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ABSTRACT

A series of analyses were made to relate attitudinal and achievement outcomes in an assessment of student achievement and of student and instructor attitudes, made by the U.S. Air Force Human Resources Laboratory (AFHRL) and the Air Training Command (ATC) as part of their joint Service Test of the PLATO IV system at Chanute Air Force Base. Data were collected on students and instructors in three treatment conditions: (1) instruction with the PLATO-Based Training System on the content of the common course segment; (2) instruction with several of the PLATO lessons, with the same material presented via conventional classroom lecture methods; and (3) no PLATO instruction. Achievement data were collected and pre- and post-tests, and attitude data were collected in one instructor and two student questionnaires. Analyses indicated that students' positive perception of effectiveness in PLATO lessons was associated with better achievement gains, and frustration and stress of learning led to less favorable achievement. Positive attitudes of instructors toward the PLATO lessons had a favorable effect on the students. (CMV)

PART A

ATTITUDES AND PERFORMANCE OF MILITARY STUDENTS IN COMPUTER-BASED TECHNICAL TRAINING

by

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I. INTRODUCTION

A. Lynn Misselt

An assessment of student achievement and of student and instructor attitudes during the period from January, 1975, to September, 1975, was made by the U.S. Air Force Human Resources Laboratory (AFHRL) and the Air Training Command (ATC) as part of their jointly-conducted Service Test of the PLATO IV System at Chanute Air Force Base. Analyses of the achievement and attitude data were carried out by the Military Training Centers (MTC) and PLATO Educational Evaluation and Research (PEER) groups of CERL and will be reported as products of the AFHRL/ATC evaluation effort. It is the understanding of the MTC and PEER groups that the AFHRL/ATC reports will treat the instructional effectiveness and instructional impact results of the Service Test independently and hence will not attempt to relate achievement results to attitudes. We believe, however, that a complete examination of the achievement-attitude relationship will enhance the understanding of the outcomes of the Chanute Service Test and may lead to useful generalizations or hypotheses. We have planned, therefore, a series of additional analyses to relate attitudinal and achievement outcomes.

Database Available from Chanute Service Test

In order to assess the effectiveness of the PLATO IV system in a military training environment, personnel at Chanute AFB developed a set of PLATO lessons covering cognitive elements of a course segment in elementary automotive principles. This six-week segment formed a basic common core of material for four special purpose vehicle repairman courses. That is, students assigned to each of the four specialty courses all received similar instruction in the fundamentals of automotive mechanics before branching off for additional instruction in the maintenance of vehicles in their own specialty (e.g., fire trucks, tow trucks, endloaders, etc.). This common course segment was taught in four units or blocks, averaging 1 1/2 weeks in length, with a Block Exam administered at the end of each block.

PLATO was introduced in the four target courses on a staggered time schedule so that classes entering one of the courses began to use PLATO as an integral part of their instruction as early as January, 1975, while conventional instruction was retained in the other courses until later in that year. By October, 1975, all special purpose vehicle repairman students were receiving instruction via what Chanute AFB calls the PLATO-Based Training System. Under this system, PLATO lessons comprised 1/3 to 1/2 of the instruction in the six-week "common course segment." The

remaining instruction was presented by programmed texts, films, and laboratory exercises.

The CBE materials used for mainline instruction consisted of thirty five on-line lessons, totaling about 20 hours in length. Each of these lessons had a criterion-referenced test at the end which was called a master validation exam (MVE). Students who failed to achieve a passing score on a lesson's MVE were required to review the lesson and to repeat the MVE until they scored above the minimum criterion for mastery.

Treatment conditions. During the period from January, 1975, until September, 1975, members of the joint AFHRL/ATC evaluation team collected achievement and attitude data on students under three treatment conditions. The first of these, the PLATO-Based or PB condition, consisted of instuction with the PLATO-Based Training System on the cognitive content of the common course segment. In the second condition, the Conventional-PLATO or CP condition, instructors assigned many of the PLATO lessons to their students but also presented the same material via conventional lecture methods in the classroom. Students in the third condition received no PLATO instruction and hence were designated as the Non-PLATO or NP group.

Achievement data. The basic achievement data collected for the AFHRL/ATC evaluation from January, 1975, to September, 1975, included scores on the four block exams, final grades (which were actually just the average of the block exam scores), and results from three administrations of a special topical test developed by the AFHRL/ATC evaluation team. The special topical test contained 30 items over five topics covered by PLATO lessons and 20 items over an additional four topics that were not presented by PLATO. The test was administered to students in all three treatment conditions on three different occasions: 1) as a Pretest on the first day of instruction, 2) as a posttest immediately following the common course segment (this administration was called Posttest I), and 3) at the end of each of the four specialty courses. This last administration was called Posttest II.

Attidudinal data. The student attitude questionnaire used in the AFHRL/ATC evaluation is reproduced in the Appendix to this report. The items in Section I (called the "short form" questionnaire) were administered to the PB and CP students after each block of instruction in the the common course segment. The NP students, meanwhile, were asked to complete a similar set of items which dealt with attitudes toward traditional instruction rather than toward computer-based education. The items in Section II sought to measure attitudes toward the PLATO-Based Training System

while those in Section III asked about the affective status aroused by working with the PLATO system. The items in Sections II and III were collectively referred to as the "long form" questionnaire. Because it assumed experience with computer-based education, the long form questionnaire was administered only to the two groups who received PLATO instruction. It was administered at the end of the common course segment just before the students moved on into instruction in their own vehicle repairman specialties.

The attitudes of instructors toward the PLATO Based Training System were also measured by a questionnaire. Unfortunately, it is impossible to relate instructor attitudes directly to the attitude or performance of their students because of the manner in which instructors were given teaching assignments in the target courses.

II. LONG FORM OF ATTITUDINAL DATA

Kikumi Tatsuoka

In order to simplify the 66 attitudinal items into several groups of related items, Factor analysis was performed on the scores of questionnare items. The responses to the 66 items of the long form attitude questionnaire (45 items from section II, 20 items from section III, plus one item indicating treatment condition) were first subjected to a Principal Components analysis. The largest seven eigenvalues were 20.4513, 4.0512, 2.2535, 1.8710, and 1.6367. Then the factor matrix associated with the largest seven principal components was rotated by the Varimax procedure. The 25 items having factor loadings larger than .5 in absolute value were extracted as a common factor of this 66-item analysis. The common factor had a variance of 15.2554 and a percentage variance of 27.1905, while the total sum of communalities was 56.1056. Indeed, many items within the questionnaire were clustered together as a common factor. Thirty-nine items in this first factor had loadings larger than .30 in absolute value.

All of these items indicated positive attitudes toward the PLATO program. However, a close examination of items in this factor indicated that there were three kinds of favorable attitudes toward PLATO: the first was personal involvement with PLATO; the the second type represented the respondent's perception of the effectiveness of PLATO lessons; the third was more affective, with responses such as, "Working with PLATO is fun, enjoyable, and encouraging." The items from Section II having loadings larger than .70 in absolute value were 3, 5, 6, 13, 17, 18, 19, 35, 43, and 44. These items probably indicated a favorable attitude toward PLATO without any noticeable reservation. Thus they will be

designated as type I items. The items having lower loadings also from Section II were connected with the second kind of attitude, a more objective statement of the perception of the effectiveness of PLATO lessons. These items were 12, 22, 33, 41, and 45. The third kind of attitudes were from Section III and they correlated highly with both the first and the second kinds of attitudes. It would be interesting to know to what extent the mechanistic and impersonal CAI lessons will work effectively and achieve the aimed goal of training.

Analysis of the items in Section III. Since our interest was to relate the attitude responses to the performance results, the common factor from this analysis seemed too general and ambiguous for our purpose. Therefore the 45 items in section II and question 2 in section III were separated from the items in Section III. Items 7-18 in section III and these 46 items were analyzed independently in the same way as the 66 items were analyzed. The result of analysis for the affective items 7 through 18 in Section III are shown in Table 1. The eigen-values of the first three components were 6.5203, 1.5518, and .7927, and the cumulative percentage of the first two components was 68.6269.

Table 1

Variance in the Two Factor Space Accounted for by each Factor Following Varimax Rotation

Factor	% of variance	Cum. of % of Var.
1	3.5720	37.4316
2	2.9769	68.6269

These factors were renamed FVI and FVII, respectively, and were retained in further analyses.

The analysis of the items in Section II. The 45 items and item 3 in Section III were factorized. The principal component analysis of the 46 items showed eigen-values of 14.1561, 3.3001, 1.9100, 1.5955, 1.4763, 1.3580, and 1.3020 as the first seven components. The variance of the first principal component was still large relative to the other components and the percentage of variance was almost 31%. Varimax rotation was then performed on the factor matrix associated with the first seven components, which accounted for 54.56% of the variance in the original 46 variables. The results are shown in Tables 2 and 3. The common factor from this 46-item analysis was very similar to the one from that in which all the 66 items were used, except for a few items. Table 4 shows the comparison of these two common factors.

