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ABSTRACT

To determine the extent to which findings from studies with learners with high-level entry proficiency might apply to other learners, a group of 80 senior education majors were assigned to the Aircraft Instrument Comprehension Program under a variety of combinations of incentive, instruction, and feedback. In general the present study supports the contention that instruction is the predominant variable also had some effect on posttest results. Feedback was not found to enhance learner performance. (SA)

ON THE DETERMINANTS OF STUDENT PERFORMANCE IN A VERIFIED INSTRUCTIONAL PROGRAM

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ON THE DETERMINANTS OF STUDENT PERFORMANCE IN A VERIFIED INSTRUCTIONAL PROGRAM

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A number of studies have demonstrated that incentive (cf. Lipe and Jung, 1971) and feedback (cf. Gagne and Rowher, 1969) enhance learner proficiency under a variety of experimental conditions. Feedback, however, tends to be more effective in tasks where instruction is not provided the learner on how to perform (Higgins, 1973). Thus, the only information the learner receives on how to perform in tasks where instruction is not available is the feedback provided after a response is emitted. The effects of incentive under conditions of instruction and no instruction have not been systematically investigated.

Feedback in the form of knowledge of correct response (KCR) did not enhance student performance in an instructional program systematically developed to train learners to read aircraft instruments (Reiser, 1975). Incentive effects, on the other hand, were manifested in reducing the amount of time learners required to complete the posttest; however, the posttest scores of these learners did not differ significantly from the scores of learners who did not receive an incentive. But these effects were obtained with learners who demonstrated a high level of proficiency on the pretest given prior to providing them with the instructional materials. Hence, we became concerned with the generality of these findings, for they might not pertain to learners who do not possess high-level entry proficiency. In order to determine the extent to which our previous findings might apply to learners other than AFROTC cadets, incentive was varied by offering undergraduate education students points

toward their final grades, feedback in the form of KCR was either present or absent, and information provided the learner regarding how to perform the task (i.e., instruction) was either present or absent.

Method

Subjects

Eighty students (64 female and 16 male) enrolled in a senior level course for education majors were randomly assigned to the experimental conditions.

Materials

Variations of a set of self-instructional materials (Higgins, 1975) were studied. The program was designed to achieve the following instructional objective:

> Given four illustrations of aircraft varying in bank, pitch, and heading, the student will identify the illustration that most nearly represents the position indicated on a compass and an artificial horizon.

Instruction in the program consisted of one instructional cue and three examples for each of three dimensions (pitch, bank, and heading) of the concept presented (aircraft position). Eight examples were also presented in which these dimensions were combined. Practice consisted of one to four items for each dimension, followed by an additional ten practice items at the end of the program. All practice items required subjects to identify which of two or more drawings of an aircraft in flight most nearly represented the position shown on an attitude indicator and a heading indicator. Feedback consisted of a latent image (A. B. Dick Company) in the form of an "X" that appeared immediately when subjects touched the appropriate space on the answer sheet with the special marking pen provided.

Procedure

Upon entering the classroom, subjects were randomly assigned the experimental materials, which consisted of an instructional booklet, pre- and posttests, answer sheet, and marking pen. A set of standard instructions were read to the subjects. The subjects were told that the study was concerned with validating a self-instructional program developed by faculty members. Next, all subjects were instructed to complete a nine-item pretest, for which three minutes were allotted. The subjects were then told to read the preliminary instructions on the first page of their tests. Written directions for the incentive condition informed the subjects that they would be required to take a test on the materials after completing them. They were also informed that both speed and accuracy were factors used in determining their scores on the posttest, and that they could earn up to ten points toward their final grade in the course (about 10% of the total points possible for the course), depending on the score they attained on the posttest. Subjects in the no incentive conditions were told that both speed and accuracy were important on the posttest and that the developers of the program would appreciate their "best efforts." Instruction was manipulated by removing the instructional cues and examples, thus leaving only the practice items in the instructional booklets that were provided for subjects in the no instruction conditions. All subjects received written directions indicating that different materials were assigned to different subjects, and that they should not be alarmed if other persons completed the experiment before they did. They were directed orally to record the time (flashed on 4 x 6 inch cards at 15-second intervals at the front of the room) when they finished the program and the posttest.

