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By-Hedl, John Joseph, Jr.

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Descriptors-Educational Technology, *Feedback, Individual Study, Learning Theories, *Programed Instruction, Student Attitudes, *Student Role, *Teacher Role, *Time Factors (Learning), Tutoring

To examine the effects of varied roles, forms of feedback, and error spacing on subject attitudes and learning in programed instruction (PI), 125 students in an introductory psychology course were randomly assigned to treatment groups differentiated by three ways of spacing error-producing frames (spaced, semi-massed, and massed), two forms of feedback (knowledge of results or explanation), and three subject roles (teacher, pupil, or individual). Over 12 days, subjects completed a pretest, an attitude toward instructional media scale, study of the course material, a posttest, a computer-based testing attitude scale, and another posttest to assess the effects of explanation on learning. Results of analyses of variance of the data showed significant learning of course material for all students between pre- and posttest scores, that individual role subjects performed better than teacher and pupil role subjects, that feedback in the form of explanation was more effective than knowledge of results, and that the method of spacing error-producing frames did not adversely affect student attitudes toward PI. In addition, it appears that attitudes toward PI and computer-based testing were generally dependent on the number of errors made on the tests, and that student attitudes toward technology did not affect performance. (SP)

A SYSTEMATIC INVESTIGATION OF THREE FACETS OF PROGRAMMED INSTRUCTION: TUTORIAL ASSISTANCE OF STUDY, EXPLANATION OF INCORRECT ANSWERS, AND THE SPACING OF HIGH-DIFFICULTY FRAMES

Technical Report 4

The work reported herein was performed in the Florida State University Computer-Assisted Instruction Center under Office of Naval Research N00014-68-A-0494.

CAI CENTER

Institute of Human Learning

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ABSTRACT

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Publication No.

John Joseph Hedl, Jr.
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The research in this report was concerned with a student tutorial method of instruction and the effects of the distribution (spacing or massing) of explanation of incorrect student responses on cognitive and attitudinal variables. The experimental design was a 3 x 2 x 3 factorial with seven observations per cell. Three types of programmed instruction treatment materials were employed reflecting the differential placement of the high-difficulty frames. Version 1 consisted of twenty-one difficult "integration" frames being placed every eighth or ninth frame. Version 2 was developed with these frames massed together at the conclusion of Units 1 and 2, ten per unit. Version 3 consisted of experimental frames being presented at the end of Unit 2.

Therefore, two types of learning materials differing only in difficulty were included in the investigation.

Two forms of feedback were employed, for the high-difficulty frames, either explanation or simply knowledge of results (KR). An explanation consisted of a detailed statement concerning the particular frame's content.

Within the paired grouping of students, two roles were possible, either tutor-role or pupil-role. The third experimental role consisted of students studying individually.

The results of this investigation showed that paired students (tutor-pupil) perform as well as the individuals for the difficult learning material while the tutor-role students performed the poorest on the conventional linear text when compared to the individuals.

The coalition of student tutor and explanation did not aid the learning of the difficult learning material, although explanation itself was found to reduce student errors for those students in the Version 3 treatment condition.

Student attitudes were not adversely affected by the manipulation of errors via the "integration" frames (error frames). The magniture of positive attitudes appeared to be dependent upon criterion test performance. Initial student attitudes toward modern instructional technology were not found to significantly effect performance.

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INTRODUCTION

The research in this report was concerned with a student tutorial method of instruction and the effects of the distribution (spacing or massing) of explanation of incorrect student responses on cognitive and attitudinal variables. Interest in a tutorial method of instruction has become a major concern of educational psychologists since the advent of Programmed Instruction (PI) and Computer-Assisted Instruction (CAI).

It may well be that a major use of student resources has been overlooked with the inception of these new technological innovations. Yancey (1968) states it this way:

> What might one do until the computer comes? Perhaps in the rush toward esoteric hardware for deliverance from our educational woes, we have overlooked a method of instrumentation that is quite sophisticated itself. This piece of gear is indeed a very good general purpose computer. It is readily available to any researcher due to the fact that it is produced happily by unskilled labor, resulting in quite an excess of supply and demand. It requires almost no maintenance and may be rented cheaply. It can be programmed via oral instructions spoken in ordinary English and/or via written material. It can also accept and process oral or written output, even diagrams drawn on the blackboard. Its output can even be a spoken word or a drawing on a surface. It can even project slides and point to relevant areas while giving concurrent verbal interaction. This computer has many names, but may be classified under the generic label "Student" (pp. 20-21).

Paired Literature

There have been far fewer studies on this topic than one would generally suppose, and thus the generalizations in the literature--that pairing is an advantageous method of programmed learning because it is more economical, is less boring for students, and that retention is better for paired students--are generalizations not well supported. There is, however, limited evidence that programmed learning in pairs may at least be as effective as individual programmed learning. Consequently, the question arises as to which is the best method of pairing.

In the experiments to date, three main methods have generally been employed: students have been paired at random, or in pairs of similar ability or pre-knowledge (homogeneous), or in pairs of dissimilar ability (heterogeneous). Sawairis (1966) paired his _S_s on the basis of both similar ability and dissimilar ability in the subject matter (geometry) as shown by pretest scores. No significant differences in posttest performance between the experimental groups was found. Hartley and Cook (1967) carried out eight miniature experiments on homogeneous and heterogeneous pairing. These authors found no evidence to support the hypothesis that working in a heterogeneous pair is an advantage for the poorer member. High-ability _S_s paired with low-ability _S_s were not hindered by the lower-ability member.

Grubb (1964) paired thirty _S_s into high-ability pairs and low-ability pairs on the basis of their scores on the College Entrance Examination Board (verbal only). His results indicated that _S_s paired according to verbal ability perform as well in statistics as their controls (individuals). No significant time difference was found.

Austwick (1965) compared three types of pairing with twelve-year-old _S_s. In this experiment high-ability _S_s were paired together, low-ability _S_s were paired together, and a random pairing was used. In addition there was a control group in which _S_s worked individually on the same program. Type of pairing was not found to significantly effect posttest performance. The paired groups performed as well as the individuals, but completed the one hundred fifty frame program in less time.

Dick (1963) was concerned with the effect upon retention of active participation in the form of discus,ion. The purpose of Experiment 1 was to determine if paired study (random pairs) of a 3,500 frame modern algebra course would result in superior retention in comparison to individual study of the program materials. The immediate posttest scores indicated no significant differences between paired and individual Ss. The paired group required significantly longer to complete the program; an average of 3.7 minutes per unit or less than two seconds longer per frame. The author reports that there were no attitudinal differences between the experimental groups.

Experiment 11 dealt with re-test results after a period of one year. Ss were the same participants involved in experiment 1. Eighty percent of the original number of Ss were available for re-testing. After adjusting for initial performance, paired students' scores were found to be significantly higher than individuals. The best single predictor of retention was the final examination score.

Two studies have reported results which do not support the use of a type of pairing within a PI framework. Jones (1963) reported on the use of intrinsic programs presented via an Autotutor to teach managerial concepts to groups of three apprentices. Group presentation was less effective than individual presentation. Noble (1967) also found individual study superior to paired study of PI.

Besides ability-type pairings, personality variables have been used as a basis for student pairing. Dick and Sequin (1963) investigated the role of a dominance-submission factor on the performance of paired Ss. This personality variable did not predict the academic performance of the pairs. Recent work conducted by Majer (1969) has shown that individual personality, ability, and background characteristics differentially predict performance success.

Tutorial Studies

None of these studies attempted to differentiate student roles during the learning of the PI materials. Ss essentially worked independently and were only involved in verbal interaction with their respective partners when difficult concepts were encountered. Two studies, however, did attempt to make a teacher-pupil role distinction within any given pair of Ss.

Myers, Travers, and Sanford (1965) examined the effect of reinforcement on verbal learning by pairs and individuals. The task consisted of sixty German words and their English equivalents presented on flash cards. This experimental condition is not exactly PI, but the situations are analogous. Four learning conditions were employed: (1) a student playing the teacher-role, (2) a student playing the pupil-role, (3) students who would switch roles at the midpoint of the task, and (4) students who worked individually. Ss received feedback by reading the feedback statement on the reverse side of the card. Feedback was always in the form, "the right answer is___________." Condition 2 Ss (pupil-role only) showed superior learning to all other treatments. Condition 3 (reverse roles) performed better than Condition 1 (teacher-role only). No significant differences were found between Conditions 3 and 4.

From the results of the above study, it appears that students can be paired to each other effectively with materials required rote learning, although the teacher-role Ss showed the poorest performance. It may be that students cannot adequately perform when given added responsibilities. Still, the nature of verbal reinforcement given by another person is important for meaningful learning.

Another study which attempted to simulate a tutorial relationship was one conducted by Yancey (1968). He investigated the feasibility of using CAI programming techniques (without hardware) as a supplementary teaching aid for college students. An introductory psychology class was divided into three matched groups. Two groups used CAI-type programs with two _S_s working together--one _S_ playing the tutor role and the other _S_ serving as the typical student. One CAI group used a set of materials prepared to motivate the students to relate to the principles of psychology in addition to a PI text. The second CAI group used a PI text for the initial five weeks. During the succeeding five weeks the tutor-role _S_s were given copies of an introductory psychology text. Their task was to develop short questions based upon the chapters and then to pose these questions to students. _S_s were allowed to change roles during the course of the experiment. It was assumed that all _S_s had read the assigned chapters before the weekly experimental sessions. The third group merely participated in extra-class psychological experiments.

The two CAI-like groups performed somewhat better than the group which simply participated in order psychological experiments. Although the differences were not significant with regard to cognitive variables, the CAI groups rated the experience as being more meaningful.

Low and High Difficulty Learning Materials

In order to study the effects of a tutorial learning situation, special materials are required. A problem arises as to how to induce tutoring when a programmed text designed for almost total correct responses (low error rate) is used. In this case the tutor is virtually unnecessary in that his function would mainly be the imparting of knowledge of results. One method to induce a tutorial relationship would be to include a number of frames within the PI units which would result in errors on the part of the student. In this way the tutor's role would be just that, a tutor attempting to explain any misconceptions on the part of the student.

It is contended that the effects, if any, of a tutor can only be shown by the use of difficult learning material. Most of the earlier studies employed conventional linear programs which were written for error-free responding, the notion being that Ss only learn from correct responses. When paired students are together, there is really no reason to assume that greater learning should result. Through the use of difficult learning materials in conjunction with a conventional PI text, this hypothesis can be explored.

With the addition of the difficult "integration" frames (to be described later), two other independent variables can be manipulated; the spacing or distribution of the error frames and the detail to which the tutor-role S explains the incorrect answer. We shall deal with the latter of these two independent variables first.

Explanation of Incorrect Answers

One should possibly view explanation of incorrect answers as really being a form of repetition. Within the realm of PI repetition has not been found to be a significant factor for increasing learning and retention of meaningful verbal discourse material (Reynolds & Glaser, 1964), although repetition has been found to be a key factor in studies of overlearning (Postman, 1961) and retroactive inhibition (Briggs, 1957) with paired associate learning. It may well be that the ineffectiveness of repetition is due to the relatively low difficulty of the frames initially, wi-h repetition being virtually unnecessary.

When repetition is focused upon errors, the results are somewhat different. Holland and Porter (1961) focus upon the effects of repetition of incorrectly answered items within a PI framework. Using the Holland and Skinner program, The Analysis of Behavior, error rates were varied on one section of a ten unit text. One experimental group used the entire program as written by the original authors, repeating missed items at the conclusion of every item set until the item was answered incorrectly. The other group did not use this review feature. Instead, each frame was answered only once, regardless of the correctness of the response. At all three-item difficulty levels, the non-review group showed lower performance than the review group. The results of a six-month retention test revealed the same findings.

Explanation as a variable has been investigated by Bryan and Rigney (1956). The Pull-Tab was a device in which the subject received not only a "right" or "wrong" indication after his choice, but also a somewhat detailed explanation of "why" a response was incorrect. The data illustrated that the combination of immediate knowledge of results (KR) plus explanation if the student was in error, produced significantly higher cirterion test scores than if no explanation had been given. This finding is consistent with the result of Krumboltz and Bonawicz's (1962) study which showed that feedback presented in the context of a complete sentence was superior to the presentation of the feedback term alone.

The importance of Bryan and Rigney's research from a historical point of view is that it investigated immediate knowledge of results as a factor existing on a continuum with varying degrees of effect. Explanation and/or repetition does seem to have an effect with difficult learning material.

Spacing of the Difficult Material

The spacing or distribution of difficult material has not been investigated with regard to its effects in conjunction with explanation or KR on learning and student attitudes. A major concern involved in the present study was an attempt to determine whether explanation would be more effective when given periodically as in the Bryan and Rigney (1956) study, or in a semi-massed session at the end of each of the two PI units (Holland & Porter, 1961), or in a massed fashion at the conclusion of the second PI unit. With these three different spacings, it is possible to assess the relative effectiveness of the coalition of a tutor plus explanation or KR of incorrect answers in three different distinct learning situations.