Table 2

Variance in the Seven Factor Space Accounted for by Each Factor following Varimax Rotation

Factor	Variance	% of variance	Cumulative % of variance
1	10.3355	41.1806	41.1806
2	3.7101	14.7825	55.9632
3	2.6446	10.5370	66.5001
4	2.6218	10.4463	76.9464
5	2.5452	10.1412	87.0876
6	1.6264	6.4801	93.5677
7	1.6141	6.4312	99.9989

Table 3

The Item Grouping by the Factors

Factors	1(≥.40)	2(≥.40)	3(≥.40)	4(≥.40)	5(≥.40)
Items	3,5,6,9, 12,13,16, 17,18,19, 22,29,30, 33,35,41, 43,44,45, 2(III)	11,-23, 31,33, 34,36, 37	2,4,7,8, 10	21,23, 25	1,15,10, 42 7

Table 4

The Common Factors in the 66-item and 46-item Analyses

	66-item Analysis	46-item analysis
|loadings|≥.65	3,5,6,9,13,17,18 19,30,35,43,44,) 2(III)	3,5,6,9,13,17,18 19,30,35,43,44, 2(III)
.65≥|loadings|≥.40	10,12,22,33,41, 45	12,16,22,29,33, 41,45

Item 10, "The equipment made it difficult to concentrate on the course material," was dropped in the 46-item analysis but new items, 16 and 29, came in there. Items 16 and 29 were "Material which is otherwise interesting can be boring when presented on PLATO," and "I was aware of efforts

to suit the material specifically to me," respectively.

The second factor in the 46-item analysis had almost the same items as the third factor in the 66-item analysis. The students felt too much material was presented and could not work at their own pace. Also they felt uncertain about their performance and the situation made them tense. They complained that irrelevant and ambiguous questions were asked in the lessons.

The third factor in the 46-item analysis had the same items as the fifth factor in the 66-item analysis, except for item 7, "I was more involved in operating the terminal than in understanding the course material." Items that fell in the factor were item 2, "The learning was too mechanical"; item 4, "The equipment interfered with learning"; and item 8, "No one cared if I learned or not, so I felt isolated and alone."

The fourth factor in the 46-item analysis shared some items with the first, second, and third factors in the same 46-item analysis and it is very difficult to give an adequate interpretation of it.

The reason that we reanalyzed the original 66-item analysis presented in "Chanute Report" by reducing the number of items to 46 was that the first factor (common factor) had too many items clustered together and the other factors were of only few items. Moreover, we felt the common factor had to be separated out into two groups, those having higher loadings and lower loadings; in other words, the type I and II as we mentioned before. Thus the 46-item analysis did not give us satisfactory results, so we separated the 46 items into 2 subsets of items: one containing the items which expressed a favorable attitude toward PLATO and the other containing the items which expressed a negative attitude toward PLATO. The 26 items having loadings greater than or equal to .3 in absolute value on the first factor were the subset of favorable items and the 29 items having factor loadings greater than or equal to .3 in absolute value on the factors other than the first one were the second subset of items. These items in the two subsets were as shown below.

The list of items analyzed separately.

Subset of 26 items 3,5,6,7,9,10,12,13,14,16,17,18,19,22,24 25,29,30,33,35,39,41,43,44,45,46

Subset of 29 items 1,2,4,7,8,10,11,12,14,15,16,20,21,23,24 25,26,27,28,29,31,32,34,36,37,38,39,40, 42.

The 26-item subset. We analyzed the two subsets separately. At first, a principal components analysis was done on the 26 item subset and the resulting factor matrix was rotated by the varimax method. The first factor was of items having loadings with absolute values greater than or equal to .65 in Table 4 except for items 35 and 2(III). This factor was named FI and retained for later analysis. The items having lower loadings in the 46-item analysis which were shown in Table 4 (12, 16, 22, 29, 33, 41, 45)formed the second factor in this analysis and it was named FII. FII became one of the discriminators of students' performance as is shown later in this chapter. The newly extracted third and fourth factors in this analysis were ignored and not used in the further analysis.

The 29-item subset was analyzed using the same procedure as with the 26-item subset. The resulting first factor was of the items in the second factor of 46-item analysis (11, 23, 31, 34, 36, 37) and of the fourth factor of the same analysis (21, 23, and 25) together. The second factor was of the items in the fifth factor of the 46-item analysis (1, 5, 40) in Table 3. The third factor included the items in the factor 3 in Table 3 (2, 4, 7, 8, 10). These three new factors were retained in later analyses and were designated FIII, FIV, and FV in the report.

A summary of the final factors is given in Table 5.

Table 5

Eight Factors Extracted From
the Student Attitude Questionnaire

FACTOR 1

Personal Involvement with PLATO, or
Acceptability

3.	I felt challenged to do my best work.	.75
5.	I felt as if someone were engaged in conversation with me.	.69
6.	As a result of having studied by this method, I am interested in learning more about the subject matter.	.69
9.	I felt as if I had a private tutor.	.67

13.	My feeling toward the course material after I had completed the PLATO portion of the course was favorable.	.66
17.	I was satisfied with what I learned while taking the course.	.62
18.	In view of the amount I learned, this method seems superior to classroom instruction for many courses.	.75
19.	I would prefer PLATO to traditional instruction	.73
30.	I was encourged by the responses given to my answers of questions.	.58
43.	The lessons on PLATO were interesting and really kept me involved.	.53
44.	What I learned from PLATO made the classroom and Laboratory instruction easier to understand.	.68

FACTOR II

Perception of effectiveness of PLATO

12.	PLATO, as used in this course, is an inefficient use of the student's time.	-.51
22.	The responses to my answers seemed appropriate.	.49
33.	I felt I could work at my own pace.	.66
35.	Material which is otherwise boring can be interesting when presented by PLATO.	.61
41.	Computer-assisted instruction did not make it possible for me to learn quickly.	-.60
45.	The PLATO lessons were dull and difficult to follow.	-.57
2.	As a student, I do my best work with PLATO lessons.	.60

FACTOR III

Alienation - PLATO as a task, not learning

11.	The situation made me quite tense.	.56
14.	I felt frustrated by the situation.	.50
20.	PLATO instruction is just another step toward de-personalized instruction.	.42
21.	I was concerned that I might not be understanding the material.	.49
23.	I felt uncertain as to my performance in the programmed course relative to the performance of others.	.59
25.	I found myself just trying to get through the material rather than trying to learn.	.48
28.	I guessed at the answers to some questions.	.52
31.	In view of the time allowed for learning, I felt too much material was presented.	.67
34.	Questions were asked which I felt were not related to the material presented.	.57
36.	I could have learned more if I hadn't felt pushed.	.64
37.	I was given answers but still did not understand the questions.	.58

FACTOR IV

Anti System

1.	The method by which I was told whether I had given a right or wrong answer became monotonous.	.65
15.	I found the computer-assisted instruction approach in this course to be inflexible.	.61
40.	While on PLATO, I encountered mechanical malfunctions.	.60

FACTOR V

Impersonal PLATO

2.	Nobody really cared whether I learned the course material or not.	.56
4.	I felt isolated and alone.	.43
7.	I was more involved in operating the terminal than in understanding the course material.	.55
10.	The equipment made it difficult to concentrate on the course material.	.50
16.	Material which is otherwise interesting can be boring when presented on PLATO.	.47
24.	I was not concerned when I missed a question because nobody was watching me.	.53
29.	I was aware of efforts to suit the material specifically to me.	.55
38.	The course material was presented too slowly.	.57

FACTOR VI

Positive feeling toward PLATO

Working with the PLATO system:

(III) 7.	Is fun.	.76
9.	Is challenging.	.85
12.	Makes me proud of myself.	.83
16.	Is enjoyable.	.70
18.	Is exciting.	.73

FACTOR VII

Negative feeling toward PLATO

Working with the PLATO system:	
8. Is frustrating.	.83
10. Is annoying.	.89
11. Is confusing.	.78
13. Is boring.	.52

III. - MEASURING THE GAIN SCORES

Kikumi Tatsuoka

The achievement data collected for the evaluation study of Chanute AFB CBE project suffered from low reliabilities of the tests, hence there is a strong possibility that the error of measurement on the test scores may wash away the correlations of the attitude scores with the achievement scores if we use the observed scores that we have now. In order to avoid the problem of error of measurements, we will use a special technique that has been developed recently. This problem was called to the attention of educational measurement specialists in connection with measuring the gain scores of a posttest from a pretest.

Measuring gain scores has been used in research in education and psychology even though it has some considerable problems. In many situations such as evaluation of educational programs, gain scores appear to be the natural measure to be looked into.

There were three major persisting dilemmas: "low reliability and error of measurement," "regression effect," and "over-correction, under-correction." Ever since E. L. Thorndike (1924) pointed out these dilemmas, measurement specialists in education and psychology have tried to overcome the difficulties by suggesting various methods to estimate gain scores. He looked into the reliability of the difference between scores of two tests, and showed that this reliability is lower than the reliabilities of two tests taken separately. This fact was explained in that errors of measurement in both separate tests affect the difference score and whatever was common to both measures was cancelled out in the difference. In our study, coefficient alpha of

pretest and posttest I were .3960 and .6300 respectively. But the reliability of simple difference scores was only .1047, which was smaller than the reliability of either pretest or posttest I.

