system, however, there may be room for investigating this parameter. Before extensive screening can take place, the basis for selection has to be determined and it may be that making such a determination may not be worth the effort it would entail. Guinti (personal communication) indicates that his program does considerable screening and that a potential instructor must be a subject matter expert, have former teaching experience, have a background in educational philosophy, but most of all have the expressed desire to participate in the program. In reality, self-selection carries the most weight on the selection criteria. Data processing or programming experience is an optional variable. Hansen (personal communication), in contrast, says that in his work with the Navy there is currently no screening program and that even instructors who are negative to the system (such as "old timers") remain in the system—yet the program does not seem to be adversely effected.

Whether extensive screening is accomplished or not, some kind of organized training program for instructors must be considered. If such a program is developed, one of the topics for discussion should be an orientation to computer products and devices. Aspects of why these topics should be considered will be developed in the following section.

Use of Computer Devices and Products

Some users "lack confidence" about using the computer (Banghart, Harris, & McGee, 1973) and seem unable to communicate with technologists who might be able to assist them. If instructors are unwilling to work with an intermediary technologist, then they may tend to be discouraged from bothering with CBI, since it takes quite an effort to learn a computer language (Silberman, 1967). It is important within any computer-based system to recognize areas of possible apprehension or irritation for the instructor and make some attempt to alleviate them. One source of irritation which is related to computer devices, accessability of authoring terminals, and one source of anxiety which is associated as a computer product, banks of student data, will be discussed here.

Accessability of Authoring Terminals. A major source of irritation (discussed in personal communications with Bitzer & Avner) stems from allowing only certain terminals to have authoring functions and, therefore, making it necessary for the instructor-author to go to that specialized or dedicated terminal for even minor changes in the course program. These investigators suggest that authoring functions such as fast editing, monitoring, etc. should be available at all terminals so that queing and accessibility problems are minimized. If required to go to a special terminal or to wait to see a particular version produced, the instructor may be less productive and generally satisfied with marginal efforts.

Banks of Student Data. In addressing the issue of what kind of data should be generated and accessible to instructors so as to optimize assessment and prescriptive procedures, Suppes (1967) has indicated that it is easy to overwhelm instructors with too much data—data which they do not have the expertise to either evaluate or utilize. Suggestions have come from Block and Avner (personal communications) and from Kooi and Geddes (1970) that the best way to proceed is first to provide some training in basic statistics. This training should stress the pragmatic applications of data analysis and interpretation (i.e., covering mean, standard deviation, and summary statistics for individuals and groups). Additionally, since the instructors may be tasked with partialing out certain influences and since interaction effects are generally difficult to understand, special considerations may have to be given to any explanations of more advanced statistics. It is important to allow individual instructors to decide what they need (Stolurow, personal communication), and through an iterative process, to allow them to update requests for data at any level and at any time (Hansen, personal communication). Further, Longo (personal communication) suggests that it is best to ask each user (e.g., evaluator, instructor, programmer) what kind of data is needed and to be selective about furnishing this information—in essence, to tailor each package to meet the user demands. Avner (personal communication) noted that very global types of measures tend to hide information which may be meaningful to the instructor in making decisions, and that individual instructors may have specialized needs for some particular analysis. Hansen (personal communication) adds that some instructors will ask for fine grain detail (e.g., even at the micro-level of what question was missed by an individual or group). Most researchers emphasize that information about current student status must be available immediately after a student finishes (Stolurow & Hansen, personal communications) and that good summaries of critical features are needed on a daily basis (Block, personal communication).

Before closing this review, two policy questions which deal with issues which are germane to military settings need to be addressed (Lamos, personal communication). Neither of these issues can be resolved at the local level, but their impact should be considered and monitored so that strategies for implementing any required changes can be developed when the time is appropriate.

1. First is the fact that the military instructor is fundamentally a specialist in some career field other than instruction (e.g., primarily an aircraft electrician, secondarily an instructor). Therefore, after a tour as an instructor, military personnel usually have to complete at least one tour in a primary career specialty before cycling back as an instructor. The implication for CBI is that it may be critical for some instructors to be first an instructor and second to have expertise in some specialty. Then, instead of complete tours in

this specialty field, the instructor could be sent on temporary duty for some appropriate length of time (e.g., six weeks) to pick up whatever new information is needed in order to be current. Of course, this philosophy would facilitate the earlier suggestion that instructional tasks under CBI may be so multifaceted that differentiation will have to take place.

2. Second, in any military setting, there are manuals and regulations which govern classroom processes and products. In fulfilling their requirements, instructors establish roles which are responses to these requirements. If the instructor is instigated by CBI into making role changes, then the regulations and manuals must permit new products and processes. In balance, there are also cases where CBI will facilitate compliance with present regulations and manuals.

For example, under a lock-step mode, so many students come to a test point at the same time that it may be virtually impossible for an instructor to give criterion performance checks simultaneously. Even though Air Force Air Training Command Regulation 52-3 establishes the requirement for criterion testing using criterion performance checks, practical classroom management considerations result in students being *asked* what they would do (i.e., multiple choice tests) instead of being tasked with the actual performance requirement. This is a case where a self-paced mode might strengthen the application of the regulation. Since students in a self-paced mode emerge from the coursework and are ready for testing at different times, the instructor can more easily comply with the regulation and give individual performance testing.