Attitudinal Effects of Errors

Variations in the spacing of the difficult material also allowed for the study of the effects of error spacing on student attitudes. The effects of errors upon student attitudes is fairly well documented. Wodtke (1966) reported that a student's attitudes toward a certain method of instruction might be a result of his performance. Students who performed better on CAI tasks showed more favorable attitudes afterwards than those who performed poorly. Mathis, Smith, and Hansen (1968) found that Ss who studied CAI material with which they were familiar showed more positive attitudes than those who studied unfamiliar materials. Ss who committed the least number of errors were also found to be more favorable to the experience. Eigen and Feldhusen (1964) reported that student attitudes toward a program are generally negatively correlated with the amount of self-identified errors made while taking the program.

The results of these investigations show evidence that attitudinal measures are correlated with performance measures--the more errors involved, the less favorable student reaction tended to be.

Hypotheses

Based upon the reviewed studies and theory, the following hypotheses were formulated for the experiment. For conceptual clarity and explanatory insight, the research hypotheses were categorized into the following groups: (1) tutorial role, (2) explanation or KR of incorrect answers, and (3) distribution of incorrect answers.

Tutorial Role

For the conventional linear text material, no effects of a tutor should be encountered. In essence, the tutor merely monitor's the student's progress through the materials.

For the difficult material ("integiation" frames), it is hypothesized that the coalition of tutor and explanation of incorrect answers should lead to increased learning of this material for both tutor and pupil over that of the individual study plus explanation.

Explanation of Incorrect Answers

A dual role of explanation is hypothesized. Explanation should increase the learning of the difficult material, and as such, result in an increase in the positiveness of student attitudes. The second role of explanation is predicated on the basis of the known negative correlation between number of errors and student attitudes.

Spacing of the Difficult Material

An exploration into the relative effectiveness of explanation or KR of incorrect answers in three different situations in combination with a tutor is being made. In this regard, no predictions can be made based upon other previous work or theoretical position.

The distribution of errors (difficult material) should have an adverse effect upon student attitudes. The larger numer of errors committed in succession (massed condition) will have a more adverse effect upon student attitudes when compared to a distributed error condition (every eighth or ninth frame) or a semi-massed error condition.

Exploratory Analyses

The relationship between performance and initial student attitudes to modern instructional technology will be studied. Also to be explored is the relationship between Computer-Based Testing attitudes and test performance. Finally, the use of confidence ratings in the determination of test internal consistency reliablity will be explored.

All hypotheses will be tested at the .05 alpha level.

METHOD

Subjects

One hundred twenty-six students (90 females and 36 males) were obtained from an introductory educational psychology class at The Florida State University during the Winter Quarter, 1969. Ss were randomly assigned to the treatment groups. Five Ss were eliminated from the investigation; three Ss had dropped the course from their schedules while two Ss completed the first treatment session but did not complete the entire treatment procedure due to illness. Thus, the total N was reduced to 121. Participation in the investigation was a course requirement with the Ss' scores on Test 1 partially determining their final educational psychology course grade.

Experimental Design

The experimental design of the present investigation was essentially a 3 x 2 x 3 factorial with seven observations per cell. Due to certain unavoidable problems three experimental cells did not have an n of seven. Table 1 presents a description of the design. Three types of treatment materials with differential spacing of errors were used. For each set of materials two forms of feedback for incorrect answers were possible, either explanation or knowledge of results (KR). The third independent variable was subject role (teacher-role, pupil-role, or individual).

TABLE 1

EXPERIMENTAL DESIGN

Treatment Materials	Type of Feedback for Incorrect Answers	Student Roles Teacher (N=40)	Pupil (N=40)	Individual (N=41)
Version 1	Explanation	n=7	n=7	n=7
Spaced "Integration" Frames	Knowledge of Results	n=7	n=7	n=6
Version 2	Explanation	n=7	n=7	n=7
Semi-Massed "Integration" Frames	Knowledge of Results	n=5	n=5	n=7
Version 3	Explanation	n=7	n=7	n=7
Massed "Integration" Frames	Knowledge of Results	n=7	n=7	n=7

Treatment Materials

Low difficulty materials.--Two programmed units from Gibson's Educational Psychology were used as the treatment materials. Topics appropriate for an introductory educational psychology class, intelligence testing (Unit 1) and Piaget's theory of cognitive development (Unit 2) were used. The text is basically a multiple-choice program, written in a linear format with approximately one hundred frames per unit. A typical program frame is depicted in Figure 1. This small-step program required an active, overt response on the part of the student for every frame. The average student error rate per unit, as reported by Gibson (1967) was less than 3 percent.

Frame Number 41, Unit 1

The formula for determining the ratio IQ is: $10 = \frac{MA}{CA} \times 100$. When we determine the ratio IQ, we are taking into consideration:

a. mental age
b. number of correct answers to questions
c. chronological age
d. all of these

41.__________

Figure 1.--Example of Program Frame from Gibson (1967)

High difficulty materials.--A number of "integration" frames were designed to evoke student errors during the treatment sessions. In most cases, these frames required the student to integrate, synthesize, and apply concepts developed in Units 1 and 2. Twenty "integration" frames were initially developed by the investigator for both Units 1 and 2. A pilot study was conducted to determine the empirical difficulty of the "integration" frames.

THE PILOT STUDY

Subjects

Twenty Ss obtained from the introductory psychology classes at the Florida State University were used in the pilot study. Participation in this experiment was considered a requirement for the Ss' psychology class.

Materials

Two programmed units from Gibson's (1967) Educational Psychology were used in original form with the addition of twenty "integration" frames placed at the conclusion of each unit.

Procedure

During the Fall Quarter, 1968, Ss studied Units 1 and 2 individually in a quiet room. Ss were told that they were aiding in the development of these materials for future educational psychology classes. Ten Ss studied Unit 1 and ten Ss studied Unit 2. Ss were required to make all overt responses to the program frames.

Ss were required to rate certain frames according to difficulty using a five point Likert-type scale ranging from extremely easy (1) to extremely difficulty (5). All twenty "integration" frames for both units were rated in terms of difficulty in addition to twenty Gibson (1967) frames chosen at random from each unit.

Results

Of the forty "integration" frames, twenty-one (eleven for Unit 1 and ten for Unit 2) were selected for use in the investigation.

The rejected frames showed error rates ranging from 20 percent to 75 percent. The twenty-one frames selected had an error rate of 90 percent or better for the pilot Ss.

A one-way analysis of variance was computed for the ratings on the Gibson (1967) frames (Units 1 and 2) and the ratings for the "integration" frames. The results of this analysis revealed an F value of 33.57, 1 and 18 df, $p < .01$. The mean difficulty rating for Gibson's (1967) frames was 1.80. The "integration" frame mean difficulty rating was 3.67.

Discussion

The "integration" frames selected for the major investigation were indeed difficult as evidenced by the 90 percent error rate shown by these pilot Ss. Further evidence of difficulty, although subjective in nature, was shown by the significant difference in mean difficulty ratings between the original program frames and the "integration" frames.

Development of the Three Versions of Treatment Materials

With these "integration" frames three different versions of the treatment materials were developed with differences in the spacing of these frames. Version 1 consisted of these "integration" frames being spaced throughout Units 1 and 2 every eighth or ninth frame (Unit 1--Frames 14, 27, 39, 48, 70, 83, 90, 95, 102, 111; Unit 2--Frames 9, 30, 39, 53, 61, 73, 77, 84, 88, 91). Version 2 was developed with the "integration" frames massed together at the conclusion of the appropriate unit (Unit 1--Frames 115-125; Unit 2--Frames 91-100). Version 3 consisted of all the "integration" frames being presented at the end of Unit 2 (Frames 90-110).

Explanations were developed for each of the "integration" frames as well as for the original frames. Figure 2 shows an "integration" frame along with its explanation. Each explanation consisted of a statement of the correct answer and a number of statements designed to explicate the desired answers.

Student sees this frame only:

Given the following data:

	Test A	Test B	Test C	Test D
Tom	10	20	10	60
Bill	20	30	10	70
Mary	10	20	10	80
Sue	40	50	10	90
Jack	50	60	10	99

a. The correlation between Test A and Test B is about ________.

b. The correlation between Test C and Test D is about ________.

a. about +1.00
b. about 0.00 (zero)

Teacher has frame plus the following explanation:

The correlation between Test A and Test B is about +1.00. From a person's score on Test A, one can accurately predict his score on the second test (B). Remeber: correlation expresses the extent to which scores on one test "go" with scores on another.

The correlation between Test C and Test D is about 0.00 (zero). It would obviously be impossible, within such a group, to predict an individual's score on Test D just knowing his Test C score. The scores on Test D reflect an increase. These scores do not "go" together, therefore, one should expect an extremely low correlation between them.

Figure 2.--Example of a unit 2 "integration" frame complete with explanation.

Dependent Measures

Pretest (Appendix A)

For use as a pretest measure, twenty representative items were selected from the fifty item posttest (Test 1); ten items per unit.

Attitude Scale Toward Instructional Media (Appendix B)

A ten item Likert-type scale was devised to assess an orientational attitudinal set toward modern instructional technology in general. The items allowed for responses on a five point scale ranging from Strongly Disagree to Strongly Agree. This scale is an adaptation of the Brown (1966) CAI attitudinal measure.

Test 1 (Appendix C)

Test 1 consisted of fifty multiple-choice items principally chosen from a number of introductory educational psychology textbooks with a minimal number (7) being devised by the experimenter. This test was used to measure student learning of the original Gibson (1967) programmed units. Twenty-five items were devoted to both Units 1 and 2.

Test 1 was administered via the IBM 1500 instructional system. This system consists of a central processing unit, storage units, a transmission control unit, and twenty-one cathode ray tube terminals (CRT). Student input for all responses was restricted entirely to light pen responding. During the administration of Test 1, Ss were required to rate their confidence in the correctness of their answers via a seven-point Likert-type scale. This scale ranges from 1 (unsure) to 7 (positive my answer was correct).

Two separate scoring procedures were employed to determine the internal reliability of Test 1. The coefficient of reliability was determined through the use of the analysis of variance. It is exactly equivalent to the Kuder-Richardson 20 estimate (Guilford, 1954, p. 383).

Method 1 consisted of assigning 1's and 0's for correct and incorrect responses respectively. Method 2 scored each item as the product of "correctness (+1 or -1) times the confidence value for the particular item." For example, if student 1 answered item 1 correctly and indicated a confidence rating of 7, his score would become +7 for that item. If he answered incorrectly and gave a confidence rating of 7, his score would be -7. The constant value of 7 was added to all transformed scores in order to eliminate the negative values obtained.

Table 2 presents the reliability estimates for Test 1 based upon the two scoring methods mentioned. Estimates for the entire fifty-item test are presented along with the estimates for the two units of the test. The scoring technique of obtaining the product of correctness times confidence increased the overall reliability from .645 to .687, which conforms to the conclusions drawn by Massengill and Shuford (1967). As to be expected, the reliability of the two units were increased with this new procedure.

KUDER-RICHARDSON 20 RELIABILITY COEFFICIENT FOR SCORING METHODS 1 AND 2

	Method 1 Reliability	Method 2 Reliability
Test 1 (50 items)	.645	.687
Part 1 (25 items)	.546	.578
Part 2 (25 items)	.404	.451

Programmed Instruction Attitude Scale (Appendix D)

To assess student attitudes toward the PI experience, a modified version of the Brown and (1966) CAI attitudinal scale was used. Brown (1966) reported a reliability of .89 for the forty-item scale. The modified version (25 items) has been shown to have a Kuder-Richardson 20 reliability of .822 (Smith, Hansen, & Hedle, 1968).

Computer-Based Testing Attitude Scale (Appendix E)

Ten attitude items were selected from an adapted version of the Brown (1966) scale by Hansen and Schwarz (1968) to measure student attitudes toward the Computer-Based Testing (Test 1) used in the present investigation.

Test 2

Basically, Test 2 was a second administration of the twenty-one "integration" frames studied in Units 1 and 2. This constructed-response measure was administered via conventional paper and pencil techniques. The purpose of this measure was to assess the effects of explanation upon the learning of difficult meaningful verbal discourse material.

PROCEDURE

Table 3 presents the experimental time schedule of the investigation.

TABLE 3

COMPLETION OF EXPERIMENTAL TEST SCHEDULE
BY DAY AND NUMBER OF SUBJECTS (n = 121)

Sequence of Events	Day			
	1	5	7	12
1. General Instructions	x			
2. Part 1, Pretest	x			
3. Administration of Orientation Attitude Scale		x		
4. Study of Unit 1		x	x	
5. Part 2, Pretest			x	
6. Study of Unit 2			x	x
7. Administration of PI Attitude Scale			x	x
8. Administration of Test 1			x	x
9. Administration of Computer-Based Testing Attitude Scale			x	x
10. Administration of Test 2			x	x
	n=121	n=121	n=58	n=63

During the scheduled class period prior to the initiation of the treatment procedures (Day 1) Ss were given general instructions concerning the investigation with regard to their assignment to the various experimental groups and also their room assignments. Ss were only told that varying study conditions would be employed. At this time Part 1 of the pretest was administered via conventional paper and pencil techniques. This pretest dealt with the concepts contained in Unit 1.