Cronbach and Furby (1970) suggested the use of multiple regression, that is, to regress the true gain score on the space spanned by both tests. By adopting a multiple regression approach, they succeeded in avoiding the persistant problem of whether the two tests measured the same thing. Indeed, estimating the true gain score by the multiple regression method provided very efficient gain scores.

The simple difference score typically has a negative correlation with the pretest. Hence it implies that if individuals with high gain scores are to be selected, there will be an over-representation of people with low pre-test scores as an artifact due to the negative correlation between gains and pretest scores. The method of using regression gain scores (or residual scores) was introduced by Debois (1957) and Manning (1962) in order to avoid this dilemma. Regression gain has a zero correlation with the pretest. This gain score was obtained by subtracting the predicted pretest score from the corresponding posttest score. We calculated the gain scores by regression method also. The resulting gain has zero correlation with the pretest and .86 with posttest I. As indicated by O'Connor (1972) and Linn and Slinde (1977), the reliability of regression gain is as low as that of raw difference scores. Our regression gain has a reliability of .33 which is higher than the reliability of difference scores. But it is still very low, and therefore it is risky to make any decisions about individuals on the basis of gains from pre- to posttesting periods on the basis of this regression gain score. It is possible to observe some individuals with large difference scores, even without any real change. Knowing that the reliability of our regression gain was only .33, we investigated the relationships between performance scores and attitude scores and compared the results with those we obtained using the multiple regression method. Applying this method, we obtained gain scores having a reliability of .74.

The calculation process of estimating an individual true gain score by the multiple regression method that was introduced by Cronbach and Furby (1970) was tedious and complicated. If other measures than pretest and posttest were used to step up the multiple R, then the procedure would be very messy algebraically and numerically. A mathematically simple method of regressing true gain scores on several variables was developed by the first author of this report (Tatsuoka, 1975). The procedure made it possible to separate the reliability (squared multiple R) of the estimated true

gain into the increment of R^2 provided by each variable. The reliability of the difference score x_2-x_1, with x_1 by posttest I and x_2 by pretest, would be calculated first, then the additional contribution by regressing t_2-t_1 (true gain score) onto x_1 and x_2 would be calculated. The sum of both values would be the reliability or squared multiple R of the estimated true gain scores by the multiple regression method. Table 6 gives the result of numerical calculation applied to one pretest and posttest I. The estimated gain score of t_2-t_1, obtained by regressing it on x_1 and x_2 will be given by $R(t_2-t_1|x_1,x_2)$. The estimated gain score of t_2-t_1, using x_1, x_2 and the scores of Block test 2 is given by $R(t_2-t_1|x_1,x_2,B_1)$, etc.

Table 6

The Estimated True Gain Scores Obtained by Multiple Regression Method

Variables	Incremental R^2	Reliability (R^2)
X_2-X_1	----	.1047
$R(t_2-t_1\|x_1,x_2)$	.63578	.74048
$R(t_2-t_1\|x_1,x_2,B_2)$	.05894	.79942
$R(t_2-t_1\|x_1,x_2,B_2,B_3)$	.11650	.91592
$R(t_x-t_1\|x_1,x_2,B_2,B_3,B_4)$	.02186	.93778

The number of students is 110, and the reliabilities of the pretest and posttest I are .3960 and .6300 respectively.

The reliability of the difference score was only 0.10470 but the multiple regression gain increased to .63578 which is six times as much as that of the difference score. We use a notation of $R(t_2-t_1|x_2-x_1)$ for the regression of true difference scores t_2-t_1 onto the difference scores of pretest scores from posttest1, where x_2 stands for posttest II and x_1 for pretest. $R(t_2-t_1|x_2,x_1,B_2)$ was the true gain that was regressed on pretest, posttest2 and block exam 2, B_2. The increment of squared multiple R by adding block exam 2 to predict true gain score in $R(t_2-t_1|x_2,x_1)$ was .05894. By adding block-tests, the increment of .71650 in squared multiple R was calculated. Block exam 4 had an increment of .02186. The rate of the increment by block exam 4 suggested that the PLATO lessons in block 3 contributed most significantly to the gain measurement by the special topical test given at the beginning and end of the program.

Table 7 shows a comparison of traditional regression gain and multiple regression gain using the pretest, posttest and Block tests 2,3 and 4, $R(t_2-t_1|x_1,x_2,B_2,B_3,B_4)$.

They are expressed as A and B, respectively, in the following table.

Table 7

The Correlations of the Gains with Various Tests

Test	A	B
pretest	.0	.6820*
posttest I	.8643*	.8354*
posttest II	.3594*	.4547*
final grade	.2677*	.4841*
block1	.1293	.3811*
block2	.1842	.1603
block3	.3031*	.6047*
block4	.1595	.3422*

*$p < .05$

It is interesting to note that the expanded multiple regression gain had larger correlations with posttest II, final grade, and block 1, 3, 4 tests than the correlations of the traditional regression gain with these tests. Since the expanded multiple regression gain had a reliability of .9378, the estimated gain scores were very close to the true gain, t_2-t_1. It is reasonable to assume that block-tests would affect the gains because the gain should be a result of learning throughout the program, and block exams were the measures of each learning segment of this period. The correlations of the regression gain with block tests were not significant except for that of block 3, which was .3031, while the expanded multiple regression gain had correlations of .6047 with block 3, .3811 with block 1, and .3422 with block 4. However, the correlations of both of the gains with pretest and posttest 1 were contradictory to the expectation that gain should have zero correlation with a pretest. The regression gain had zero correlation with the pretest but both of the expanded multiple regression gain and multiple regression gain did not have it. Indeed, it is mathematically impossible to expect that a true gain vector t_2-t_1 and pretest vector would be orthogonal.

IV. RELATIONSHIP BETWEEN PERFORMANCE AND ATTITUDE

Five items in the first section of the attitude questionnaire were repeatedly given to the students (four times at the end of each block). The results of repeated measures analysis of variance are given later.

The item in section II and the second item in section III were rotated by factor analysis and five factors were extracted. These five factors were used to relate students' performance scores together with the three factors obtained from items 7 through 18 in section III. Items 1, 3, 4, 5, 6 and 19, 20, 21 in section III were also used in order to relate with the performance score and the factors FI through FVII.

Seven factors were correlated with the scores of the four block exams and the time that a student needed to complete a block. It turned out that the factors did not correlate with the time data.

The relation between time in block and mechanical failure. Question 20 in Section III was "How often has PLATO worked when you have attempted to use it?" The responses correlated with time in blocks 1 and 4 at -.25 and -.27 respectively, but at -.14 and -.03 with blocks 2 and 3. Apparently, there was a considerable amount of system failures during blocks 1 and 4, and thus the mechanical trouble affected students' study time. The more often PLATO encountered mechanical trouble, the more time students had to spend to complete the instruction. The interruptions made students' learning less efficient. The time in block 4 correlated with question 21 at -.26. Since this question asked "During your school day, if you had your choice, how much of your time would you spend working with PLATO?" the time needed for completing block 4 had a non-significant relationship with the motivation that was asked in question 21. It is interesting to note that time needed to complete block 4 correlated with questions 19, 20, and 21 at .27, -.05, and -.26. Time in block 4 was affected by mechanical interruptions but this did not make the students want to stop using PLATO. However, it did affect their wishes to spend time working with PLATO in a negative direction. The summary of correlation between time in blocks and mechanical failure is given in Table 8.

Table 8

Time in Blocks and Mechanical Failure

Question	Block1	Block2	Block3	Block4
19	-.25*	-.14	-.03	-.27*
20	-.13	-.20	-.10	-.05
21	-.11	-.02	-.10	-.26*

*p<.05

The relation between performance and mechanical failure. The most interesting question would be whether or not mechanical interruption affected students' performance. From our study, there was no indication of a negative effect. But it should be noted that students' learnning in this study was controlled by a mastery learning strategy. Hence students were forced to study until they passed the criterion-referenced tests given at the end of each PLATO lesson.

Table 9

Correlation of Performance and Questions 19, 20, 21

Question	Gain	Pre-test	Post-testI	Post-testII	Final	Block 1	Block 2	Block 3	Block 4
19	0.18	.17	.20	-.04	.17	.13	.15	.08	.15
20	0.17	.05	.18	.10	.16	.22	.09	.20	.13
21	0.06	-.10	.00	.01	-.07	.04	-.04	.01	-.07

The relation between attitude factors and mechanical failure. Students' attitudes were affected by mechanical interruptions in a negative way. Both FI and FII correlated with 19 at .49 and with 20 at -.45, -.43 respectively. Factors FVI, FVII also correlated with 19 at .47, -32 and with 20 at -.42 and .39. Negative attitude factors FIII, FIV, FV--alienation, frustration or training stress as FIII, anti-system attitudes as FIV, and impersonal PLATO as FV--did not correlate with 19, but FIII and FIV correlated with 20 at .27 and .23. Frequent occurance of mechanical interruptions made students less favorable toward PLATO and PLATO lessons, produced more frustration in learning, and made the students complain more about impersonal learning. It was interesting to note that FIV correlated with 20 at .15 which is not significant. Items in FIV were anti-system attitude in a general way, so this just might imply that they just did not like the system a priori. Therefore frequency of mechanical interruption did not affect or stimulate their anti-system attitude. No matter how well the system worked, or how frequently the system failed, this attitude must have always been negative toward PLATO. Question 21 correlated with all factors in the same direction as 19 did. The high rate of mechanical interruption discouraged students' wishes to work with PLATO.

