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Effects of Classroom Testing by Microcomputer

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Microcomputers are being used for a variety of purposes, but research about their instructional effectiveness lags behind adoption rates for the technology. However, several researchers have examined competencies vocational education teachers need to use effectively this emerging technology (Bowen, 1984; Cantrell, 1982; Chase, Gordon, & Makin, 1984; Hudson, 1983; Miller & Foster, 1985; Roth, Tesolowski, Rankin, & Blackman, 1984). These studies were exploratory and descriptive in nature.

Further, there is a limited research base about the effects of microcomputers in vocational agriculture on learning in the affective, cognitive and psychomotor domains. Rohrbach (1983) investigated the effects of microcomputer instruction versus lecture-discussion in teaching college students a farm management lesson. The lecture-discussion group in the Rohrbach study performed significantly better than two microcomputer groups did on a cognitive measure. However, Becker and Shoup (1985) concluded that significant increases in student knowledge of safe tractor operation concepts resulted when vocational agriculture students as well as a class of University of Florida agriculture students were taught using microcomputers,

The research base is even more shallow when effects of testing students by computer technology are explored. Biskin and Kolotkin (1977) found that computer-based, teletype and paper and pencil methods of test administration produced similar results when students were given the Minnesota Multiphasic Personality Inventory. Cory (1977) found that paper and pencil and computerized administration methods predicted job performance equally well on four of five attributes studied. These findings about the effectiveness of computer technology are generally consistent with the conclusions Clark (1983) made after his meta-analyses of research about the influence of media on learning. Clark contended that the teacher rather than instructional media brings about student achievement.

Objectives and Hypotheses

This research tested hypotheses about how effectively microcomputers could be used to administer an objective classroom test to students who had studied and used computer technology. Specifically, the study sought to determine: (a) the effect taking an objective final examination by microcomputer would have upon student cognitive performance; (b) the effect this method of testing would have on student attitude about computers immediately after the examination; and (c) whether this method of testing would require more time than conventional paper and pencil testing procedures.

Three hypotheses were formulated for testing ($p<.05$);

1. No significant difference in student cognitive knowledge will be observed for the two testing procedures when midterm examination scores are used as a covariate.

2. There will be no significant difference in student attitude about computers immediately after the final examination is given by the two testing procedures.

3. No significant difference will be observed in the time needed to complete the final examination using the two testing procedures.

Procedures

The study followed the posttest only control group design (Campbell & Stanley, 1963). Spector (1981) noted that experimental studies need to be replicated to minimize external validity threats; consequently, the study involved two replications. Replication 1 was conducted during the 1983 Fall Semester at Carthage (MS) High School and Replication 2 during the 1984 Spring Semester at Petal (MS) High School. Both replications were conducted during a Mississippi State University course, Application of Computer Technology to Agricultural and Extension Education. The same instructor and teaching assistant conducted both replications.

The three-hour undergraduate/graduate level course provided 30 hours of lecture and 30 hours of laboratory activities. The subjects in each replication worked in pairs for 15 hours using a microcomputer and a printer to complete a series of laboratory activities. They also completed 15 hours of laboratory activities away from a microcomputer. Replication 1 met over a 15-week period. Each Replication 1 session consisted of a two-hour lecture, one hour of microcomputer activities per week and included 49 subjects. Replication 2 involved 28 subjects and met for 10 weeks. Each Replication 2 session consisted of 2-1/2 hours of lecture and 1-1/2 hours of microcomputer activities per week.

The Treatment

During the session a week before the final examination was administered, the instructor reviewed the areas the test would include. The students were informed that half of them would take the cognitive test on microcomputers and the other half with paper and pencil. They were instructed to report to their regularly scheduled laboratory period to take the examination. Two-stage random assignment was used to place the students into either the microcomputer or conventional testing groups. Participants in each replication were first randomly assigned to Group 1 or 2, and the treatment was then randomly assigned to the two groups. The instructor administered the final examination in the laboratory with one student per microcomputer while the teaching assistant administered the same examination in a classroom using conventional test booklets and optical scan sheets. The final test consisted of 35 multiple-choice items.

The testing and grading software used by the experimental group was available from a commercial vendor. This package presented one test item on the screen at a time and did not advance to the next item until the students entered the correct answer. However, only the first response a student entered was used in tabulating that person's score. The testing package informed students of their scores on the test immediately after the last item was answered. The microcomputer group was

given three sample items before starting the test. After the sample items were completed, the instructor fielded questions about the process. Concurrently, the teaching assistant explained the directions and fielded questions from students in the conventional group. Both teachers then proceeded to record the number of minutes each student needed to complete the test. After completing the cognitive test, the students completed an instrument designed to measure their attitudes toward computers.

The three dependent variables measured in this study were: (a) minutes to complete the test; (b) score on the test; and (c) score on the attitudes about computers instrument. The test was developed by the instructor , and reliability coefficients from 10 prior administrations ranged from .78 to .90. In this study, the conventional test group data were used to compute reliability coefficients which were .80 for Replication 1 and .78 for Replication 2. Data were not available to compute reliability coefficients for the microcomputer testing group. Although the software recorded each student's score on the test, it did not store data about individual test items. The l0-item attitudinal instrument was validated by a panel of experts and yielded a .74 Cronbach's alpha reliability coefficient for Replication 1 and .76 for Replication 2.