Five days later the students reported to their assigned rooms at the regularly scheduled class meeting time.

Each major treatment group (paired groups with explanation of incorrect answers, paired groups with KR of incorrect answers, and individuals) reported to a separate room.

Copies of student directions for all treatments are presented in Appendix F.

After the distribution the treatment materials (Unit 1 only at this time) Ss were instructed to read the instructions carefully and to pose any questions before study began. Following the instructions, the attitude scale toward instructional media was completed. Study via the different modes then ensued for approximately one hour. At the conclusion of the class period, Ss were required to hand all treatment materials to the assistants before leaving.

Two days later, Ss reported to their assigned rooms at the scheduled hour and received their materials from the assistants (Unit 1 and 2). The assistants instructed the Ss to complete study of Unit 1 before commencing to work on Unit 2. Upon completion of Unit 1, Ss completed Part 2 of the pretest. After completing this test (paper and pencil), Ss began study of Unit 2. Fifty-eight Ss finished the treatment materials during this two-hour session. Ss who completed the materials during this session were tested that afternoon and evening at the Florida State University CAI Center. Approximately 10

Ss were tested at any one of the scheduled testing times. Ss who did not finish at this time handed in their materials to the assistants at the conclusion of the class period.

On the twelfth day, the 63 Ss who had not completed Unit 2 reported to the main classroom to conclude study. All Ss completed the Pl attitude questionnaire immediately upon conclusion of study, regardless of the session in which they had completed the treatment materials.

Testing was accomplished as follows. Ss reported to the Florida State University CAI Center at their appointed time. After general instructions concerning terminal operations, Test 1 was administered via the IBM 1500 instructional system during the afternoons and evenings of February 27, 1969, and March 1, 1969. Ss were required to rate their confidence in the correctness of their answers for every Test 1 question. Ss were not given KR knowledge of results about their Test 1 responses, and were forced to rate each answer before continuing to the next question. At the conclusion of Test 1, three scores were displayed to the Ss on the CRT screen: (1) the score for Unit 1, (2) the score for Unit 2, and (3) the total score for Test 1.

Immediately following the administration of Test 1, the Computer-Based Testing Attitude Scale was completed by the Ss. Test 2 was then administered to Ss in a quiet room at the CAI Center.

Total testing time per subject was one-hour. Two Ss were tested later in the week due to scheduling problems.

RESULTS

There were one hundred twenty-one student performance records available for the analyses.

For efficiency of comparison, five mean scores were inserted into a number of analyses with the error term being adjusted (Kempthorne, 1952, p. 174) by a loss of 1 df for each inserted score.

For the present investigation, all independent variables were assumed to be fixed factors.

Pretest-Posttest Results

To determine whether or not students learned during the experimental sessions a 3 x 2 x 3 x 2 analysis of variance for three types of treatment materials, two forms of feedback, and three student roles, and pretest and posttest Test 1 scores (repeated measure) with seven replications was calculated for the Test 1 scores. Since these two dependent measures were not comparable with regards to the same total number of items, all scores were converted to proportion correct before analysis.

The results of this analysis (Table 4) revealed that Ss showed significant learning of the low difficulty Gibson (1967) material (F=486.0, 1 and 103 df, $p < .001$). A significant interaction between type of feedback (explanation or KR) and pre and posttest Test 1 scores was found (F=7.82, 1 and 103 df, $p < .01$). On the pretest, Ss assigned to the KR groups scored lower than the Ss assigned to the explanation groups while the reverse was true for the posttest. No other main effects or interactions were found to be significant.

TABLE 4

ANALYSIS OF VARIANCE OF PRE AND POSTTEST SCORES UTILIZING PROPORTION CORRECT AS THE DEPENDENT VARIABLE

Source	DF	MS	F
Between Subjects			
Materials (I)	2	.0238	2.48
Feedback (J)	1	.0010	----
Roles (K)	2	.0223	2.32
IJ	2	.0157	----
IK	4	.0099	----
JK	2	.0120	----
IJK	4	.0132	1.74
Subjects within groups L(IJK)	103	.0096	----
Within Subjects			
Tests (M)	1	3.6939	486.04**
IM	2	.0028	----
JM	1	.0594	7.82*
KM	2	.0187	2.46
IJM	2	.0008	----
IKM	4	.0064	----
JKM	2	.0027	----
IJKM	4	.0071	----
Mx Subjeccs within groups	103	.0076	----

*$p < .01$
**$p < .001$

Test 1 Results (low difficulty material)

A 3 x 2 x 3 analysis of variance for three types of treatment materials, two types of feedback, and three student roles with seven replications in each group was calculated for total posttest Test 1 scores. The results of this analysis (Table 5) yielded a significant difference on the role factor only (F=4.38, 2 and 103 df, $p < .05$). No significant effect for type of material or type of feedback was found. No interactions were found to be statistically significant.

TABLE 5

ANALYSIS OF VARIANCE FOR 3 TYPES OF MATERIALS, TWO TYPES OF FEEDBACK, AND 3 ROLE DIFFERENTIATIONS FOR TOTAL TEST 1 SCORES

Source	DF	MS	F
Materials (I)	2	24.44	----
Feedback (J)	1	40.80	----
Roles (K)	2	104.75	4.38*
IJ	2	11.78	----
IK	4	2.36	----
JK	2	19.51	----
IJK	4	39.51	----
ERROR	103	23.91	

*p < .05

To compare the mean scores for the three role variations, a Duncan's Multiple Range Test was computed (Table 6). Individual role Ss showed higher performance when compared to the teacher-role Ss. Individual-role Ss did not differ significantly from the pupil-role only Ss, nor did the pupil-role only Ss differ significantly from the teacher-role Ss.

TABLE 6

DUNCAN'S MULTIPLE RANGE TEST FOR TOTAL TEST 1 SCORES FOR STUDENT ROLES

Means		Difference Between Means	Least Significant Range Value
Individuals -	Teachers		
29.16	26.05	3.11	2.23 *
Individuals -	Pupils		
29.16	27.11	2.05	2.11
Pupils -	Teachers		
27.11	26.05	1.06	2.11

$*p < .05$

Two similar analyses (3 x 2 x 3) were computed on the two units of Test 1 with the above mentioned role effect being the only significant finding in both analyses. A Duncan's Multiple Range Test (Table 7) was computed for the mean student role scores for Unit 1, Test 1, The initial result of the Duncan's Multiple Range Test was confirmed in this analysis.

TABLE 7

DUNCAN'S MULTIPLE RANGE TEST FOR TOTAL SCORE ON UNIT 1 OF TEST 1 FOR STUDENT ROLES

Means		Difference Between Means	Least Significant Range Value
Individuals -	Teachers		
14.20	12.45	1.75	1.38 *
Individuals -	Pupils		
14.20	13.41	.79	1.31
Pupils -	Teachers		
13.41	12.45	.96	1.31

$*p < .05$

The results of Duncan's Multiple Range Test (Table 8) for the mean scores for Unit 2, Test 1 revealed slightly different findings for Unit 2 than for Unit 1. Individuals showed significantly higher performance than either the tutor-role Ss ($p < .05$) or the pupil-role Ss ($p < .05$). Tutors did not differ significantly from the pupil-role Ss.

TABLE 8

DUNCAN'S MULTIPLE RANGE TEST FOR UNIT 2 TOTAL SCORE OF TEST 1 FOR STUDENT ROLES

Means		Difference Between Means	Least Significant Range Value
Individuals -	Teachers		
14.96	13.61	1.35	1.23*
Individuals -	Pupils		
14.96	13.70	1.26	1.17*
Pupils -	Teachers		
13.70	13.61	.09	1.17

*$p < .05$

This performance difference cannot be attributed to time spent in learning the stimulus materials. A one-way analysis of variance for total time in minutes for tutors, pupil-role Ss, and individuals revealed no significant differences.

Test 2 Results

A 3 x 2 x 2 analysis of variance with seven replications was computed on the total number of errors on Test 2 (Table 10). Although there were only twenty-one "integration" frames, a total of forty-one possible errors could be committed by the $\underline{S}$s.

TABLE 9

ANALYSIS OF VARIANCE: TEST 2 TOTAL ERROR SCORES

Source	OF	MS	F
Materials (I)	2	235.19	7.30 **
Feedback (J)	1	.001	----
Roles (K)	2	17.32	----
IJ	2	119.33	3.70 *
IK	4	75.07	2.29
JK	2	27.77	----
IJK	4	35.25	----
ERROR	103	32.74	

*$p < .05$
**$p < .01$

A significant material effect was found ($\underline{F}$ = 7.30, 2 and 103 $\underline{df}$, $p < .01$). The $\underline{S}$s who studied Version 3 of the materials committed fewer errors on Test 2 than the $\underline{S}$s who had Versions 1 and 2. No significant differences were found for either type of feedback or student role. The manner in which explanation was presented (via tutor or reading) was not found to significantly effect Test 2 performance. A significant second-order interaction ($\underline{F}$ = 3.70, 2 and 103 $\underline{df}$, $p < .05$) was found between type of materials and type of feedback. A graphical representation of this interaction is presented in Figure 3. The cause of this effect appears upon first inspection to be due to the fact that the explanation $\underline{S}$s showed fewer errors on

Version 3 (massed condition) than did the KR Ss with the opposite effect being true for Versions 1 and 2 of the treatment materials.

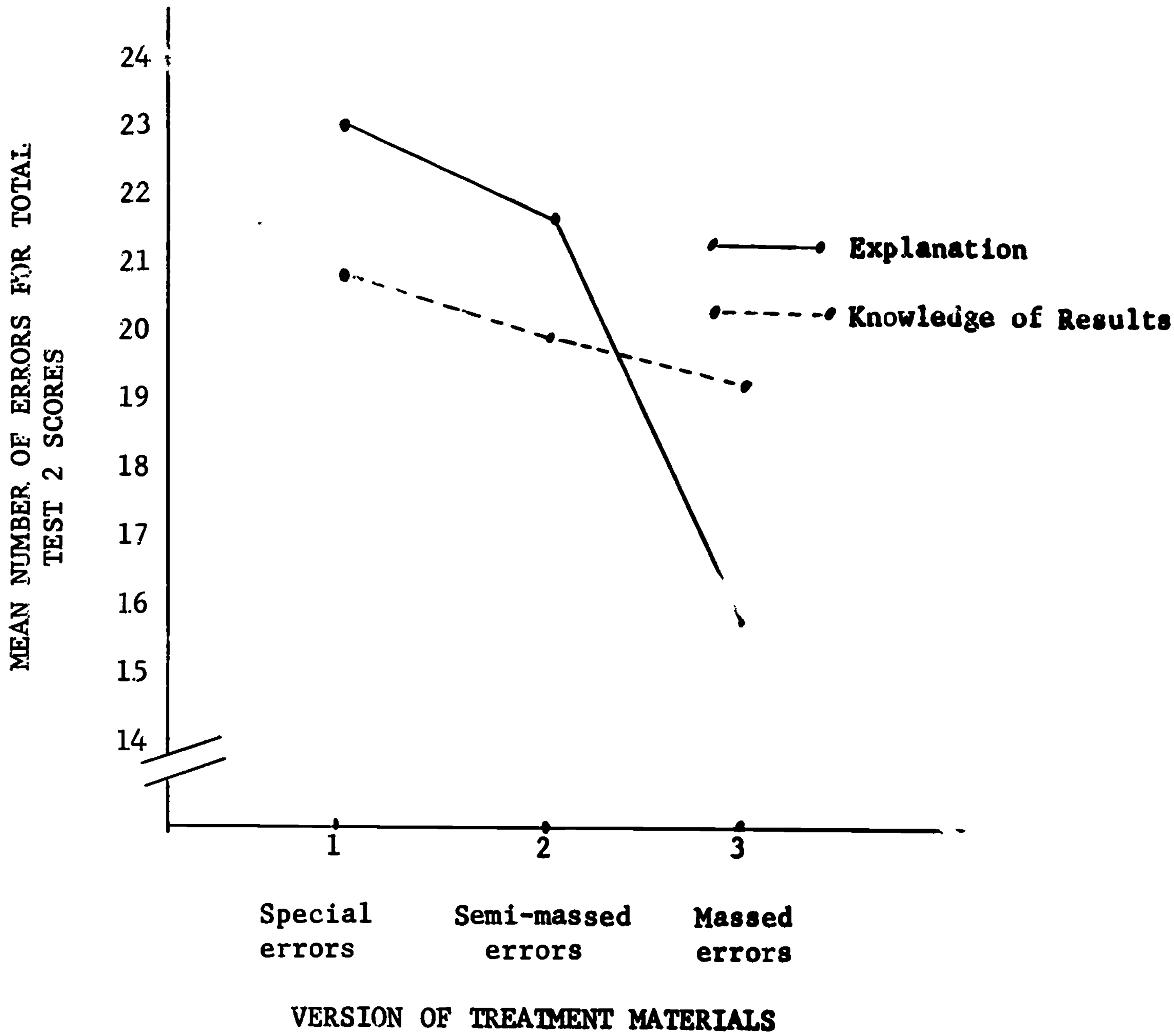

Figure 3.--Mean number of errors for total test 2 scores for materials by feedback.