Table 10

The Correlation of the Attitude Factors with Mechanical Failure

	FI	FII	FIII	FIV	FV	FVI	FVII	19	20	21
19	.49	.40	-.17	-.10	-.17	.47	-.32	1.00	-.29	.42
20	-.45	-.43	.27	.15	.23	-.42	.39	-.29	1.00	-.41
21	.72	.63	-.34	-.29	-.47	.70	-.52	.42	-.41	1.00

The relation between attitude factors and achievement. Correlational analysis of factors and performance scores revealed that FII, FIII, and FVI were discriminators of performance.

Table 11

The Correlation of the Attitude Factors with Achievement

	Pre-test	Post-test I	Final grade	Reg. gain	Mult. gain
FI	.04	.18	.20	.18	.15
FII	.24*	.29*	.28*	.19	.32*
FIII	-.33*	-.35*	-.37*	-.20	-.37*
FIV	.03	-.00	-.03	-.02	-.01
FV	-.06	.16	-.15	-.15	-.16
FVI	.10	.23*	.27*	.21	.23*
FVII	-.11	-.12	-.19	-.08	-.12

*$p<.05$

The correlations of factor FI with performance scores were not significant. Personal involvement with PLATO and favorable attitude toward PLATO did not relate with academic performance measured by a special topical test, final grade, and gain scores. Table 11 does not include the correlations of FI with block exams and posttest II, but they were all non-significant. Factor FIV represented the anti-system attitude--complaining that answering to responses became monotonous, the CAI approach was inflexible, and mechanical malfunctions encountered while on PLATO--and did not correlate with performances. Attitudes toward a teaching medium--whatever it was--were independent from achievement of learning, and those attitudes must have been planted before the program started. Pretest did not correlate with FI, FIV, and FV. Factors FIV and FV stayed at zero correlation level as the program went by, while correlation of FI

increased according to an order of tests given from earlier to later. However, these values were not statistically significant. Hence no conclusions should be from Table 11.

Factor FV, impersonal PLATO, did not correlate with performance scores. Items in FV represented the weakness of instructions that had been attributed to CAI in general, using a machine to teach and interact with students. "Nobody really cared whether a student learned the course material or not"; "I was not concerned when I missed a question because nobody was watching me"; "I felt isolated and alone"; "I was not aware of efforts to suit the material specifically to me and I thought the course material was presented too slowly." Students were more involved in operating the terminal than in understanding the course material and hence the equipment made it difficult to concentrate on the course material. The question of to what extent mastery learning techniques played a role of reducing the effect of FV on the students' achievements was not clearly answered from our data.

Table 12

The Correlations of Attitudinal Data and FI, IV, and V

	Pre-test	B1	B2	B3	B4	Post-test1
FI	.04	.08	.09	.12	.18	.18
FIV	.03	-.07	.01	-.02	-.05	-.00
FV	-.06	-.04	-.02	-.08	-.09	.16

FII was originally clustered together with FI in the first analysis we conducted. The correlation of FI + FII, items in FI and FII together, and FI and FII separately are presented in Table 13.

Table 13

The Comparison of FI, FII, and FI+FII

	Pre-test	Post-testI	Final grade	Reg. gain	Mult. gain
FI	.04	.18	.20	.18	.15
FII	.24**	-.29*	.28*	.19	.32*
FI + FII		.23	.24**	.20	.22

*p<.01
**p<.05

FII was significantly correlated with all performance scores except for regression gain, but FI + FII were not significant except for the final grade. FII was perception of effectiveness of PLATO lessons; the students felt they could work at their own pace and thought that material which was otherwise boring could be interesting when presented by PLATO. Moreover, they thought CAI made it possible for them to learn quickly and did their best work with PLATO lessons. They believed that PLATO lessons were not dull and not difficult to follow. PLATO as used in this course was an efficient use of the student's time and responses to their answer seemed appropriate. It was interesting to note that FII correlated with the performance scores but FI did not.

FIII was also a discriminator of performance scores. This factor expressed frustration and stress in learning PLATO lessons. The factor represented "alienation," i.e. feeling little involvement with learning, and seeing PLATO only as a task necessary to complete the program. Items included "PLATO instruction is just another step toward depersonalized instruction"; "Too much material was presented, so I felt pushed"; "I was uncertain as to my performance relative to the performance of others." "I could not follow the questions I have been asked and I felt some questions were not related to the material presented"; hence, "I guessed at the answers to some questions." Students felt "Tense and frustrated by the situation." They were concerned that they "might not be understanding the material," and "just tried to get through the material rather than trying to learn." FII correlated positively and FIII correlated negatively with all performance scores consistently.

FVI correlated with some performance scores, posttestI, final grade and multiple gain scores but their magnitudes were smaller than those of FII and FIII. FVI represented a positive feeling toward PLATO teaching. For example, "Working with the PLATO system was challenging, made me proud of myself, was fun, exciting and enjoyable."

FVII represented the negative feeling toward PLATO teaching--that working with the PLATO system was annoying, frustrating and confusing. But FVII did not correlate with any one of the performance scores.

The relation of Posttest II with attitude factors and time in blocks. Posttest II was given at the training course. The test consisted of the same items as the pretest, and posttest I that was given at the end of the PLATO program, but orders of items were randomly changed. The time needed for completing each block did not correlate with either pretest or posttest I, but the time spent in blocks 3 and 4 correlated with posttest II at -.41 and -.32 respectively. The scores of posttest II correlated with posttest I, final

The scores of posttestII correlated with posttestI, final, B1, B2, B3, and B4 at .482*, .440*, .292*, .365*, .425*, and .211 respectively (*p<.01). These results implied that time spent in the last two blocks had more effect on the performance of posttestII, that was given eight weeks after the PLATO program was over, than achievement scores of blocks 3 and 4 tests. It probably was related to a retention-of-learning effect.

The relation to attitude factors was checked and only FIII had a significant correlation with posttest II of -.302. The correlation of FII dropped to .202 which was not significant anymore. It indicated that FIII was also a discriminator of future performance.

V. SHORT FORM ATTITUDE QUESTIONNAIRE

Patrick Maritz

Parallel, five-item attitude questionnaires were repeatedly administered to the three trainee groups at the end of each block of lessons. The questionnaire was designed to measure attitudes towards the trainees' respective forms of instruction. Thus, the short form attitude questionnaire was able to measure the amount and direction of change of trainees' attitudes towards their curriculum during the four instructional periods.

Since the trainees had recently arrived at their training school and were about to embark upon their specialized fields of military interest, it would be expected that trainee attitudes would initially be highly positive toward their training irrespective of the form of their training. As the trainees experience frustrations encountered during the training, the average group attitudes toward their training would decline. The attitude decline would become less from period to period as the trainees began to cope with the frustrations. With the forms of frustration during training being different for each of the groups and attitude parameters largely being a function of the effects of instructional frustration, it would be expected that the groups would have different initial attitudes and different rates of attitude change. Type one training was a pure computer-assisted instruction (CAI) curriculum. Type three was a programmed text instruction presentation. Several ratios of the two previous types make up the second curriculum form. All the curricula were measured with parallel attitude questionnaires concerned with the same aspects of curriculum. The aspects considered were enjoyment of the time spent in instruction, perceived achievement of curriculum goals, desire to continue with instructional form, general sense of accomplishment derived

from the curriculum, and whether the curriculum was challenging.

Analysis and result. A completely crossed 3x4x5 factorial analysis of variance was performed upon the corresponding factors; instructional format, blocks of time, and questionnaire items concerned with attitudes toward curriculum. The students were nested within the instructional format and crossed with blocks and items. A significance level of $\alpha=.05$ was utilized. For the main effects, all of the F-ratios were significant. All of the two-way interactions were also significant. The three-way interaction was not significant.

A series of post-hoc pair-wise mean contrasts were performed using the Sheffé test at a significance level of $\alpha=.05$. The Sheffé test was used due to unequal cell sizes. Pair-wise contrast for instructional formats showed that the significantly different pair of means was the mixed form and the programmed text form. For blocks of time, all of the pair-wise differences among the four blocks were significant with the exception of the blocks two-three contrast. The items dealing with the student's attitudes toward curriculum had no differences among any pair of means.

Complex contrasts for the main effect of instructional form showed a significant difference between the mixed group's mean and the composite mean of the CAI group and the programed text group. Similarly, when the programed text group was contrasted against the composed mean of the other two groups, the difference was again significant. Since the only non-significant pair-wise difference for blocks of time was between blocks two and three, the only complex contrast performed was to look at the first half of the time against the second half, i.e. blocks one and two against three and four. The blocks complex contrast was significant. When the greatest pair-wise difference among the items of curriculum was not at the significant level, it was indicated that the significant ANOVA F-ratio for the item main effect was reflecting a complex contrast. Therefore, a complex contrast between the highest mean and the two lowest means was performed and found significant thus confirming the F-ratio.