Conversely, the specialty training standard (STS) governs all course control documents and in order to be in compliance, the instructor must develop a lesson plan. Under the self-paced mode of CBI, this may prove very difficult and, thus, may be a case where the regulation needs to be made flexible enough to accommodate a changed product.

V. CONCLUSIONS AND RECOMMENDATIONS

To conclude this review of student and instructor attitudes toward CBI, evidence has been provided which indicates that CBI may not be a threat to humanization, but in fact when utilized properly can increase the effectiveness and personalization of the instructor-student relationship. It has been determined that students are apt to be initially positive, so that the focus of any CBI system should be to sustain and enhance this positiveness. Instructors appear to have initially less favorable attitudes toward CBI (Tobias, 1968) and any growing enthusiasm seems to be directly proportional to the amount of administrative burdens relieved by the computer (Coulson, 1971) and how much time it saves the instructor (Toggenburger, 1973). However, since student attitudes may be easily modified by instructor attitudes (Avner, personal communication), consideration must be given to techniques and procedures which may effectively generate and sustain positive attitudes.

The following suggestions are offered as being steps or items to consider when optimizing CBI-student interactions.

1. Give *orientation* program which covers:
   a. Overview of system
   b. Instructional modes to be encountered
   c. Devices and terminals
   d. Do not oversell system, but present a realistic discussion of positive and limiting features.
2. Optimize and monitor *system variables* such as:
   a. Courseware generation
   b. Subject matter characteristics
   c. Legislation of success through adaptive models
   d. Utilization of derived principles of learning theory (e.g., schedules of reinforcement)
3. Insure that *instructors* are:
   a. Present and accessible for answering questions

b. Reflecting positive attitudes

4. *Monitor human factors* with regard to:

a. Terminal screen (for eyestrain, angle, brightness)

b. Keyboard (for sharp edges, length of stroke)

c. Images and type fonts (for sharpness, size)

d. Carrel design (for comfort, utility, work space)

e. Time to fill screen (text, graphics, both)

f. Secondary devices: AV, microfiche, tapes (does user load?)

g. Downtime

h. Response time

Within the literature, two philosophies on how to influence instructors' attitudes can be observed: one is just to make a computer device, such as a teletypewriter, available and someone is bound to get "hooked" on its potential (Silberman, 1967); the other is to have a systematic and intensive orientation program which is primarily designed to alleviate fears and apprehensions toward CBI and to explore fully the ramifications of potential role changes (e.g., Coulson, 1971). Under the assumption that most CBI system managers will determine that taking the later stance will prove more effective, this report will end by offering the following suggestions.

1. Since any given instructor cannot be expected to perform every identified task either in terms of time or effectiveness, a team approach of differentiated responsibilities is recommended.

2. Regardless of what the individual instructor's role is determined to be, that instructor must be made to feel *personally involved*. Level of personal involvement may ultimately determine how effective the system will be.

3. All aspects of roles can not be anticipated, therefore, the system should have flexibility sufficient to let the instructor work out the areas and the specifics of any new role:

4. Within an orientation program:

a. *Screen* for instructors, particularly for any CAI mode. Allow as much *self-selection* as is feasible.

b. *Give demonstration programs* in each instructor's area and incorporate suggestions when appropriate. Get the instructor involved. Commitment will overcome a multitude of problems and commitment can be obtained by making each instructor an integral part of the innovation.

c. *Do not oversell* the new technology—otherwise the positive attitudes generated through the orientation program may regress as reality impinges. It will be more productive to present the technology as just another tool and attempt to give a realistic picture of what will and will not happen in the classroom.

d. Determine and spell-out the *rationale* for the new system. Describe at the pragmatic level why it will be better.

e. If possible, *determine* on what basis each instructor decides whether a particular resource is useful (i.e., *face validity*) and then capitalize on this information by incorporating it into the orientation program. For instance, ask why the instructor likes a particular piece of equipment and you would probably assess the answer, "Because the kids like it" as substantially different from "Because it saves me work."

f. *Stress any reductions in administrative load* on the instructor. Record-keeping functions of the computer, such as scoring objective tests, computing grade averages, rankings, etc., can be used to note that, if the computer is doing clerical jobs, then the instructor is free to instruct.

g. Primarily, *acknowledge* possible *role changes* and give prestige to every role. This can be accomplished by openly discussing changes and exploring the impact new roles may have on the instructor's affect, security, advancement, prestige, etc.

h. *Reduce role ambiguity* as much as possible. The clearer the anticipated role changes are, the better the adjustment of the instructor.

i. During the initial phases, *monitor* instructor activities: The structuring of individual roles, the assumption of predefined or stereotyped aspects of roles, and the adjustments made in order to cope with unexpected developments. Use this information to make the orientation program more realistic.

j. Throughout the tenure of CBI instructors, *give inservice mini-courses* which include orientations to new and on-going computer products and up-date background in statistics.

It is anticipated that a systematic effort to monitor these areas will not only solidify the positive findings obtained in the literature thus far, but contribute substantially to the continued evolution of CBI.

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