A Duncan's Multiple Range Test was computed in order to isolate the cause of the interaction. The results of this analysis are presented in Table 10.* As can be seen, no significant difference was found between mean error scores for the explanation Ss who studied

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*Only the significant mean differences are reported.

TABLE 10

DUNCAN'S MULTIPLE RANGE TEST FOR EXPLANATION BY FEEDBACK

Means		Mean Difference	Least Significant Range Value
Explanation (1)	- Explanation (3)		
23.05	15.45	7.60	3.94 *
Explanation (2)	- Explanation (3)		
21.57	15.45	6.12	3.87 *
KR (1)	- Explanation (3)		
20.92	15.45	5.47	3.78 *
KR (2)	- Explanation (3)		
19.80	15.45	4.35	3.66 *
KR (3)	- Explanation (3)		
19.33	15.45	3.88	3.47 *

*$p < .05$

Versions 1 and 2 while both these means were significantly greater for the Ss who studied Version 3. No significant differences were found between Version 1 and 2 and 3 for the KR Ss. Explanation Ss utilizing Versions 1 and 2 did not differ significantly from the KR Ss for the same treatment materials. Explanation Ss showed significantly less errors for Version 3 than the KR Ss, this difference being seen as the cause of the interaction.

The fact that fewer errors were committed by Ss who used Version 3 is borne out also from the significant materials effect found in the initial 3 x 2 x 3 analysis. Results of a Duncan's Multiple Range Test (Table 11) showed that the mean differences in number of errors made on Test 2 by Ss using Versions 1 and 2 was not statistically significant while the Version 3 Ss made significantly fewer errors than either of the two other treatment groups.

TABLE 11

DUNCAN'S MULTIPLE RANGE TEST FOR MEAN NUMBER OF ERRORS FOR 3 VERSIONS OF MATERIALS FOR TEST 2

Version	Mean Difference	LSR
1 3 21.98 - 17.38	4.60	2.59*
1 2 21.98 - 20.69	1.29	2.46
2 3 30.69 17.39	3.30	2.46*

*p <.05

This effect seemingly holds true for both sections of Test 2. Two analyses of variance were computed for the mean number of errors for both sections of Test 2. Part 1 results (Table 12) revealed a significant material effect (F = 8.56, 2 and 103 df, $p < .01$), and a significant second-order interaction between materials and feedback (F = 4.05, 2 and 103 df, $p < .05$). This interaction is depicted in Figure 4. The effect seems to be of the same order as found in the overall Test 2 analysis.

TABLE 12

ANALYSIS OF VARIANCE: PART 1, TEST 2
ERROR SCORES

Source	DF	MS	F
Materials (1)	2	145.74	8.56 **
Feedback (J)	1	1.79	----
Roles (K)	2	39.88	----
IJ	2	69.02	4.05 *
IK	4	14.73	----
JK	2	3.50	----
IJK	4	26.99	----
ERROR	103	17.03	

*p < .05
**p < .01

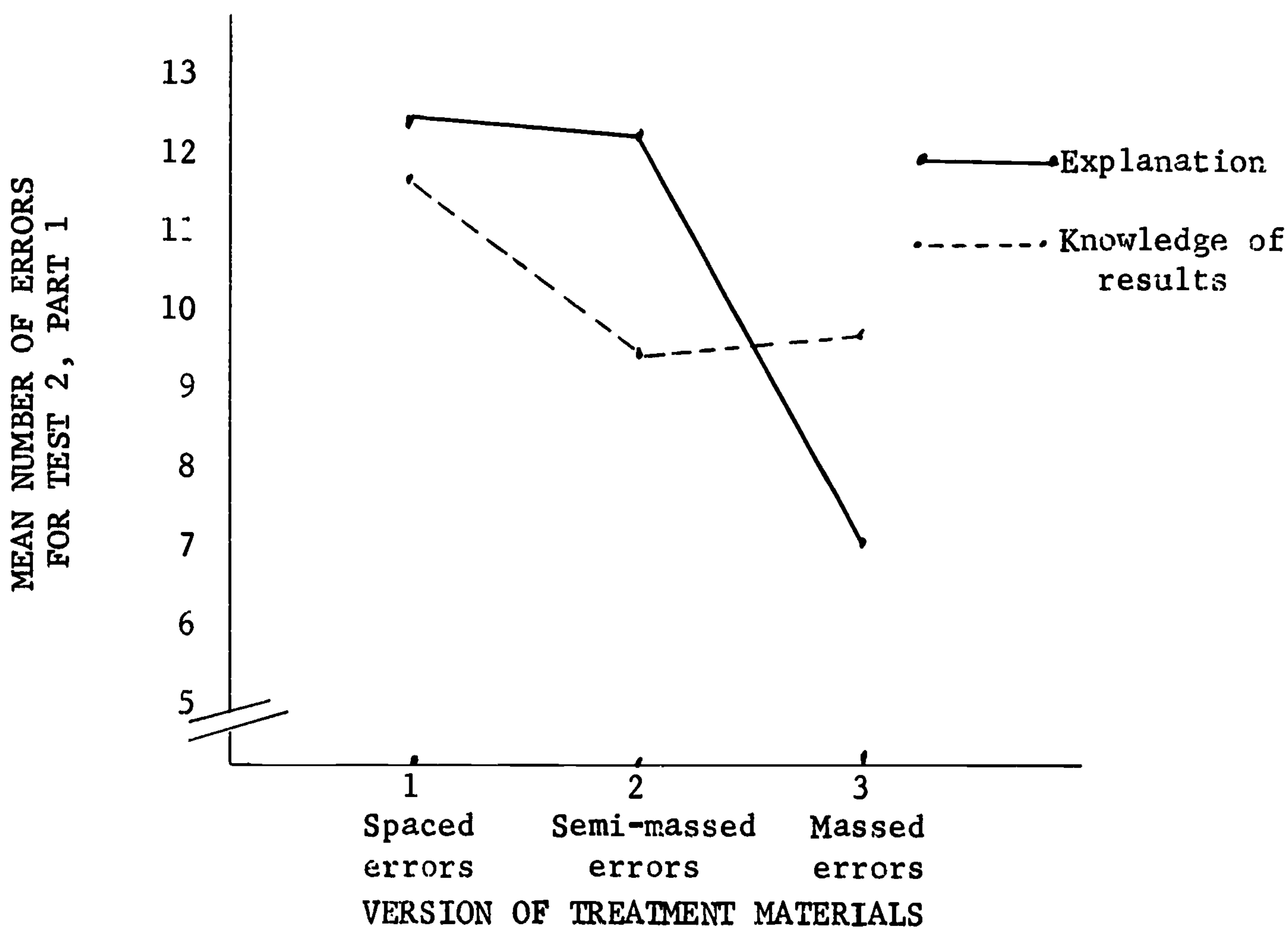

Figure 4.--Mean number of errors for part 1 of test 2 for materials by feedback.

Results of the analysis of variance for Part 2, Test 2 (Table 13) showed nearly the same findings. None of the main effects

TABLE 13

ANALYSIS OF VARIANCE: PART 2, TEST 2
ERROR SCORES

Source	DF	MS	F
Materials (1)	2	9.60	----
Feedback (J)	1	.39	----
Roles (K)	2	9.07	----
IJ	2	30.39	4.42 *
IK	4	4.31	----
JK	2	2.91	----
IJK	4	12.27	----
ERROR	103	6.88	

*$p < .05$

was significant, but a significant interaction between materials and feedback was found again ($\underline{F} = 4.42$, 2 and 103 $\underline{df}$, $p < .05$). This relationship is shown in Figure 5. Inspection of Figures 3, 4, and 5 shows that nearly the same relationship seems to hold for both Parts 1 and 2, Test 2. Explanation seemed only to have an effect when received in massed "integration" frame condition.

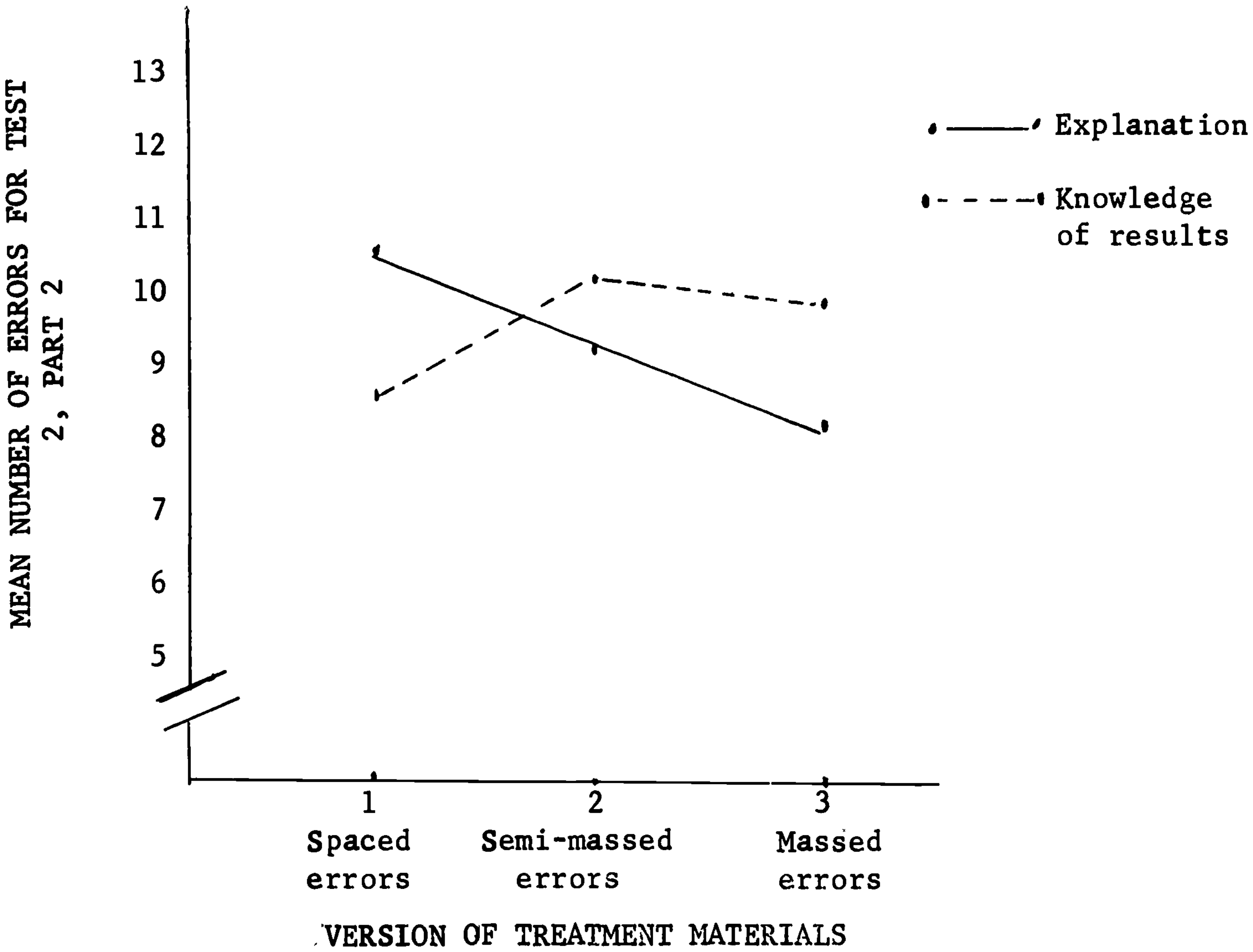

Figure 5.--Mean number of errors for part 2 of test 2 for materials by feedback.

Programmed Instruction Attitude Questionnaire

A 3 x 2 x 3 analysis of variance was calculated with the dependent measure being the total attitude scale score. No significant differences were found for any of the independent variables. In other words, manipulation of the spacing or massing of errors did not have an adverse effect upon student attitudes as measured by this attitude scale.

Ss were then grouped into High and Low PI attitudes. The median attitude scale score was used as the basis for the division. Ss were then compared with regard to type of materials (spacing of errors) and student roles via the general linear hypothesis model

(Graybill, 1961). The dependent variable was the total Test 1 performance. The results of this 2 x 3 x 3 analysis of variance (See Table 14) revealed that the High PI attitude Ss showed significantly

TABLE 14

ANALYSIS OF VARIANCE: HIGH-LOW PI ATTITUDES, 3 TYPES OF MATERIALS, AND THREE ROLE DIFFERENTIATIONS FOR TEST 1 SCORES

Source	DF	MS	F
Attitudes (I)	1	96.03	4.33 *
Materials (J)	2	25.06	1.13
Roles (K)	2	86.04	3.88 *
IJ	2	.77	----
IK	2	20.37	----
JK	4	3.03	----
IJK	4	70.52	3.18 **
ERROR	103	22.16	

$^{*}p < .05$
$^{**}p < .01$

higher Test 1 performance than the Low PI attitude Ss (F = 4.33, 1 and 103 df, $p < .05$). A significant role effect was again found (F = 3.84, 2 and 103 df, $p < .05$). The effect for spacing of errors (materials) was not significant. None of the second-order interactions reached statistical significance. However, a significant third-order interaction between High and Low attitudes, types of materials, and roles was found (F = 3.18, 4 and 103 df, $p < .05$). This relationship is depicted in Figure 6 (high attitude Ss) and Figure 7 (low attitude Ss).