The results show that initial attitudes toward instruction among the groups were different after the first block of lessons. The NP groups were confronted with the conventional instructional frustrations of lectures, such as failure to hear or comprehend portions of the lecture, not being able to immediately repeat difficult points, peer distraction, etc. New frustrations of machine down time, improperly working programs, ambiguous statements, etc., were the problems of the PB groups. The PB groups may have

had as many frustrations as the NP groups but the problems were new to the PB group. As compared to the familar problems with which the NP group coped, the new PB problems would initially have a lesser attitude depression effect. The CP group's frustrations were partially alleviated by having their routines broken up by having different instructional settings. One type of frustration, boredom, was alleviated. Thus, the groups are initially ordered.

The next question is whether the group's attitudes differentially declined during the periods. With the exception of the NP group after the third period of instruction, the groups displayed a smooth negative exponential decline in attitudes even though remaining favorable. Being confronted with familiar frustrations induces the NP group's attitudes to decline at the greatest rate. Being presented with new roles in a CAI environment mitigates instructional frustrations in the PB groups generating the most stable attitudes even though not the highest. By combining the previous two methods, the CP group's attitudes decline at a rate between the other two types while maintaining consistantly more favorable attitudes than the previous two groups. The groups did not significantly interact with the questionnaire items nor the items with the blocks of instruction. Thus, the differences attributable to the groups are mainly a function of attitude differences.

Conclusion. Difference among the groups are mainly attributable to attitude differentials. CP produces consistently more favorable attitudes. PB attitudes are the most stable. Depending on how much weight is to be attributed to degree of favorability and degree of stability of attitude, the percent of instructional time on PLATO could be determined. A more extensive investigation of the percent of time spent on PLATO would help to determine the interaction between attitude favorability and stability.

VI. SUMMARY AND DISCUSSION

Kikumi Tatsuoka

Factor analysis was performed on the 66-item attitude questionnaire and seven factors were extracted. They are summarized as follows:

I. Personal involvement with PLATO, or acceptability.
II. Perception of effectiveness of PLATO.
III. Alienation - PLATO as a task, not learning.
IV. Anti-system.
V. Impersonal PLATO.
VI. Positive feeling toward PLATO.
VII. Negative feeling toward PLATO.

Positive perception of effectiveness in PLATO lessons was associated with better achievement, and frustration and stress of learning led to less favorable achievement results. It probably could be concluded that the lessons on the PLATO system needed to implement more help branches, and more individualized feedback on the questions. The length of each lesson must be carefully planned so that presentation of too much material at a time can be avoided. It was apparent that some students could take long lessons that might continue for more than one hour or two, but other students felt pushed and that they were presented with too much material. Hence, they needed more time to complete their assignment.

It was interesting to note that regression gain did not correlate with any attitude factors, while multiple regression gain and pre- and posttest I correlated with some factors. Although the reliability of regression gain scores was low, pre- and posttest I suffered from low reliabilities too. Moreover, the multiple regression gain correlated with three Block tests, 1, 3, and 4, at moderately high correlation values, but the regression gain correlated only with block 3 test at .30, which is barely significant. Final grade and posttest II showed larger correlation values with the multiple regression gain than with the regression gain. This fact implied that the traditionally used regression gain measured something different from all other tests. Therefore, there was a serious doubt about using regression gain (residual gain) to measure the difference between a posttest and a pretest.

The gain scores measured by multiple regression with some block tests were also affected by attitude factors FII, FIII, and FVI. More positive attitude, as measured by FII and FVI, was associated with a better gain, while more negative attitude, as measured by FIII, went along with less gain in performance. It should be noted that the achievement was not affected by mechanical failure or system failure, counter to the instructors' negative expectation, but students' attitudes were affected significantly negatively. The interpretation of the result may be attributed to the mastery learning strategy which the Chanute AFB CBE project adopted in their program, and students were forced to study until they passed the criterion-referenced tests given at the end of each PLATO lesson.

The time spent in the last two blocks had more effect on the performance of posttest II, which was given eight weeks after the PLATO program was over, than the achievement scores on Block tests 3 and 4 had. This is particularly interesting because the retention may depend more on how much time a student spent on a given topic until he/she masters it, and less on how well he/she did on the test.

The analysis of the short form attitude questionnaire repeatedly given four times at the end of Block tests revealed that both PLATO-Based and Combined PLATO groups maintained a consistently favorable and stable attitude toward the program, but the attitude of Non-PLATO group fluctuated according to their instructors' popularity.

REFERENCES

Cronbach, L.J., and Furby, L. How we should measure "change" - or should we? Psychological Bulletin, 1970, 74, 68-80. See also Errata, Ibid., 1970, 74, 218.

Debois, P.H. Multivariate correlational analysis. New York: Harper, 1957.

Linn, R.L., & Slinde, J.A. Significance of pre- and posttest change. Review of Educational Research, 1977, 47, 121-150.

Manning, W.H., & Dubois, P.H. Correlational method on research on human subjects. Perceptual Motor Skills, 1962, 15, 287-321.

O'Connor, E.F., Jr. Extending classical test theory to the measurement of change. Review of Educational Research, 1972, 42, 73-97.

Thorndike, E.L. The influence of change imperfections of measures upon the relation of initial score to gain or loss. Journal of Experimental Psychology, 1924, 7, 225-232.

Tatsuoka, K.K. Vector-geometric and Hilbert space reformation of Classical Test theory. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign, 1975.

APPENDIX

(Part A)

BLOCK #
SHRED A B C -1

PLATO QUESTIONNAIRE

NAME _____ SSAN _____ DATE _____

Circle the number that represents how you feel about the following statements.

	Very Strongly Disagree									Very Strongly Agree
1. I enjoyed the time I spent on PLATO.	0	1	2	3	4	5	6	7	8	9
2. I learned what the PLATO lessons tried to teach.	0	1	2	3	4	5	6	7	8	9
3. I would like to study more PLATO lessons.	0	1	2	3	4	5	6	7	8	9
4. I feel PLATO didn't teach me very much.	0	1	2	3	4	5	6	7	8	9
5. I feel challenged to do my best work on PLATO.	0	1	2	3	4	5	6	7	8	9
6. What have you enjoyed most about using PLATO? (You may use the other side.)	0	1	2	3	4	5	6	7	8	9

If you could change anything about PLATO what would you change? (You may use the other side).

PLATO QUESTIONNAIRE

SECTION II

	Very Strongly Disagree									Very Strongly Agree
1. The method by which I was told whether I had give a right or wrong answer became monotonous.	0	1	2	3	4	5	6	7	8	9
2. Nobody really cared whether I had learned the course material or not.	0	1	2	3	4	5	6	7	8	9
3. I felt challenged to do my best work.	0	1	2	3	4	5	6	7	8	9
4. I felt isolated and alone.	0	1	2	3	4	5	6	7	8	9
5. I felt as if someone were engaged in conversation with me.	0	1	2	3	4	5	6	7	8	9
6. As a result of having studied by this method, I am interested in learning more about the subject matter.	0	1	2	3	4	5	6	7	8	9
7. I was more involved in operating the terminal than in understanding the course material.	0	1	2	3	4	5	6	7	8	9
8. The learning was too mechanical.	0	1	2	3	4	5	6	7	8	9
9. I felt as if I had a private tutor.	0	1	2	3	4	5	6	7	8	9
10. The equipment made it difficult to concentrate on the course material.	0	1	2	3	4	5	6	7	8	9
11. The situation made me quite tense.	0	1	2	3	4	5	6	7	8	9
12. PLATO as used in this course, is an inefficient use of the student's time.	0	1	2	3	4	5	6	7	8	9
13. My feeling toward the course material after I had had completed the PLATO portion of the course was favorable.	0	1	2	3	4	5	6	7	8	9
14. I felt frustrated by the situation.	0	1	2	3	4	5	6	7	8	9
15. I found the computer-assisted instruction approach in in this course to be inflexible.	0	1	2	3	4	5	6	7	8	9
16. Material which is otherwise interesting can be boring when presented on PLATO.	0	1	2	3	4	5	6	7	8	9

	Very Strongly Disagree								Very Strongly Agree
17. I was satisfied with what I learned while taking the course.	0	1	2	3	4	5	6	7	8 9
18. In view of the amount I learned, this method seems superior to classroom instruction for many courses.	0	1	2	3	4	5	6	7	8 9
19. I would prefer PLATO to traditional instruction.	0	1	2	3	4	5	6	7	8 9
20. PLATO instruction is just another step toward de-personalized instruction.	0	1	2	3	4	5	6	7	8 9
21. I was concerned that I might not be understanding the material.	0	1	2	3	4	5	6	7	8 9
22. The responses to my answers seemed appropriate.	0	1	2	3	4	5	6	7	8 9
23. I felt uncertain as to my performance in the programmed course relative to the performance of others.	0	1	2	3	4	5	6	7	8 9
24. I was not concerned when I missed a question because nobody was watching me.	0	1	2	3	4	5	6	7	8 9
25. I found myself just trying to get through the material rather than trying to learn.	0	1	2	3	4	5	6	7	8 9
26. I knew whether my answer was right or wrong before I was told.	0	1	2	3	4	5	6	7	8 9
27. In a situation where I am trying to learn something, it is important to me to know where I stand relative to others.	0	1	2	3	4	5	6	7	8 9
28. I guessed at the answers to some questions.	0	1	2	3	4	5	6	7	8 9
29. I was aware of efforts to suit the material specifically to me.	0	1	2	3	4	5	6	7	8 9
30. I was encouraged by the responses given to my answers of questions.	0	1	2	3	4	5	6	7	8 9
31. In view of the time allowed for learning, I felt too much material was presented.	0	1	2	3	4	5	6	7	8 9