Design and Data Analysis

Dependent measures were time and criterion posttest scores. The experimental design consisted of a pretest-treatment-posttest sequence. A 2x 2 x 2 completely randomized analysis of variance included the following factors: instruction (presence or absence), incentive (presence or absence), and feedback in the form of KCR (presence or absence).

Results

An analysis of variance on pretest scores revealed a significant difference for subjects in the feedback condition ($p < .05$). Consequently, an analysis of covariance was used to evaluate differences among treatment groups on posttest scores, using pretest scores as the covariate.

Table 1 presents the mean scores on the 36-item posttest for all

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Insert Table 1 about here

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treatment groups. The overall mean for the group receiving instruction was 27.80 and for the group not receiving instruction 15.65; $F = 101.69$, $df = 1/71$, $p < .001$. An omega-squared (Hays, 1963) comparison revealed that instruction accounted for 52% of the total variance. The overall mean for the group that received KCR (22.10) did not differ significantly from the mean of the group that did not receive feedback (21.35). Although the means did not differ significantly between the group that received an incentive and the group that did not (21.62 and 21.82, respectively; $F = 0.03$, $df = 1/71$, $p < .70$), a significant interaction was obtained between instruction and incentive ($F = 9.18$, $df = 1/71$, $p < .003$). Figure 1 shows, however, that the interaction was not in the direction that might be anticipated. The group that received instruction and an

Insert Figure 1 about here

incentive obtained a lower mean posttest score than the group that received instruction without an incentive. The situation was reversed for the group that did not receive instruction: subjects who received an incentive surpassed the mean performance of subjects that did not receive an incentive. An omega-squared comparison indicated that this interaction accounted for 4% of the total variance.

Table 2 shows the mean time in minutes required to complete the

Insert Table 2 about here

posttest for all treatment groups. The overall mean time for the group that received instruction (12.79) differed significantly from the group that did not receive instruction (10.37; $F = 12.05$, $df = 1/72$, $p < .01$). An omega-squared comparison revealed that instruction contributed to 12% of the total variance in posttest time. Neither feedback nor incentive contributed significantly to posttest time differences. None of the interaction effects were significant with respect to posttest time.

Discussion

In general, the present study supports the contention that instruction is the predominate variable controlling learner performance on the aircraft instrument comprehension task. This result, however, was attenuated by the presence of an incentive offered the learners contingent on their posttest performance. Although this combined effect of instruction and incentive was highly significant in the present study

($p < .003$), more research is required to determine both the reliability and the generality of this effect. Indeed, a substantial body of evidence (cf. Lipe and Jung, 1971) indicates that a variety of incentives can exert powerful facilitative control over learner performance. Clearly, more systematic research is needed to determine how incentive influences learner performance under different instructional conditions; the relevance of these efforts is obvious for instructional systems where incentive variables are commonly in effect in the form of grades, teacher and parental approval, etc.

The present data also support previous findings (Reiser, 1975) that feedback in the form of KCR does not enhance performance on the aircraft instrument comprehension task. In general, these data suggest that when instruction is carefully designed and developed, added refinements such as feedback do little to further enhance learner performance. However, it is clear that the aircraft instrument comprehension task encompasses a rather restricted range of learner competencies; further research is required to determine the range of learning tasks and response characteristics that are enhanced by instruction per se.