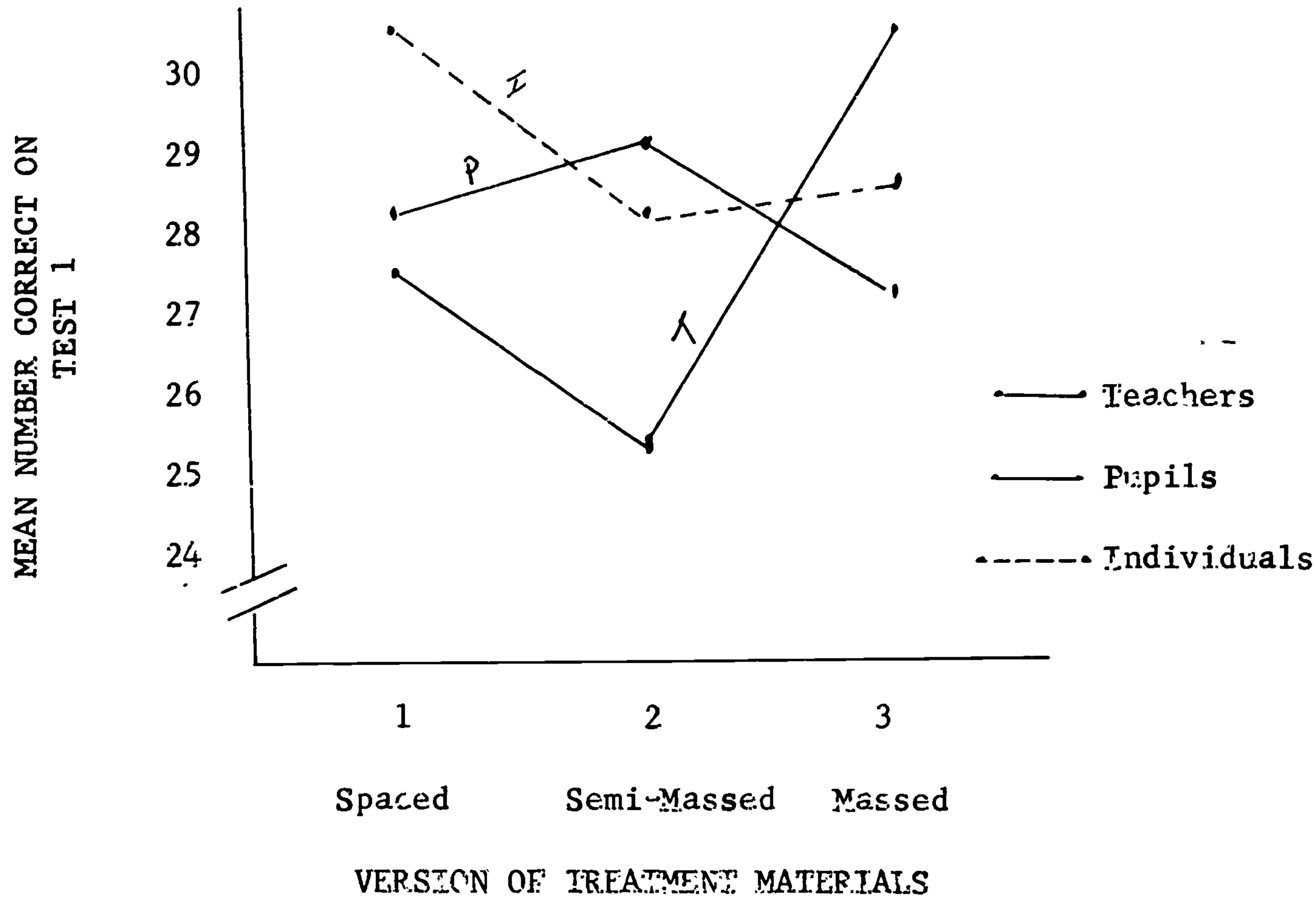

Figure 6.--Mean test 1 scores for high PI attitude students, materials and student roles.

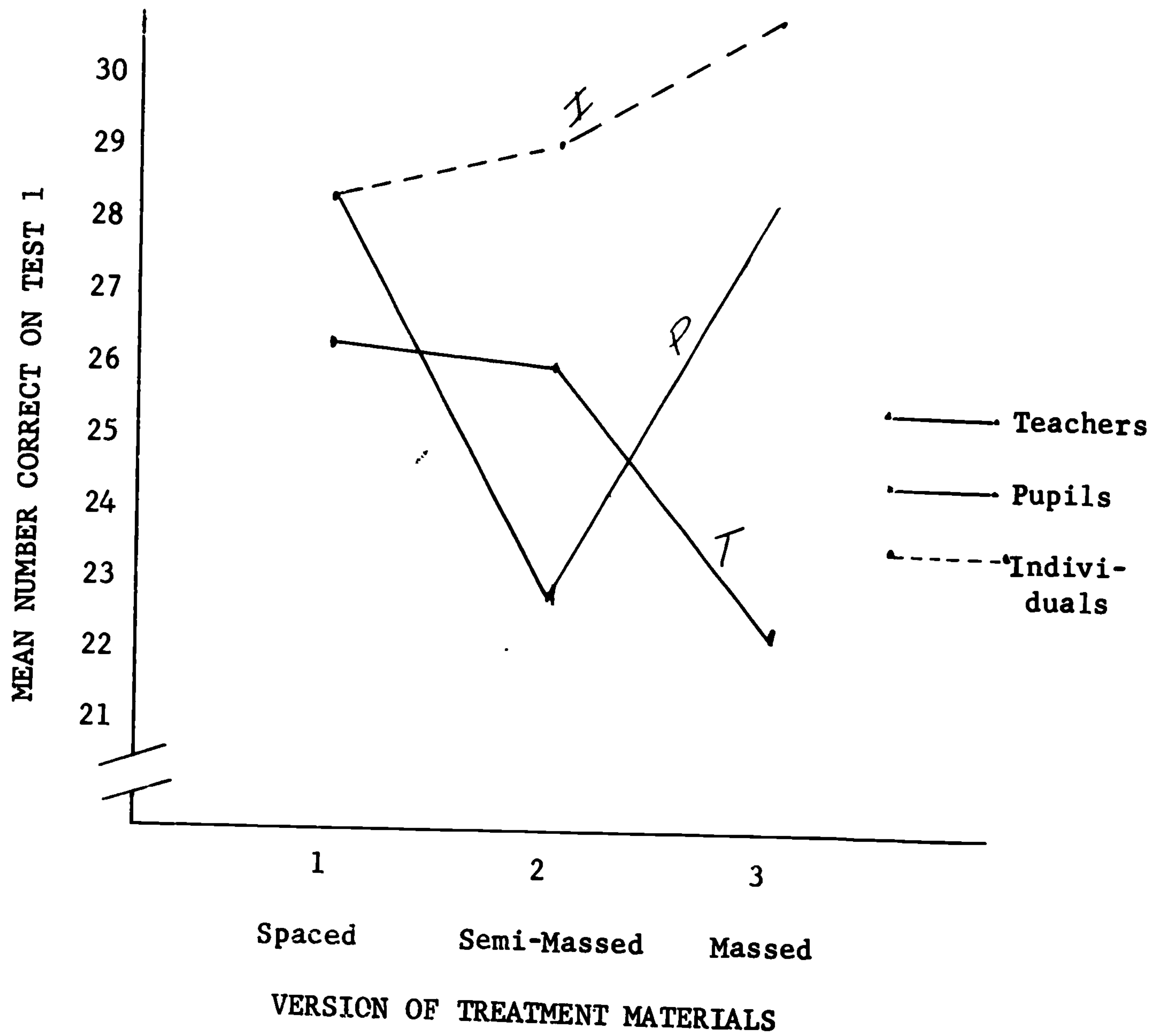

Figure 7.--Mean test 1 scores for low PI attitude students, materials and student roles.

Apparently, individuals who received spaced errors ("integration" frames) performed well on Test 1, and consequently, showed a favorable reaction; whereas, individuals receiving massed errors at the conclusion of treatment showed poor PI attitudes, although these Ss performed well. Teachers who used the massed error material (Version 3) did well on Test 1 and also showed favorable PI attitudes. On the other hand, teachers who used the same materials and performed poorly on Test 1 did not favor PI.

Computer-Based Testing Attitudes

A 2 x 3 analysis of variance was computed for High-Low Computer-Based testing Attitudes (division at the median) and the three student roles. The dependent variable in question was Test 1 performance. The results of this analysis are presented in Table 15.

TABLE 15

ANALYSIS OF VARIANCE: HIGH-LOW COMPUTER-BASED TESTING ATTITUDES AND THREE RULES FOR TEST 1 SCORES

Source	DF	MS	F
Attitudes (J)	1	118.54	5.46 *
Roles (J)	2	103.46	4.76 *
IJ	2	80.37	3.75 *
ERROR	115	21.72	----

$^*p < .05$

High attitude Ss performed significantly better than Low attitude Ss ($F = 5.46$, 1 and 115 df, $p < .05$). A significant role effect was again found ($F = 4.76$, 2 and 115 df, $p < .05$), with individuals showing higher performance than teacher-role Ss or pupil-role Ss. A significant interaction was found ($F = 3.75$, 2 and 115 df, $p < .05$) between attitude and student role. This relationship is depicted in Figure 8.

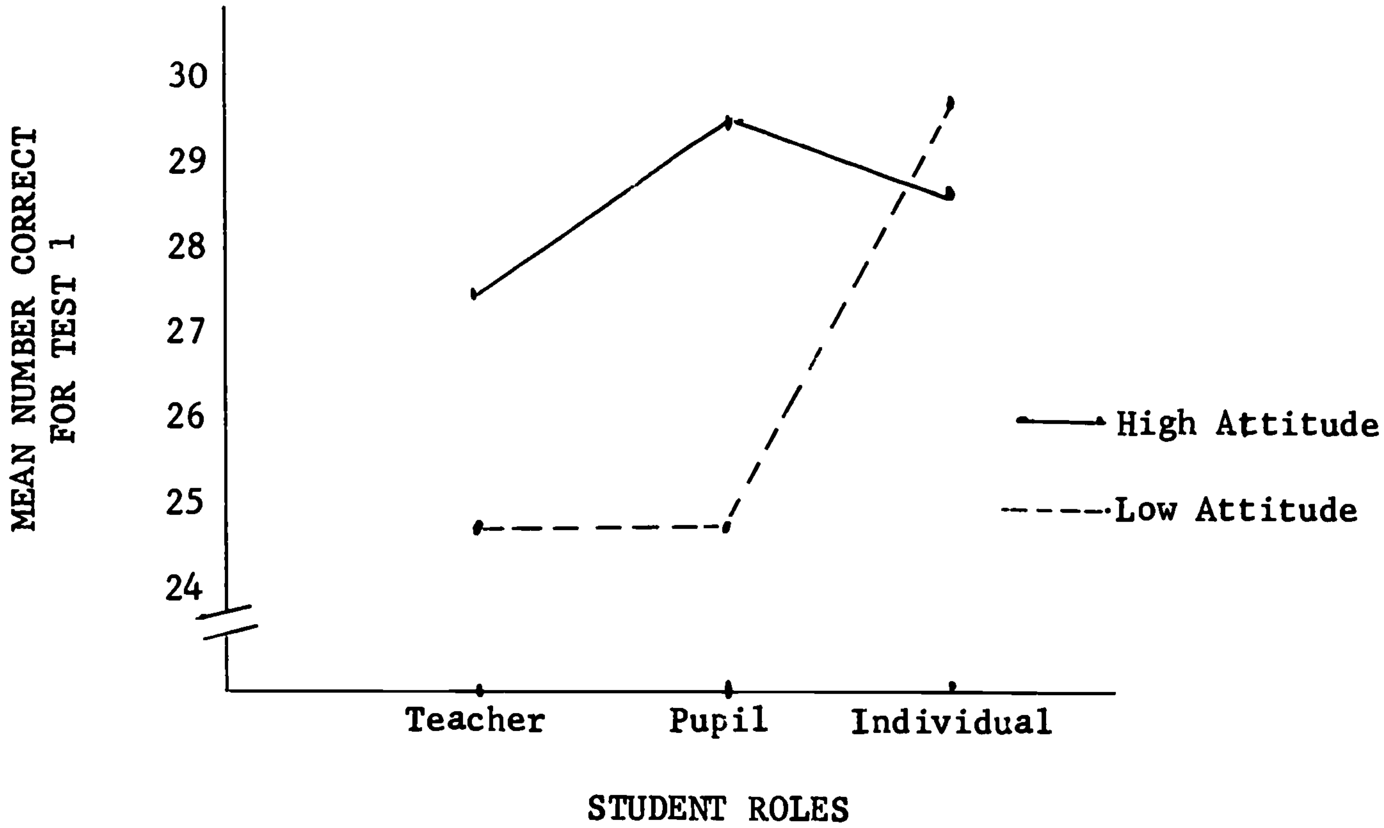

Figure 8. Mean test 1 scores for high-low computer-based testing attitudes by three roles.