	Very Strongly Disagree									Very Strongly Agree
32. I entered wrong answers in order to get more information from the machine.	0	1	2	3	4	5	6	7	8	9
33. I felt I could work at my own pace.	0	1	2	3	4	5	6	7	8	9
34. Questions were asked which I felt were not relaed to the materials presented.	0	1	2	3	4	5	6	7	8	9
35. Material which is otherwise boring can be interesting when presented by PLATO.	0	1	2	3	4	5	6	7	8	9
36. I could have learned more if I hadn't felt pushed.	0	1	2	3	4	5	6	7	8	9
37. I was given answers but still did not understand the questions.	0	1	2	3	4	5	6	7	8	9
38. The course material was presented too slowly.	0	1	2	3	4	5	6	7	8	9
39. The responses to my answers seemed to take into account the difficulty of the question.	0	1	2	3	4	5	6	7	8	9
40. While on PLATO, I encountered mechanical malfunctions.	0	1	2	3	4	5	6	7	8	9
41. Computer-assisted instruction did not make it possible for me to learn quickly.	0	1	2	3	4	5	6	7	8	9
42. PLATO could be much better if the lessons were improved.	0	1	2	3	4	5	6	7	8	9
43. The lessons on PLATO were interesting and really kept me involved.	0	1	2	3	4	5	6	7	8	9
44. What I learned from PLATO made the classroom and laboratory instruction easier to understand.	0	1	2	3	4	5	6	7	8	9
45. The PLATO lessons were dull and difficult to follow.	0	1	2	3	4	5	6	7	8	9

PLATO QUESTIONNAIRE

SECTION III

	Very Strongly Disagree									Very Strongly Agree
As a student, I do my best work with										
1. Movies and filmstrips.	0	1	2	3	4	5	6	7	8	9
2. PLATO lessons.	0	1	2	3	4	5	6	7	8	9
3. Study guides and workbooks.	0	1	2	3	4	5	6	7	8	9
4. Instructor lessons.	0	1	2	3	4	5	6	7	8	9
5. Laboratory instructions.	0	1	2	3	4	5	6	7	8	9
6. Programmed texts.	0	1	2	3	4	5	6	7	8	9
Working with the PLATO system:										
7. Is fun.	0	1	2	3	4	5	6	7	8	9
8. Is frustrating.	0	1	2	3	4	5	6	7	8	9
9. Is challenging.	0	1	2	3	4	5	6	7	8	9
10. Is annoying.	0	1	2	3	4	5	6	7	8	9
11. Is confusing.	0	1	2	3	4	5	6	7	8	9
12. Makes me proud of myself.	0	1	2	3	4	5	6	7	8	9
13. Is boring.	0	1	2	3	4	5	6	7	8	9
14. Is relaxing.	0	1	2	3	4	5	6	7	8	9
15. Is depressing.	0	1	2	3	4	5	6	7	8	9
16. Is enjoyable.	0	1	2	3	4	5	6	7	8	9
17. Is de-personalizing.	0	1	2	3	4	5	6	7	8	9
18. Is exiting.	0	1	2	3	4	5	6	7	8	9

	10% Of The Time									100% Of The Time
19. How often has PLATO worked when you have attempted to use it?	0	1	2	3	4	5	6	7	8	9
20. During how many sessions have the echanical interruptions made you want to stop using PLATO?	0	1	2	3	4	5	6	7	8	9
21. During your school day, if you had your choice, how much of your time would be spent working with PLATO?	0	1	2	3	4	5	6	7	8	9

PART B

INSTRUCTOR ATTITUDE RELATED TO THE USE OF THE PLATO IV SYSTEM AT CHANUTE

by

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TABLE OF CONTENTS - PART B

I. INTRODUCTION

Background

An important aspect of the implementation of computer-based education (CBE) is the attitude of instructors. This report examines the attitudes of instructors at Chanute AFB, a site with 30 PLATO IV terminals. These attitudes were shaped by the instructors' experience while observing students as they proceeded through their CBE lessons or while working at PLATO terminals (i.e., "on-line") themselves. The significant impact of the instructor attitudes on the pedagogical effectiveness of the lessons is noted (see section on "Attitudes of Others").

These attitudes were measured in several ways. MTC staff interviewed the instructors individually and in a group. This investigator administered to the instructors a questionnaire regarding the specific lessons and an on-line survey (Avner, 1976a) on attitudes in general. In addition, separate reports on student attitudes in the vehicle training course have been prepared by Dallman, DeLeo, Main, and Gillman (1977), and by Tatsuoka, Misselt, and Maritz (1978).

Relevant Factors

Several factors contributed to the formation of instructor attitudes:

1. the ease with which the terminal keyset could be used (i.e., design/use characteristics);
2. the reliability of the system during the time when the students were scheduled to work;
3. the quality of the lesson materials being used;
4. the attitudes of fellow instructors, and less directly, other individuals who influenced the students' feelings toward the system;
5. the quantitative and qualitative benefits the students perceived from the time and effort invested in study of the lessons.

Each of these factors is considered in the formulation of a comprehensive estimate of instructor attitudes.

Expression of Attitudes

Students and instructors indicated their opinions in various ways:

1. orally to each other or to the staff during or after a session in a particular lesson;

2. in written form either on paper (i.e., hard copy) or in various comment files maintained on the PLATO system;

3. in a non-verbal fashion by their action/inaction when observers from CERL were present (i.e., a student spending an excessive amount of time on certain frames) the instructors could, if they were so inclined, then act on this situation by calling these frames to the attention of the authors.

The attitudes of the teaching and support staff, coupled with those of the students, helped to give a comprehensive perspective of the total learning environment.

II. SPECIFIC FACTORS AFFECTING ATTITUDES

Interaction with the Keyset and Terminal

It was the considered opinion of the instructor staff that students had little trouble working with the keyset at the PLATO terminal. This was the case even though the students taking the special purpose vehicle and general purpose vehicle courses had a technical, "hands-on" orientation to work. As one former instructor put it, these students would rather "have a wrench in their hands," instead of a keyset.

The instructor staff members were conscientious and concerned with the needs of students interacting with PLATO. As an example, when some of the students complained that the semi-darkness in the PLATO classroom (to control glare on terminal screens from overhead lighting) made note-taking difficult, a small high-intensity lamp was installed near each terminal. In addition, most of the questions within the lessons were multiple choice, one word, or short answer in format. This facilitated the interaction with the terminal by reducing the amount of typing required. These concerns for human factors tended to eliminate any difficulty with the use of the keyset.

Reliability of System

In the first few years of PLATO system operation, there was considerable concern over the reliability of continuous service. That there were major problems at that time cannot be denied. However, the quantity and duration of interruptions have been steadily reduced by system changes and improvements, both in software and hardware technology.

In addition, careful records have been kept since 1974 listing interruptions of service during prime time usage periods as well as reasons for the interruptions (Avner, 1974). Statistics on reliability have also been documented in the ARPA annual and semi-annual reports (i.e., CERL, 1975, 1976). Nevertheless, the general increase in trouble-free operating time is of little comfort to the student who experiences a crash in the middle of a lesson.

When there is an interruption of system operation, the Chanute instructors wait to see if service will resume momentarily. The PLATO system staff members are sometimes queried by telephone regarding the expected time of resumption of service. If it is apparent that service will not be restored shortly, the instructors take the students to a different classroom and proceed to teach (via traditional lecture and discussion methods) the materials that would have been covered in the PLATO materials had there been no interruption. There is the chance that the instructors might not feel prepared to take over the class on a moment's notice, and thus they are very concerned about the probability of resumption of service. In addition, there appears to be little enthusiasm for these impromptu lectures among the instructor staff even though some may have been critical of PLATO system operation in general.

System interruptions occur for a variety of reasons as a result of software and hardware problems. During scheduled weekday periods, there is usually no advance warning before an interruption or "crash" occurs. However, authors can insert special commands at appropriate places in their lessons so that, once the system is working again, a student can continue on from approximately the point he or she had reached before the interruption to service. This "restart" feature also allows students to leave the terminal either for a break or at the end of the day and automatically return at a later session to where they had left off.

Observations made at Chanute show that these precautions were not always taken by the authors of the CBE materials, and even when implemented, the existence or use of these restart points was apparently not understood by instructors. They were observed informing the students that they should leave their records "signed-in" while the students left the room to take a short break. The reason given was that this procedure would keep their place so that the students would not have to repeat a large portion of the lesson when they resumed work. This caution on the part of the instructors indicates that either there were some lessons with inadequate numbers of -restart- points or that the instructors had not been fully trained as to the normal functioning of the -restart- points.