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TABLE 1

Mean Posttest Scores by Treatment
Number of Items Correct out of 36 Possible (n = 10 per cell)

	Incentive		No Incentive	
	Instruction	No Instruction	Instruction	No Instruction
Feedback	24.30	19.80	29.60	14.20
No Feedback	26.90	15.00	29.90	13.60

TABLE 2

Mean Posttest Time (Minutes) by Treatment

	Incentive		No Incentive	
	Instruction	No Instruction	Instruction	No Instruction
Feedback	13.60	10.45	12.52	10.37
No Feedback	12.70	10.92	12.37	9.75

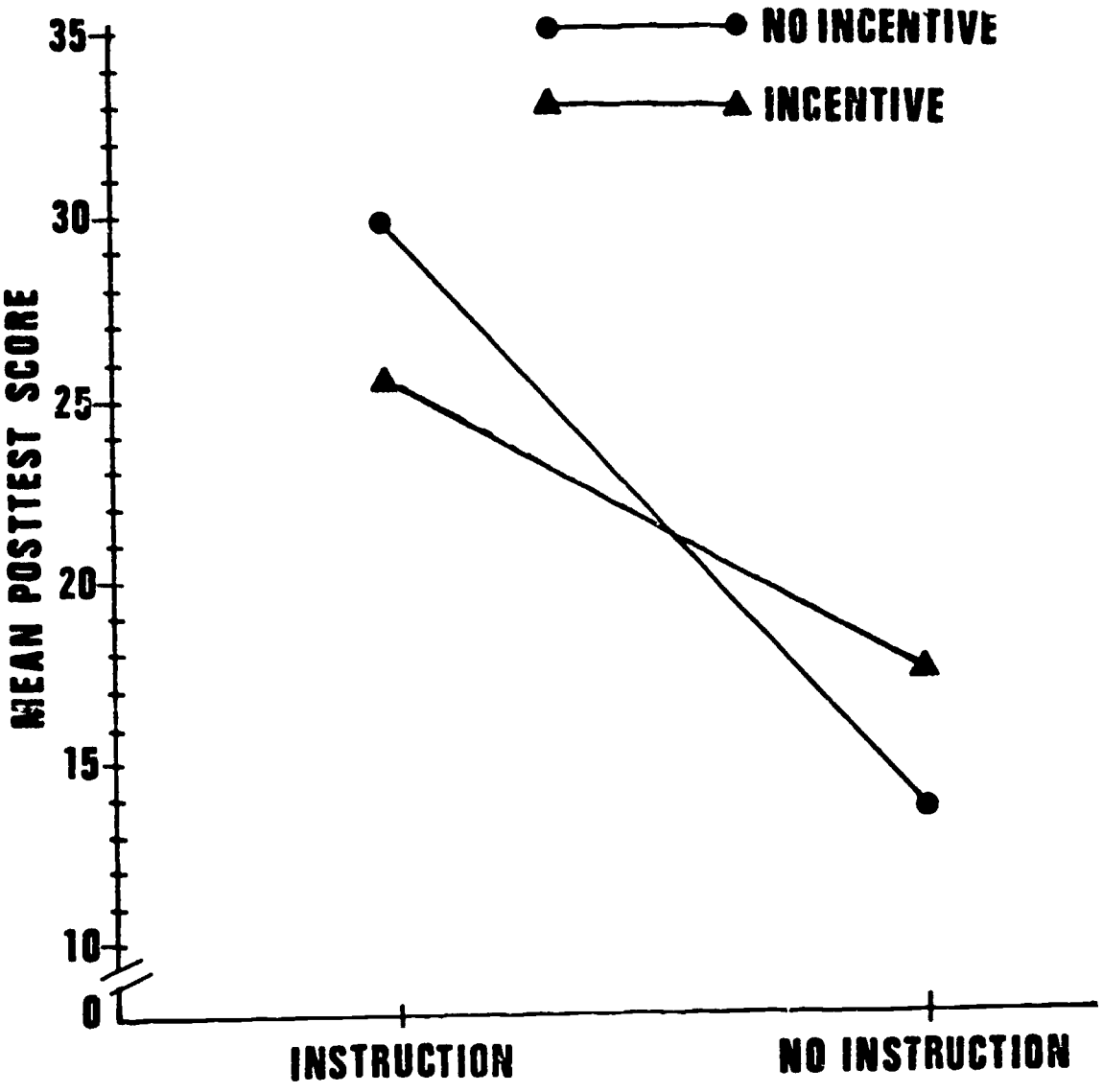

Figure 1. Mean number of total correct responses on immediate posttest for incentive and no incentive groups under different conditions of instruction.