High attitude Ss performed basically alike with the difference lying in the Low attitude Ss. Low attitude teacher-role Ss and pupils showed similar performance, whereas Low attitude individuals performed on a par with the High attitude pupils and individuals.

Confidence Ratings

A 3 x 2 x 3 analysis of variance was calculated on the total confidence rating scores per subject obtained from the Test 1 administration. No significant differences were found for any of the independent variables.

Attitude Scale Toward Instructional Media Student Orientation

A 3 x 2 x 3 analysis of variance with seven replications per cell was calculated on the total attitude score toward instructional media. No significant differences were found for any of the independent variables. It was concluded that the students in the various treatment groups did not differ in initial attitude.

Ss were then grouped into High and Low "Orientation" attitude groups. The median "orientation" attitude was used as the basis for the division of the groups. A 2 x 3 analysis of variance was computed for High and Low "orientation" attitudes and the three types of student roles, the dependent variable being total Test 1 performance. The mean scores for the six groups are presented in Table 16.

TABLE 16

MEAN "ORIENTATION" ATTITUDE SCALE SCORE FOR THREE STUDENT ROLE

"Orientation" Attitudes	Student Roles		
	Teachers	Pupils	Individuals
High	28.86	28.33	39.32
Low	28.11	26.00	29.00

The method of the general linear hypothesis (Graybill, 1961) was used for the unbalanced data.

High or Low "orientation" attitudes were not found to have a significant effect upon performance while a significant effect for student role was again found (*F* = 4.42, 2 and 115 *df*, $p < .05$) No significant interaction was found (See Table 17).

TABLE 17

ANALYSIS OF VARIANCE: HIGH-LOW ORIENTATION ATTITUDES AND THREE ROLE DIFFERENTIATIONS FOR TEST 1 SCORES

Source	DF	MS	F
Attitudes (J)	1	64.63	2.76
Roles (J)	2	103.51	4.42 *
IJ	2	10.85	.46
ERROR	115	23.42	

*p < .05

DISCUSSION

This research should be examined with the following points in mind relating to the external validity of the study: (a) the Ss were not randomly selected, but participated in the investigation to fulfill a course requirement, (b) ninety of the one hundred twenty-one Ss were female, and (c) the program of instruction was relatively short (215 frames).

The finding of this research did not support the major hypotheses, but a number of interesting findings did emerge. There is no doubt that the Ss learned during the experimental treatment as shown by the significant difference between pretest and posttest scores (Test 1 scores).

An interesting finding was that the tutor-role Ss showed lower performance when compared to the individuals. However, tutor-role Ss did not differ from the pupil-role Ss, and pupil-role Ss did not differ significantly from the individuals for overall Test 1 performance. One must remember that Test 1 was based upon the material taught in the conventional linear program style (Gibson, 1967), and this material, for the most part, was the low difficulty material. This finding was also found by Myers, Travers, and Sanford (1965) for young children. In their study Ss who gave feedback to others showed lower performance than the Ss who received verbal feedback.

These results may possibly be explained on the basis of a number of tutor verbal protocols. At the conclusion of the experiment a number of tutor-role <u>S</u>s indicated that they misunderstood their role-function in that they did not think they would be examined on the material, and consequently did not always read the frame along with their pupil. Also a few tutors indicated that upon occasion they did not have enough time to read the entire frame before their pupil had responded. These types of problems may account of the differences observed in the overall Test 1 analysis.

This finding is not consistent with the test 2 results ("integration" frames), which showed no significant differences between student roles. For the difficult material, tutors do not seem to add to the learning process. On the other hand, tutors learned this difficult material as well as the other student role-types, even with their increased responsibilities.

The definition of a tutor in this study is quite unlike that which is found in the typical school setting. A tutor is usually a subject matter expert and adept at explaining student misconceptions. Since the "integration" frames were designed to be extremely difficult for this population of students, both student tutors and pupils probably did not understand the materials. The combination of tutor plus explanation, for the above reason, undoubtedly did not contribute to the learning process.

It must be remembered that explanation was only found to have an effect for Version 3 of the treatment materials (massed "integration" frame condition) as seen by the second-order interaction between type of feedback for incorrect answers and type of materials (Figure 3). One might hypothesize that this effect was basically a recency effect. If this were the case we would have expected a decrease in the number of errors of the KR groups on Version 3 as well; as the time between learning and testing was the same for both groups. The results of a Duncan's Multiple Range Test showed no mean differences for Test 2 scores between the KR groups for the three versions of the materials. It does seem that explanation did increase the learning of the difficult material and that this effect is not just a recency factor.

The results concerning the effects of explanation must always be examined with two factors involved: (1) the quality of the explanations employed and (2) the extreme "integration" frame difficulty level. It is possible that a more profound effect of explanation would occur with items of a more moderate difficulty level.

While it was quite clear from this study that the spacing or massing of errors did not adversely affect student attitudes as hypothesized, the magnitude of positive attitudes appears to be dependent upon the number of errors committed upon the test instruments, at least for the paired groups. This was found for PI attitudes and the Computer-Based Testing Attitudes. The effect is consistent for High and Low attitudes tutors and pupils, but not as consistent for individuals. Some individuals performed relatively well and consequently put forth favorable attitudes, while other individuals showed good performance and disliked the experience regardless of the treatment materials studied.

Initial student attitudes toward modern technology in general were not found to significantly effect performance. High "orientation" attitude Ss did not perform significantly better than low "orientation" attitude Ss. This finding is consistent with the results of Wodtke (1965), Eigen and Feldhusen (1964), and Mathis, Smith, and Hansen (1968). The investigators found that student attitudes depend upon immediate experienced factors such as number of errors committed and familiarity with the subject matter. The observed Computer-Based Testing attitudes reflect this relationship very clearly with the exception of the Low attitude individuals who performed well.

An interesting finding concerned the use of confidence ratings in the determination of internal consistency reliability of the Test 1 data. The use of the product of "correctness" (+1 or -1)times the confidence rating increased Test 1 reliability from .645 to .687. This is not a large increase, but lends support to the Massengill and Schuford (1967) notion that confidence ratings add more information concerning test responses than can be obtained from the correct or incorrect responses themselves.

APPENDICES

APPENDIX A

DIRECTIONS FOR PRE-TEST, PART 1

The following ten-item test is taken from the program unit on intelligence testing which you will be studying from on Tuesday. These items are typical of the concepts involved in the unit.

Answer each item as best you can. Please answer all ten items on the separate answer sheet. Please make sure to print your name clearly.

1. Which test would it be best to administer to a nine-year-old Greek boy who has been in American three months?
   a. Stanford-Binet Intelligence Scale
   b. Kuhlmann-Anderson Intelligence Scale
   c. Arthur Point Scale
   d. Otis Quick-Scoring Mental Ability Test

2. A child whose family often play number games with him is able to increase his score on the numerical reasoning portion of an IQ test. This indicates that:
   a. the child's innate capacity cannot be increased by experience.
   b. the child's ability to answer test questions may be increased by experience.
   c. the child will also be able to increase his score on verbal reasoning since numerical and verbal abilities are moderately correlated.
   d. b and c only are correct.

3. The amount of score fluctuation to be expected in most cases when a second form of a test is given is measured by the:
   a. standard error
   b. standard deviation
   c. validity
   d. mental age

4. A WAIS IQ score of 100 is obtained by every person:
   a. answering correctly every item on the test.
   b. answering correctly 100 items on the test.
   c. who has a MA equal to his CA.
   d. obtaining the mean score obtained by a standardization sample of his own CA.

5. To establish the reliability of a test:
   a. the test items should be carefully examined for objectivity.
   b. one needs to know the extent to which it is valid.
   c. it must be administered to the same group of people twice.
   d. one needs an outside criterion of some sort.

6. The Wechsler tests of intelligence:
   a. have different test items for each age level.
   b. have a verbal, performance, and full-scale IQ.
   c. can be administered to groups.
   d. have standard deviations of 20 IQ points

7. Which of the following is likely to increase the potential capacity of the individual?
   a. favorable environmental conditions
   b. stimulating educational experiences
   c. excellent guidance services
   d. none of the above
   e. a and b only

8. Miss Henderson taught in a large urban high school last year where the students were drawn from various sections of the city. Next year she will teach in a homogeneous group of students. She can expect what changes between the relationship of IQ and school achievement?
   a. it will increase
   b. it will decrease
   c. there should be no change
   d. cannot tell

9. Miss Cole was asked to make an assessment of a student in her class who was doing poorly. The intelligence test she should most likely use would be which of the following?
   a. individual test
   b. group test
   c. test battery
   d. none of the above

10. An anxious mother was insistent upon determing whether or not her small son possessed the special aptitude for creative writing that her famous husband has. To arrive at the most satisfactory conclusion, which of the following tests could be used?
   a. WAIS
   b. Multi-test Battery
   c. Stanford-Binet
   d. SAT
   e. Kuhlmann-Anderson

DIRECTIONS FOR PRE-TEST, PART 2

The following ten-item test is taken from the program unit on Piaget's theory on intellectual functioning which you will be studying in a few minutes. These items are typical of the concepts involved in the unit.

Answer each item as best you can. Please answer all ten items on the answer sheet provided. Please make sure to print your name and code number clearly.

1. A child, who uses a stool to reach a cookie jar, one day cannot find the stool and uses a box. In Piaget's theory he is:
   a. accommodating
   b. assimilating
   c. showing evidence of formal operations
   d. showing a circular reaction

2. The order in which stages of mental development occur:
   a. appears to be constant from culture to culture.
   b. appears to differ from child to child
   c. appears to differ from environment to environment
   d. is highly related to the background of the learner

3. A "normal" rate of mental development:
   a. requires adequate stimulation
   b. is dependent solely on maturation
   c. can occur without stimulation in early stages of development
   d. always results from children "normal" at birth

4. Verification of Piaget's findings are difficult to obtain because:
   a. the backgrounds of children he worked with are different from that of many other groups of children
   b. the particular developmental stages enumerated may be a result of the kinds of problems used in testing
   c. both of the above are correct
   d. neither of the above are correct

5. The situation in which the child shows new behaviors or modifications of past behaviors is called_______________by Piaget.
   a. assimilation
   b. accommodation
   c. matching
   d. resemblance

6. Preliminary grouping of equalities (i.e., if A=B and B=C, then A=C) are, according to Piaget, most likely to occur in:
   a. preoperational thought stage
   b. formal operations stage
   c. concrete operations stage
   d. mental combinations stage

7. The major characteristic of the period of formal operations is:
   a. engaging in hypothetico-deductive thinking
   b. capacity for propositional thinking
   c. thinking which involves combinatorial analysis
   d. seeing the possible in the real

8. The stage in which the child is perceptually dominated by the stimulus is the:
    a. circular reaction stage
    b. intuitive stage
    c. concrete stage
    d. preconceptual thought stage

9. Piaget distinguishes between what two major stages of mental development?
    a. sensorimotor--formal
    b. concrete-formal
    c. sensorimotor--conceptual
    d. concrete operation stage

10. What stage of mental development occurs during the years four to seven?
    a. stage of preconceptual thought
    b. intuitive stage
    c. circular reaction stage
    d. concrete operation stage

APPENDIX B

ATTITUDE SCALE TOWARD INSTRUCTIONAL MEDIA

This is not a test of information; therefore, there is no one "right" answer to a question. We are interested in your opinion on each of the statements below. Your opinions will be strictly confidential. Do not hesitate to put down generally how you feel about each item. We are seeking information; not compliments.

Do not spend too much time on any one statement, but give the answer which seems to describe how you generally feel.

CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW:

1. New approaches to education (i.e., language labs, film strips, slides, computer-assisted instruction, etc.) usually challenge me to do my best work.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

2. New technological innovations in education stir my interest in trying to find out more about the subject matter.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

3. Learning becomes too mechanical when studying via the new approaches to education.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

4. Technological innovations in education are an inefficient use of the student's time.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

5. New approaches to education are inflexible.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

6. Even otherwise interesting material would be boring when presented by new techniques in education.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

7. I am not in favor of technological innovations in education because they are just another step toward de-personalized instruction.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

8. I would say that the new techniques in education are superior to the tranditional methods of instruction.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

9. I will be concerned that I might not be understanding the material.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

10. In a situation where I am trying to learn something, it is important to me to know where I stand relative to others.

Quite often	Often	Occasionally	Seldom	Very Seldom

APPENDIX C

TEST 1

1. Which test would it be best to administer to a nine-year-old Greek boy who has been in American three months?
   a. Stanford-Binet Intelligence Scale
   b. Kuhlmann-Anderson intelligence Test
   c. Arthur Point Scale
   d. Otis Quick-Scoring Mental Ability Test

2. Which test would probably give the highest IQ to a seventy-three-year-old woman who reads a lot?
   a. 1937 Stanford-Binet
   b. WAIS
   c. WISC
   d. Arthur Point Scale

3. A child whose family often play number games with him is able to increase his score on the numerical reasoning portion of an IQ test. This indicates that:
   a. the child's innate capacity cannot be increased by experience.
   b. the child's ability to answer test questions may be increased by experience.
   c. the child will also be able to increase his score on verbal reasoning since numerical and verbal abilities are moderately correlated.
   d. b and c only are correct

4. The amount of score fluctuation to be expected in most cases when a second form of a test is given is measured by the:
   a. standard error
   b. standard deviation
   c. validity
   d. mental age

5. In order to adequately interpret an IQ score, we need to know:
   a. what abilities the IQ test is supposed to measure.
   b. whether the test is verbally-oriented or performance-oriented.
   c. the educational background and physical background of the subject.
   d. all of these

6. Perfect correlation between two IQ tests indicates that:
   a. both tests are valid.
   b. both tests are good measures of IQ.
   c. the scores on the first test always "go" with scores on the second.
   d. the two tests are identical in format.