A frustration frequently expressed by the Chanute staff members is that they received insufficient information from PLATO system staff when they inquired about the reasons for interruptions of service: the estimated length of the break in service, type of problem, action being taken, or related matters. The instructors found no relief in answers that they considered vague and lacking substantive information. Because they reacted rather subjectively, they often felt that the PLATO computer's operator and other system staff were unaware of the consequences of interrupted service. The instructors gave the impression that they felt that Chanute in particular was being victimized: "Don't they realize we have a classroom full of students up here?" was a remark made by several of the staff during a group interview.

Leaving aside the obvious fact that central system failures affect all users, not merely those at one site, there may have been legitimate grounds here for expecting improved feedback about the anticipated duration of the downtime. Since the time that these instructor opinions were gathered, a device has been implemented to indicate this information. A CERL report deals with the problem of reporting reliability (Avner, 1978).

The instructors felt that system failures were a serious problem for students. However, there was little understanding of the possible reasons for these interruptions. Even the usual preventive maintenance time (0600-0740 every day) was viewed critically: "Don't they know that we want to run students early in the morning?" might sum up their collective rejoinder. This same feeling about system interruptions in general was expressed in an on-line survey (Avner, 1976a). Fifteen Chanute instructors were asked to respond to an attitude survey using this same instrument: of the ten respondents, six instructors felt that system interruptions were a minor problem while four considered them to be a major problem (Table 1). Therefore, it is clear that any lost time in service, scheduled or not, resulted in a very negative impression on the Chanute staff.

The actual student attitudes toward interruptions of service may be different from what was suggested by the instructors. Preliminary results from the analysis of student questionnaires indicate that the influence of the crashes may not have been as substantial as previously expected. For more details on student attitude results, see Tatsuoka et al. (1978).

Table 1: Survey of Author/Instructor Attitudes toward your class.

Suppose in the future you had to teach the course for which you had the most PLATO experience. Would you use PLATO again?

a. never	0
b. probably not	0
c. not really sure	0
d. probably would	4
e. absolutely	6

Potential problems you have seen with PLATO

	no prob	minor prob	major prob
1. lessons not designed for students	6	3	1
2. low quality of lessons	3	6	1
3. lack of lessons on desired topics	2	5	3
4. system crashes in the middle of classes	0	6	4
5. red-lighting of terminals*	2	7	1
6. keeping terminals repaired	0	10	0
7. having enough terminals for all students	0	8	2
8. ECS (can't use all lessons needed during class)	0	5	5
9. basic dehumanizing character of computers	8	2	0
10. student difficulties in use of equipment	6	4	0

*Telephone line errors interfering with the transmission of student key presses between the terminals and the central computer.

Potential benefits of using PLATO

	no evidence	possible ev.	clear ev.
1. gives students experience not otherwise available	3	6	1
2. allows better teaching of regular material	2	4	4
3. permits more to be covered	1	6	3
4. saves time of students	1	2	7
5. saves time of instructors	0	1	9
6. gives instructors better evidence of student needs	2	6	2

Quality of the Lessons

Notwithstanding any hardware or software difficulties of the system, the lessons themselves have made a very favorable impact on the students, according to the instructors at Chanute. During a group interview, the instructors unanimously agreed that the lesson quality was high and covered all the necessary subject matter for the relevant areas. A similar result was found when a questionnaire on specific lessons was sent to each indiviual instructor; thirteen instructors were asked to fill out the questionnaire. Though only four responded, three felt that the lessons were average or above average in quality (Table 2). As additional evidence, an unsolicited conversation with a former Chanute student has confirmed this positive orientation (personal communication to a CERL staff member, 1976).

During MTC observations of students, some lesson characteristics were noted as making a positive impression on the students. For example, the complimentary feedback after a correct answer to a question (e.g., "Fantastic!") and the visual impact of microfiche images were seen to generate enthusiasm. However, students sometimes failed to read the feedback to an incorrect response and they did not always study the "HELP" sequences suggested by the lesson's program. The old bromide about leading a horse to water seems appropriate here.

Table 2: Ranking of Eight Specific Lessons[1]

Categories:

1 = unacceptable as it stands
2 = acceptable only if substantially improved
3 = acceptable as is
4 = a fairly good lesson
5 = one of the best lessons I've seen

--- = instructor not familiar with lesson

	Inst.A	Inst.B	Inst.C	Inst.D	Avg.
emissions (cha3)	4	3	4	3	3.5
starters (cha41)	5	3	3	4	3.7
transmission(cha73)	5	---	4	4	4.3
diesels (cha74)	3	2	3	4	3.0
hydraulics (cha78)	5	2	2	5	3.5
drive shaft (cha82)	3	2	4	3	3.0
PTO (cha86)	3	2	3	2	2.5
electricity (cha97)	5	2	2	4	3.2
Averages	4.1	2.3	3.1	3.6	3.3

(Table 2 cont.)

Comments:

1. These particular lessons were selected since detailed reviews of them had been prepared by the author (Klecka, 1977a).

2. The small number of respondents to the questionnaire makes any conclusions drawn from it very tentative.

3. The data available indicate that most instructors felt the lessons were at least satisfactory in quality.

4. A group interview with Chanute authors and instructors revealed little dissatisfaction with the lessons except for a lack of enthusiasm for the forced review technique.

5. The group interview also included instructors who did not respond to the questionnaire above. The conclusions drawn from that interview support the data above.

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[1]These lessons were critiqued in Klecka (1977a).

Students were frequently observed by Chanute and MTC staff to be taking extensive notes while going through the PLATO lessons. When queried, the instructors readily agreed that this habit was not only tolerated but openly encouraged; however, the checking of notebooks by the instructors was considered optional, according to a Chanute staff member. Also, in some cases an instructor would even help a student take notes properly so that he would not continue to copy everything on the screen. When questioned about this, several instructors suggested that the students felt more comfortable when they had something in a written form that they could take with them for later review.

This feeling of satisfaction when their well-annotated notebooks were at hand may have been a contributing factor to a positive attitude toward the PLATO system. Also, the lack of a textbook written specifically for the topics covered in the CBE lessons may have been significant in encouraging extensive note-taking. The students may have felt that the material presented on the screen was worth transcribing and retaining for future reference. In addition, the lessons on the system were only available to students during their CBE class periods--they had no

opportunity to come in at other times to review material for added comprehension. All these factors played a part in the extensive note-taking, and there were few objections to this practice from the staff.

Attitudes of Others

In past studies of PLATO usage, the attitude of the instructor toward the computer system has been shown to have an effect on student attitudes (Avner, 1976b). Consequently, this relationship was investigated at Chanute in the present study. When instructors were interviewed, they stated that they were all very interested in student opinions of the PLATO system and solicited such opinions regularly. They tried to keep their own feelings to themselves in order to avoid coloring student attitudes, but in general they had a rather positive CBE orientation.

A negative attitude in particular might have a deleterious effect on the impact of the materials on students. If the instructors are not convinced of the value of CBE, it is possible that this feeling will be transmitted to the students. Since it is unlikely that anyone can be truly impartial and unbiased, the neutral to positive attitude of the Chanute instructors is preferred. It is a definite improvement over the initial lack of enthusiasm that was present among the staff members (Klecka, 1977b; Dallman, et al., 1977).

In spite of the fact that most of the classroom instruction for the vehicle maintenance course is presented via PLATO lessons, staff members must still be present with the students working in the classroom. The instructors or instructors' assistants (Dallman et al., 1977) are needed to answer any questions that come up on specific points in the lessons as well as to provide alternative explanations for students having difficulty with the standard presentation. Even though they felt that PLATO instruction provided a standardized format (not subject to the vagaries of instructors' methods on different days of teaching), they agreed that there is still room for each student to get individualized help from the instructor if needed and/or wanted.

Contrast the above picture of instructor attitudes with that given by a former director of the Instructional Systems Development group. He argued that the group-paced mode of operation is the worst possible for instructors since the slowest student sets the pace. The instructor cannot sit down with the slower students for review and teach them carefully--that would generally mean the group would move at a still slower rate. He continued by saying that all the

instructor can do is prod the student, or sit at the terminal and give him the answers so the group can move on. Further, the instructor is no longer the center of attention in the classroom, no matter what the subject of his lectures is (related to the instructional objectives or otherwise). The loss of the position of authority might reasonably tend to make the instructors less enthusiastic about the PLATO system.

Remarkably, the attitudes which the MTC/PEER Group found when interviewing instructors did not reflect the pessimism suggested by the discussion above nor the instructor dissatisfaction found by AFHRL evaluators (Dallman et al., 1977). This discrepancy may be due to the time variation at which the attitude measurements were made. The AFHRL evaluators gathered their data in February and July of 1975 and the comment from the ISD chief was made in the summer of 1975. In contrast, the data for this report were gathered in October, 1976. Some of the problems with the lessons may have been worked out along with increasing familiarity with the system by the instructors--these developments may have helped to improve their attitudes in time.

There was general agreement among the author and instructor staff that providing more Extended Core Storage (ECS or computer memory space) for accessing lessons during times of peak usage would help alleviate some difficulties. Certain problems with inadequate storage space mentioned by the instructors have also been observed by MTC staff: students frequently were unable to proceed from one lesson to another when ECS usage exceeded the base allotment guaranteed to the Chanute site for their use. It appears likely that these problems could be remedied by adding more ECS or similar memory space to the computer or by scheduling PLATO courses at other than peak usage time, a less likely alternative.

Another possibility is dividing the larger lessons into smaller segments to fit more easily into the limited ECS allocation. Doing this would also alleviate the memory shortage. As a consequence, it seems probable that an increase in available space for accessing lessons would improve instructor and possibly student attitudes. Of the ten instructors responding to the MTC survey, five felt that insufficient ECS was a minor problem while the remainder considered it a major problem (Table 1).

Interviews have suggested that instructor attitudes may have been influenced by an upper-level administrator who was reported to be reluctant to accept the computer as a suitable vehicle for delivering effective instruction. This reluctance was perceived by the instructors and the

authoring staff as a tendency by the administrator in question to simply mark time in hopes that the whole CBE program at Chanute would just fade away. The chief administrator was not interviewed so that an independent assessment of his attitudes cannot be given. However, his lack of apparent support was widely perceived among those closest to the project.

No evidence of any "ripple effect" was detected by this investigator among the instructors, but several lesson authors indicated this administrative feeling made them apprehensive about their status.

Perceived Benefits of System

Some indications of lesson quality can be gained from the previously-mentioned questionnaire as well as interviews with the instructors themselves. Although not specifically stated by the instructors, it might be correctly assumed that not only what is presented (i.e., technical subjects), but also the interactive format in which this material is displayed plays an important role in the positive benefits that can be gained. Also, it was suggested by the instructor staff in an interview, but not actually observed by them, that a student might be more inclined to ask a question at the terminal (e.g., the definition of an unfamiliar term) than he would in the classroom before the critical gaze of his peers. If the CBE tutorial format does make students less inhibited about the subject matter, it in fact is fulfilling a very useful role.

It cannot be denied that recreational uses of the computer contribute to students' positive feelings toward the PLATO system. In fact, the authors and/or instructors had to enforce a policy that recreational uses of the system were not allowed during the class period since they interfered with progress through the assigned lessons--the students would rush through the material in order to begin playing games, according to Chanute staff. This inclination to utilize the system resources for recreational uses may have been a factor at an early stage for a very casual attitude on the part of the instructors toward CBE: it was satisfactory for playing games but perhaps not for more serious instructional purposes.

The extent to which the students were cognizant of the individualizing character of PLATO lessons can only be measured approximately. However, some of the previous comments on their reaction to feedback indicate that they can appreciate the individualizing aspects of a CBE lesson when these are encountered. Nevertheless, there is a question as to the difficulty of the reading level of

particular lessons. Some instructors felt that the students could read at an acceptable level to understand all the lessons, while others were less certain.

Conveniently, as part of another study, an analysis of the reading levels in selected lessons was undertaken ("Readability study" by R. A. Avner in Klecka, 1977a). In that study it was determined that the reading level in some was approximately three grade levels higher than the reading level of a typical Chanute student. Thus the observations of the instructors to the effect that the lessons were of an appropriate level of readability seem to be confirmed. Unpublished studies by the Military Training Centers and PLATO Educational Evaluation and Research group staffs indicated that the reading level variations from lesson to lesson apparently have a relatively small effect on a broad range of performance variables.

III. MONITORING and RECORDING of STUDENT/INSTRUCTOR COMMENTS

The instructor opinions discussed above were shaped through lengthy interaction with the students in their courses. These students expressed their opinions either orally as they went through their assignments or in written comments solicited at the end of the course. The communication of these remarks will be discussed in more detail since they furnished the foundation for much of the material in this report.

Oral Remarks

As they went through their assignments, the students were quite expressive to their peers and to the instructors on various aspects of the lessons and system. For example, a system crash would occasion negative comments which were vocalized loudly enough to be heard by the instructors present. Also, particular frames of a lesson might elicit questions from the student or even exclamations on some aspect of that particular frame or interaction. Thus, the instructor present in the classroom was in an excellent position to collect and interpret these informative comments.

Written Comments

Two avenues were available for students to record their comments in written form:

1. a notes file available while the student was on-line, or

2. AF form 736 administered at the end of whole course of instruction.

In addition, an instructor notes file ("chanotes") was available for staff use to insert specific comments on particular lessons. Each method furnished different types of information regarding the course, particular lessons, or the instructor staff.

Student notes file. Use of the student notes file ("chastudent") after January 1, 1977, served to open up another means for obtaining feedback from students. It was accessible by students at any point in the lessons to make comments of either a general or specific nature. Appropriate encouragement from the instructors and an observed willingness on the part of the students to cooperate indicated that this means of communication about lesson problems would be useful in making the needed changes.

Points of high student frustration can be readily identified through the student notes mechanism because notes initiated by students are automatically labeled with location information. At the time of this writing, the use of the lesson notes feature at Chanute was still in the early stages of implementation. Some of the comments were generally favorable, but they, like some derisive ones, were not specific enough to be useful i.e., they didn't identify strategies that were well-liked and hence should be replicated. Some more recent notes, however, did pertain to specific aspects of the lessons and may be worth considering. Examples of the latter are given below, with the names changed to protect anonymity.

Figure 1: Examples of Useful Student Notes

chastudent 2/10/77 11:54 am harris/ spveh1
lesson: mrouter site: chanute 10-11

Concerning the section on transmissions there should be either plato pictures or slides on the location and operation of turbines and stator. Diagrams are needed for a proper understanding of the operation of transmissions.

chastudent 2/15/77 11:54 am blake/ spveh1
lesson: mrouter site: chanute 10-11

In the basic electricity course, there aren't enough examples on parallel and series-parallel circuits. So I feel you should correct your lesson plan.

Course critique form. The regulation AF course critique form (AF form 736) furnished only general comments on the particular course, and it was not very useful for locating specific problems within the lessons or in teaching strategies. Also, the time span between completing the lessons and filling out the form made the recall of specific comments difficult. The course critiques are all given at the end of the entire course, according to a staff member. Although any comments are usually better than none at all, the data presented in these forms were difficult to evaluate due to their general nature.

When instructors were queried regarding the usefulness of these critiques, there was limited interest in them as a tool for corrective action. It was felt by the evaluator that they were administered because AF regulations required them; but no enthusiasm was evident for analyzing their contents. This feeling is probably justifiable considering the format as well as the timing: the form is administered when students have already completed the course and hence have little additional interest in it.

Instructor notes file. A fairly late development in the operation of the PLATO-based Training System at Chanute was the use of a group notes file ("chanotes") for instructors to put in their comments on lessons. These notes were read by the Chanute CBE authoring staff and the recommendations for changes in the lessons were taken under advisement. This file offered another avenue of recording and acting on relevant remarks.

Instructors were also able to make comments on individual test items and specific student responses to these items by the use of various data collection and management files. For detailed information on this subject, see "Computer-Aided Management at Chanute," Chapter 2 of Klecka (1977b).

IV. CONCLUSIONS

As in any situation, the attitude of the users and thus the benefits derived from the system can be improved by implementation of certain changes. It is hoped that this process will be aided by the following conclusions:

1. interruptions of system service had a negative effect on the attitudes of the instructors;

2. virtually all instructors surveyed felt that the Chanute lessons were of average or above average pedagogical quality;

3. the attitudes of instructors did have a generally favorable effect on the students, according to Chanute staff;

4. in general, according to the instructors, the students had a positive attitude toward the PLATO system, although there was still some residue of viewing it as experimental which may have induced a slightly more casual attitude;

5. up to the time of the writing of this report, student comments delivered orally tended to be more specific and therefore more useful for lesson revision and pedagogical modifications than those written down in course critique forms (AF form 736);

6. the student notes and lesson file capability offered the opportunity for improvement of lessons based on a broader range of specific comments.

REFERENCES

Avner, R.A. "crash." A University of Illinois PLATO system lesson. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, 1974.

Avner, R.A. "output." A University of Illinois PLATO system lesson. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, 1976a.

Avner, R.A. Personal communication, 1976b.

Avner, R.A. Reliability of CBE systems. Urbana, Ill: University of Illinois, Computer-based Education Research Laboratory, 1978.

Dallman, B.E., DeLeo, P.J., Main, P.S., & Gillman, D.C. Evaluation of PLATO IV in vehicle maintenance training (AFHRL-TR-77-59). Lowry AFB, Col.: Air Force Human Resources Laboratory, 1977.

Computer-based Education Research Laboratory. Demonstration and evaluation of the PLATO IV computer-based education system. Annual report sponsored by Advanced Research Projects Agency for the period January 1, 1974 - December 31, 1974. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, April 1975.

Computer-based Education Research Laboratory. Demonstration and evaluation of the PLATO IV computer-based education system. Semi-annual report sponsored by Advanced Research Projects Agency for the period January 1, 1976-June 30, 1976. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, August 1976.

Klecka, J.A. An overview of Chanute lessons. MTC Report #10. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, 1977a.

Klecka, J.A. Three aspects of PLATO use at Chanute AFB. MTC Report #11. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, 1977b.

Tatsuoka, K.K., Misselt, A.L., & Maritz, P.L. Attitudes and performance of military students in computer-based technical training. In K.K. Tatsuoka & A.L. Misselt (Eds.), Attitudes and performance of military students and instructor attitudes in computer-based technical training. Urbana, Ill.: University of Illinois, Computer-based Education Research Laboratory, 1978.