7. A WAIS IQ score of 100 is obtained by every person:
    a. answering correctly every item on the test.
    b. answering correctly 100 items on the test.
    c. who has an MA equal to his CA
    d. obtaining the mean score obtained by a standardization sample of his own CA

8. The best test of intelligence for a seemingly bright <u>mute</u> child of six would be:
    a. Stanford-Binet
    b. Arthur Point Scale
    c. WAIS
    d. WISC

9. A valid test is one that:
    a. is highly correlated with an accepted criterion measure.
    b. shows a high correlation between socres obtained on two forms of the same test.
    c. is acceptable at the 100 per cent criterion level.
    d. uses no essay questions.

10. Which type of instrument should <u>not</u> be administered by a teacher?
    a. standardized achievement
    b. individual intelligence
    c. group intelligence
    d. interest

11. A child eight years and six months old has a mental age of fourteen years and one month. His IQ is:
    a. 100
    b. 102
    c. 128
    d. 146
    e. 166

12. Occasionally children are assigned to long-term instructional programs solely on the basis of an IQ score. This practice is largely due to the incorrect assumption that:
    a. IQ alone is an adequate basis for assigning children to programs.
    b. scores on IQ tests reflect accurately an important ability.
    c. IQ tests can be used with comparable validity for all children.
    d. all of the above.

13. Which of the following does not belong with the other three?
    a. standardized administration
    b. standardized validity
    c. standardized norms
    d. standardized scoring

14. Pat is a poor reader and achieves an IQ score of 30 on the Otis Quick-Scoring Test. We can conclude that:
    a. he is brighter than the test indicates.
    b. his poor reading may lower his performance on the test.
    c. he would probably score higher on a different group IQ test.
    d. he is too dull to profit from school.

15. To establish the reliability of a test:
    a. the test items should be carefully examined for objectivity.
    b. one needs to know the extent to which it is valid.
    c. it must be administered to the same group of people twice.
    d. one needs an outside criterion of some sort.

16. The extent to which a test measures what it purports to measure constitutes its:
    a. reliability
    b. validity
    c. standard deviation
    d. coefficient of correlation

17. The Wechsler tests of intelligence:
    a. have different test items for each age level.
    b. have a verbal, performance, and full-scale IQ.
    c. can be administered to groups
    d. have standard deviations of 20 IQ points.

18. Most intelligence tests are designed to measure the ability or abilities involved in:
    a. abstract thinking
    b. adapting to new situations
    c. creative thinking
    d. numerical reasoning

19. Which of the following is likely to increase the potential capacity of the individual?
    a. favorable environmental conditions
    b. stimulating educational experiences
    c. excellent guidance services
    d. none of the above
    e. a and b only

20. Miss Henderson taught in a large urban high school last year where the students were drawn from various sections of the city. Next year she will teach in a homogeneous group of students. She can expect what changes between the relationship of IQ and school achievement?
    a. it will increase.
    b. it will decrease.
    c. there should be no change.
    d. cannot tell.

21. Miss Cole was asked to make an assessment of a student in her class who was doing poorly. The intelligence test she should most likely use would be which of the following?
    a. individual test
    b. group test
    c. test battery
    d. none of the above

22. Intelligence as potential capacity is probably a function of:
    a. heredity
    b. congenital development
    c. growth
    d. all of the above
    e. a and b only

23. If there is a correlation coefficient of -.02 between physical education and reading scores, one might conclude:
    a. a good reader will be good in physical education.
    b. a poor reader will be good in physical education.
    c. there is little relation between these variables.
    d. none of the above

24. The relative mental-ability standing many students decreases as they proceed from grade school to high school to college because:
    a. their mental abilities decrease.
    b. they become less able to learn.
    c. mental growth stops in the early twenties.
    d. the average mental abilities of students are higher in college.

25. An anxious mother was insistent upon determining whether or not her small son possessed the special aptitude for creative writing that her famous husband has. To arrive at the most satisfactory conclusion, which of the following tests could be used?
    a. WAIS
    b. Multi-test Battery
    c. Stanford-Binet
    d. SAT
    e. Kuhlmann-Anderson

26. A child, who uses a stool to reach the cookie jar, one day dan't find the stool and uses a box. In Piaget's theory he is:
    a. accommodating
    b. assimilating
    c. showing evidence of formal operations
    d. showing a circular reaction

27. According to Piaget, cognitive development is due to:
    a. maturation
    b. interaction with the environment

c. a and b functioning together
d. none of these

28. Piaget's concept of accommodation refers to the child's tendency to:
    a. relate what new stimuli he perceives to what he already knows how to do.
    b. utilized less information in making a perceptual recognition
    c. change his older conceptual understandings so that they fit new perceptions.
    d. telescope two concepts into a superordinate concept.

29. According to Piaget's theory, there should always be__________ discrepancy between the level of difficulty of new problems presented in a learning situation and the child's level of mental development.
    a. a small
    b. a large
    c. no
    d. some optimal amount of

30. The order in which stages of mental development occur:
    a. appears to be constant from culture to culture.
    b. appears to differ from child to child.
    c. appears to differ from environment to environment.
    d. is highly related to the background of the learner.

31. When children reach the stage of ______________, they are ready to learn totally abstract concepts.
    a. preconceptual thought
    b. formal operations
    c. concrete operations
    d. sensorimotor development

32. In his studies, Piaget used children:
    a. from upper-socioeconomic classes.
    b. from middle-class backgrounds with "average" amounts of stimulation.
    c. with exceptionally high IQ scores.
    d. with exceptionally low IQ

33. We know from Piaget's research that his nomothethic laws appear to hold true for the development of the concepts of:
    a. logic, mathematics, and physical phenomena.
    b. biological and social phenomena.
    c. artistic and dramatic phenomena.
    d. all of these

34. A "normal" rate of mental development:
    a. requires adequate stimulation
    b. is dependent solely on maturation.

c. can occur without stimulation in early stages of development.
d. always results from children "normal" at birth.

35. Verification of Piaget's findings are difficult to obtain because:
 a. the backgrounds of children he worked with are different from that of many other groups of children.
 b. the particular developmental stages enumerated may be a result if the kinds of problems used in testing
 c. both of the above are correct
 d. neither of the above are correct.

36. Piaget gathered his data by which one of the following methods?
 a. experimental method
 b. logitudinal method
 c. observational method
 d. analytical method

37. The situation in which the child shows new behaviors or modifications of past behaviors is called___________by Piaget.
 a. assimilation
 b. accommodation
 c. matching
 d. resemblance

38. Intelligence test theory and Piaget's theory are similar in which of the following ways?
 a. both are concerned with similar intellectual tasks
 b. both are concerned with hereditary characteristics
 c. both contain a time dimension
 d. both a and c are correct

39. A child in the period of concrete operations of thinking can:
 a. understand what is real
 b. distinguish between the possible and the real
 c. see how the real can lead to the possible
 d. consider the possible in abstract thought

40. Helen, a 16 year-old Negro attended a predominately white high school. When she first enrolled she had few friends but became well-acquainted after the first year, primarily because she changed her conception of white students. This is an example of:
 a. accommodation
 b. assimilation
 c. organization
 d. none of the above

41. Preliminary grouping of equalities (i.e., if A=B and B=C, then A=C) are, according to Piaget, most likely to occur in:
    a. preoperational thought stage
    b. formal operations stage
    c. concrete operations stage
    d. mental combinations stage

42. The major characteristic of the period of formal operations is:
    a. engaging in hypothetico-deductive thinking
    b. capacity for propositional thinking
    c. thinking which involves combinatorial analysis
    d. seeing the possible in the real

43. The situation in which the child learns to make new responses to familiar stimuli is called_________________by Piaget.
    a. assimilation
    b. accommodation
    c. matching
    d. resemblance

44. The final stage of the sensorimotor period is the:
    a. reflexive stage
    b. mental combinations stage
    c. circular reaction stage
    d. preconceptual thought stage

45. Assimilation often implies which of the following?
    a. learning
    b. generalization
    c. discrimination
    d. a and b only
    e. all of the above

46. The stage in which the child is perceptually dominated by the stimulus is the:
    a. circular reaction stage
    b. intuitive stage
    c. concrete stage
    d. preconceptual though stage

47. Accommodation refers to:
    a. an internal change in a persons
    b. a change in an external idea
    c. the functional invariant of organization
    d. the assimilation of new ideas

48. Piaget distinguishes between what two major stages of mental development?
    a. sensorimotor-formal
    b. concrete-formal
    c. sensorimotor-conceptual
    d. intuitive-conceptual

49. What stage of mental development occurs during the years 4-7?
    a. stage of preconceptual though
    b. intuitive stage
    c. circular reaction stage
    d. concrete operation stage

50. The reflexive stage takes place during what age range?
    a. the first month of life
    b. from the first to the eighth month
    c. from the eighth month to the eighteenth month
    d. beyond the eighteenth month.

APPENDIX D

STUDENT ATTITUDE TOWARD PROGRAMMED INSTRUCTION
COMMUNICATION SKILL

This is not a test of information; therefore, there is no one "right" answer to a question. We are interested in your opinion on each of the statements below. Your opinions will be strictly confidential. Do not hestitate to put down exactly how you feel about each item. We are seeking information; not compliments. Please be frank.

Name:______________________________________Date:____________________

Name of Course:____

CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW:

1. While taking programmed instruction, I felt challenged to do my best work.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

2. I was concerned that I might not be understanding the material.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

3. I was not concerned when I missed a question because no one was really watching me carefully.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

4. While taking programmed instruction, I felt isolated and alone.

:	:	:	:	:
All of the time	Most of the time	Some of the time	Only occasionally	Never

5. I felt uncertain as to my performance in the programmed course relative to the performance of others.

:	:	:	:	:
All of the time	Most of the time	Some of the time	Occasionally	Never

6. I found myself just trying to get through the material rather than trying to learn.

:	:	:	:	:
All of the time	Most of the time	Some of the time	Occasionally	Never

7. I knew whether my answer was correct or not before I was told.

Quite often	Often	Occasionally	Seldom	Very seldom

8. In a situation where I am trying to learn something, it is important to me to know where I stand relative to others.

:	:	:	:	:
Quite often	Often	Occasionally	Seldom	Very seldom

9. As a result of having studied some material by programmed instruction, I am interested in trying to find out more about the subject matter.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

10. I was more involved in verbal interaction with my partner than in understanding the material.

:	:	:	:	:
All of the time	Most of the time	Some of the time	Only occasionally	Never

11. I felt I could work at my own pace with programmed instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

12. Programmed instruction makes the learning too mechanical.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

13. I felt as if I had a private tutor while taking the program.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

14. I was aware of efforts to suit the material specifically to me.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

15. I found it difficult to concentrate on the course material because of the (teacher or pupil).

:	:	:	:	:
All of the time	Most of the time	Some of the time	Only occasionally	Never

16. Questions were asked which I felt were not relevant to the materials presented.

:	:	:	:	:
All of the time	Most of the time	Some of the time	Only occasionally	Never

17. Programmed instruction is an inefficient use of the student's time.

:	:	:	:	:
Strongly agree	Disagree	Uncertain	Agree	Strongly agree

18. Programmed instruction made it possible for me to learn quickly.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

19. I felt frustrated by the programmed instruction situation.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly Agree

20. The programmed instruction approach is inflexible.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

21. Even otherwise interesting material would be boring when presented by programmed instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

22. In view of the effort I put into it, I was satisfied with what I learned while taking programmed instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

23. In view of the amount I learned, I would say that programmed instruction is superior to any other instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

24. With a course such as I took by programmed instruction, I would prefer programmed instruction to any other instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

25. I am not in favor of programmed instruction because it is just another step toward de-personalized instruction.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

26. Programmed instruction is too fast.

:	:	:	:	:
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

27. Programmed instruction is boring.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

APPENDIX E

STUDENT ATTITUDE TOWARD COMPUTER-BASED TESTING

This is not a test of information; therefore, there is no one "right" answer to a question. We are interested in your opinion on each of the statements below. Your opinions will be strictly confidential. Do not hesitate to put down exactly how you feel about each item. We are seeking informaion; not compliments. Please be frank.

Name:______________________________ Date:______________

Name of Course:______________________________

CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW:

1. While taking the computer test, I felt challenged to do my best.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

2. I was concerned that I might not understand the material.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

3. While taking the computer test, I felt isolated and alone.

All of the time	Most of the time	Some of the time	Only occasionally	Never

4. I guessed at the answers to questions.

Quite often	Often	Occasionally	Seldom	Very seldom

5. I was more involved in running the machine than in understanding the question.

All of the time	Most of the time	Some of the time	Only occasionally	Never

6. I was aware of efforts to suit the material specifically to me.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

7. The computer situation made me feel quite tense.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

8. Questions were asked which I felt were not relevant.

All of the time	Most of the time	Some of the time	Only occasionally	Never

9. I could have done better if I hadn't felt pushed.

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

10. I would say computer testing is superior to class testing.

Strongly disagree	Disagree	Uncertain	Agree	Strongly Agree

APPENDIX F

STUDENT DIRECTIONS FOR TUTORS IN THE EXPLANATION CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology. In the past this has been attempted via the usual reading assignments, class lectures, and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational methods and equipment, i.e. programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES OF THE "INSTRUCTOR."

Your role is that of an "Instructor." You will have a copy of an "instructor's" manual containing program frame answers and comments to make (sic) to assist "your" student in answering the study materials. If the student should give a correct answer, you should tell him so by saying, "That is right, good, correct," or a similar comment. Do not be afraid to encourage the student to answer the question. In some instances, your "student" may have a great deal of difficulty in formulating any kind of answer. At such points, the "instructor" should make every effort to get some sort of response from the "student." It isn't at all necessary that the "student" always give a brilliant answer (or even a correct answer). The real point is to get both "instructor" and "student" actually thinking about the question.

Please do not just dismiss all questions with a "who knows?" attitude.

There are, for the most part, questions that one might reasonably expect college students to occasionally ponder. If both "instructor" and "student" do in fact give these questions serious thought, a good answer will almost always be the result. One of the surest signs of intellectual maturity is the tendency to think seriously about serious questions and formulate some sort of answer. (On the other hand, there is no point in prolonging a discussion beyond the point that it seems mutually profitable.)

The goal here is to understand and discuss the material when problems arise, not to get through it as quickly as possible. If you are unlucky enough to draw a "student" who gives only a "yes" or "no"--or "beats me"--kind of answer to a difficult question, accept this as a challenge! Try to modify his behavior via the techniques you have learned from your education courses. If you do go skipping through the program hurriedly, the whole bit will be a loss mostly to you and the "student."

SPECIFIC DIRECTIONS

1. Your student should read each frame silently and then orally give you his answer.

2. If he is correct--tell him so and continue to the next frame.

3. If he makes an error, use the comments provided as guidelines in helping to understand his errors.

4. Write down his response as best you can in your answer booklet. In some cases, only a letter or number answer is required.

5. Use the guidelines provided. If you are told to review certain frames, review them. In other cases you are left to your own ingenuity. Use it.

6. Remember--your goal as an "instructor" is to have your "student" learn the material. Feel free to discuss any errors or problems and to insert your own comments wherever you think they will be most beneficial to your student.

7. Your job is a tough one. Accept the challenge and do the best job you possibly can. Your "instructor" position will be the same when you acquire a teaching job in a school system--to teach. Do just that.

If at any point you or your student do not understand the program, consult one of the "assistants" on duty.

Please keep track of all time spent on each unit in minutes. If you and your student spend an hour and a half on Unit 1, place the number 90 on the front page of your manual. This is important.

If your experience this quarter seems to warrant continuing, we shall make every effort to develope this type of material for further student use.

STUDENT DIRECTIONS FOR PUPILS IN THE EXPLANATION CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology In the past this has been attempted via the usual reading assignments, class lectures, and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational methods and equipment, i.e., programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES OF THE "STUDENT"

Your job is that of a "student." Basically the "student" needs only to follow the directions of his "instructor."

THE MOST IMPORTANT DUTY OF THE "STUDENT" IS TO MAKE A VERY CONSCIENTIOUS EFFORT TO ANSWER ALL QUESTIONS TO THE BEST OF HIS ABILITY. Even if you have absolutely no idea what the "correct" answer might be, give the matter some serious though and then indicate your best guess. At the very least, do not discourage your "instructor" by showing any indication that you are incapable of even thinking about the question.

SPECIFIC DUTIES

1. You are to read each frame silently. When you have formulated an answer, tell your "instructor"your answer.

2. Your "instructor" will write your answer down and then tell you if it is correct or not.

3. If you are incorrect, your "instructor" will try to assist you in understanding what the correct answer is.

4. Do not be afraid to verbally interact with your "instructor." He is trying to do his best to help you get the most out of the materials. To help him you should do the best job you can in answering the program frame questions.

5. Feel free to discuss any questions you have with your "instructor."

If at any point you or your "instructor" do not understand the program, consult one of the "assistants" on duty.

If your experience this quarter seems to warrant continuing, we shall make every effort to develop this type of material for further student use.

STUDENT DIRECTIONS FOR TUTORS IN THE KNOWLEDGE OF RESULTS CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology. In the past this has been attempted via the usual reading assignments, class lectures and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational methods and equipment, i.e., programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES OF "INSTRUCTOR"

Your role is that of an "instructor." You will have a copy of the program unit and answer booklet. Only your booklet will contain answers to the questions.

After securing the booklets from the "assistants," you will direct your "student" to read silently each program frame. After he has finished reading it, he will orally give you his answer. Write that answer down on the answer sheet.

If your student is correct, tell him so by saying, "That's right, good, correct," etc. If he is wrong or partially wrong, tell him that he is wrong and give him the correct answer.

The correct answer completion should be given only after it is quite apparent that your "student" is not likely to ever get the correct answer short of being supplied with it directly. If the "student" makes no effort to provide the correct completion for the frame, encourage him to give some kind of answer.

Your major function as an "instructor" is to ensure that the student proceeds in a conscientious fashion and to give him the correct answers when he fails to give the correct response. Following this method, both "instructor" and "student" should learn a great deal.

If your experience this quarter seems to warrant continuing, we shall make every effort to develop this type of material for further student use.

If at any point, you or your "student" do not understand the <u>program</u>, consult one of the <u>assistants</u> on duty.

Keep an accurate record of amount of <u>time</u> (in minutes) spent on both program units. Indicate this on the cover of your teacher's manual.

STUDENT DIRECTIONS FOR PUPILS IN THE KNOWLEDGE OF RESULTS CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology. In the past this has been attempted via the usual reading assignments, class lectures, and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational methods and equipment, i.e., programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES OF "STUDENT"

Your job is that of a "student." Basically the "student" needs only to follow the directions of his "instructor."

THE MOST IMPORTANT DUTY OF THE "STUDENT" IS TO MAKE A VERY CONSCIENTIOUS EFFORT TO ANSWER ALL QUESTIONS TO THE BEST OF HIS ABILITY.

Even if you have absolutely no idea what the "correct" answer might be, give the matter some serious thought and then indicate your best guess. At the very least, do not discourage your "instructor" by showing any indication that you are incapable of even thinking about the question.

SPECIFIC DUTIES

1. Read each frame silently. When you have formulated an answer, tell your "instructor" your answer.

2. Your "instructor" will write your answer down and then tell you if it is correct or not.

3. If you are incorrect, your "instructor" will give you the correct answer.

It is very important that you not look ahead in the program! To "answer" a question by looking at the next frame will defeat most of the design of the project. It is not so important that you always get the "right answer" as that you follow very precisely the instructions of the program and your "instructor."

STUDENT DIRECTIONS FOR INDIVIDUALS IN THE EXPLANATION CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology. In the past this has been attempted via the usual reading assignments, class lectures, and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational materials and equipment, i.e., programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES

Your job is that of a student working his way through the programmed units individually at your own rate.

THE MOST IMPORTANT DUTY IS TO MAKE A VERY CONSCIENTIOUS EFFORT TO ANSWER ALL QUESTIONS TO THE BEST OF YOUR ABILITY.

Even if you have absolutely no idea what the "correct" answer might be, give the matter some serious thought and then indicate your best guess.

SPECIFIC DUTIES

1. Read each frame carefully. When you have formulated an answer, write your answer in the program unit itself where indicated.

2. Then check your answer with the one provided in your answer booklet.

3. If you were correct, continue on to the next frame.

4. If you were incorrect, circle your answer and then read the comments under the heading Explanation provided for each frame.

5. In some cases, a restatement of the question is given as an aid to help you in understanding the concepts. In other cases, you are told to review previous frames. Follow the instructions carefully because they were written with your interest in mind.

6. Sometimes you are left to your own ingenuity. USE IT. Review or continue as you see best in these cases.

It is very important that you do not look ahead in the program! To "answer" a question by looking at the next frame will defeat most of the design of the project. It is not so important that you always get the right answer as that you follow very precisely the instructions of the program.

On the front page of each unit, keep tract of all the time in minutes which you spend on each unit. If you spend 1 hour on Unit 1, you should put the number 60 on the front page of Unit 1 and so on.

If your experience this quarter seems to warrant continuing, we shall make every effort to develop this type of material for further student use.

STUDENT DIRECTIONS FOR INDIVIDUALS IN THE KNOWLEDGE OF RESULTS CONDITIONS

The primary purpose of the introductory course in educational psychology is just that--to introduce the student to educational psychology. In the past this has been attempted via the usual reading assignments, class lectures, and periodic examinations. The usual results were that most students seemed to learn an adequate amount of material, but many did not.

This term we shall attempt to improve the rate of student learning via the use of new technological educational methods and equipment, i.e., programmed instruction. You have been selected to participate in an experimental learning experience.

DUTIES

Your job is that of a student working his way through the programmed units individually at your own rate.

THE MOST IMPORTANT DUTY IS TO MAKE A VERY CONSCIENTIOUS EFFORT TO ANSWER ALL QUESTIONS TO THE BEST OF YOUR ABILITY.

Even if you have absolutely no idea what the "correct" answer might be, give the matter some serious thought and then indicate your best guess.

SPECIFIC DUTIES

1. Read each frame carefully. When you have formulated an answer, write your answer in the program unit itself where indicated.

2. Then check your answer with the one provided in your answer booklet.

3. If you were correct, continue on to the next frame.

4. If you were incorrect, circle your answer, try to decide why you were incorrect when you check the correct answer.

5. Continue to the next frame.

It is very important that you do not look ahead in the program! To "answer" a question by looking at the next frame will defeat most of the design of the project. It is not so important that you always get the right answer as that you follow very precisely the instructions of the program.

On the front page of each unit, keep track of all the time in minutes which you spend on each unit. If you spend 1 hour on Unit 1, you should put the number 60 on the front page of Unit 1, and so on.

If your experience this quarter seems to warrant continuing, we shall make every effort to develop this type of material for further student use.

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VITA

Biographical Data:

John J. Hedl, Jr.
Upper Darby, Pennsylvania
August 11, 1945
U. S. Citizen
Single

Academic History:

B. S., Psychology, The Pennsylvania State University, 1967
M. S., Psychology, Florida State University, 1969

Professional Experience:

Graduate Fellow, Department of Psychology, Florida State University, 1967-1968.

Research Assistant, Department of Psychology, Florida State University, 1967-1968.

Research Assistant, Computer-Aided Instruction Laboratory, Harvard University, Cambridge, Massachusetts, Summer Quarter, 1968. Worked with the automation of diagnostic reading tests.

Research Assistant, Computer-Assisted Instruction Center, Florida State University, 1968-1969.

Publication:

Smith, T. A., Hansen, D. N., and Hedl, J. J., Jr. College student attitudes toward four methods of instruction. Unpublished paper, Florida State University, 1968.

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13. ABSTRACT

The research in this report was concerned with a student tutorial method of instruction and the effects of the distribution (spacing or massing) of explanation of incorrect student responses on cognitive and attitudinal variables. The experimental design was a 3x2x3 factorial with seven observations per cell. Three types of programmed instruction treatment materials were employed reflecting the differential placement of the high-difficulty frames. Version 1 consisted of twenty-one difficult "integration" frames being placed every eighth or ninth frame. Version 2 was developed with these frames massed together at the conclusion of Units 1 and 2, ten per unit. Version 3 consisted of experimental frames being presented at the end of Unit 2.

Therefore, two types of learning materials differing only in difficulty were included in the investigation.

Two forms of feedback were employed, for the high-difficulty frames, either explanation or simply knowledge of results (KR). An explanation consisted of a detailed statement concerning the particular frame's content.

Within the paired grouping of students, two roles were possible, either tutor-role or pupil-role. The third experimental role consisted of students studying individually.

The results of this investigation showed that paired students (tutor-pupil) perform as well as the individuals for the difficult learning material while the tutor-role students performed the poorest on the conventional linear text when compared to the individuals.

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The coalition of student tutor and explanation did not aid the learning of the difficult learning material, although explanation itself was found to reduce student errors for those students in the Version 3 treatment condition.

Student attitudes were not adversely affected by the manipulation of errors via the "integration" frames (error frames). The magnitude of positive attitudes appeared to be dependent upon criterion test performance. Initial student attitudes toward modern instructional technology were not found to significantly effect performance.