Findings

Personal data by treatment and control group are provided in Table 1 for Replications 1 and 2. The mean age for the 49 subjects in Replication 1 was 33.8 (treatment, 34.9; control, 32.5). The 28 subjects in Replication 2 were older, with a mean age of 38.4 (treatment, 42.7; control, 34.1). There were 38 females in Replication 1 and 7 in Replication 2. In Replication 1, 33 subjects had no bachelor's degree, and 16 had a bachelor's degree or higher. Replication 2 consisted of 12 subjects with a bachelor's only and 16 with a master's or educational specialist degree. The objective midterm examination (See Table 1) was used as a covariate in the study. The midterm and final examinations were very highly correlated (r=.77) for Replication 1 and moderately related in Replication 2 (r=.43). Midterm scores for the treatment and control groups were compared using a t-test, and no significant difference was found in either replication (Replication 1: $t[47]=-.74$, $p>.05$; Replication 2: $t[26]=1.04$, $p>.05$).

Test of Hypothesis One: Final Evaluation Scores

A one-way analysis of covariance revealed that the two groups were not significantly different in terms of their scores on the 35-item final examination. Table 2 lists the measures of central tendency and the ANCOVA for the final examination scores. Hypothesis One was not rejected for either replication since the experimental and control groups had similar scores on the final examination.

Test of Hypothesis Two: Student Attitudes Toward Microcomputers

The mean attitudinal scores of the two groups were positive in both replications. The scale had a possible range of 10 (negative) to 50 (positive). The t-test performed for both replications indicated that Hypothesis Two should not be rejected since the two groups had similar positive attitudes about computers (Replication 1: microcomputer, 40.9, and control, 41.0; Replication 2: microcomputer, 39.3 and control, 41.4). Hypothesis Two was not rejected for either replication.

Table 1

A Comparison of Treatment and Control Groups on Selected Variables for Replications 1 and 2

Variable	Treatment Replication 1	Treatment Replication 2	Control Replication 1	Control Replication 2	Overall Replication 1	Overall Replication 2
Age						
Mean	34.9	42.7	32.5	34.1	33.8	38.4
S.D.	12.9	8.8	9.4	7.9	11.0	9.3
Sex						
Males	7	9	4	12	11	21
Females	18	5	20	2	38	7
Degree						
No B.S.	15	0	18	0	33	0
B.S. or Higher	10	0	6	0	16	0
Bachelor's Only	0	6	0	6	0	12
Master's or Higher	0	8	0	8	0	16
Marital Status						
Single	4	2	6	1	10	3
Married	21	12	18	13	39	25
Midterm Score (100-point scale)						
Mean	78.7	79.1	81.3	83.1	80.1	81.0
S.D.	12.2	11.0	12.2	9.4	12.1	10.2

Test of Hypothesis Three: Minutes to Take the Examination

A t-test used to compare the two groups indicated there was a significant difference in minutes required to complete the examination in Replication 1. The microcomputer group took 5.7 minutes longer to complete the examination (32.7 vs. 27.0; $t[47]=2.36$, $p<.05$). There was no significant difference in minutes needed to complete the examination in Replication 2 (microcomputer, 22.0 vs. 27.4 control; $t[16.15]=-1.40$, $p>.05$). Hypothesis Three was rejected for Replication 1 but not for Replication 2. The control group needed 27 minutes in both replications, but the microcomputer group needed 10 minutes less in Replication 2 (32 vs. 22).

Conclusions and Implications

Conclusions and implications were formulated with the knowledge that subjects for this study used microcomputer technology extensively during a computer applications course. In this investigation, final examination scores were independent of the method of testing. Further, the objective midterm examination administered by paper and pencil procedures was moderately to highly correlated with the final examination. This suggests that how students scored on the final examination was best indicated by scores made on the midterm examination and not by the method of testing.

Table 2

ANCOVA of Final Examination Scores for Replications 1 and 2

Group	n		Adjusted Means		S.D.	
	Replication 1	Replication 2	Replication 1	Replication 2	Replication 1	Replication 2
Treatment	24	14	28.4	26.5	4.27	4.29
Control	25	14	28.9	26.3	4.58	4.27

Source	df		ss		MS		F	
	Replication 1	Replication 2	Replication 1	Replication 2	Replication 1	Replication 2	Replication 1	Replication 2
Midterm (Covariate)	1	1	565.8	90.3	565.3	90.3	69.5*	5.82*
Treatment	1	1	2.7	.3	2.7	.3	.3	.02
Residual	46	25	374.6	388.1	8.1	15.5	–	-
Total	48	27	943.1	478.7				

*p<.05.

The positive attitudes of the treatment and control groups immediately after the final examination would suggest that the method of testing was not a major determinant of how students felt about computers. The fact that the subjects were completing a computer applications course would suggest that the course and factors other than the method of testing were probably responsible for the positive attitudes about computers.

Since time requirements for the microcomputer testing procedure were not consistent over two replications, the method of testing as well as other factors appear to influence the time needed for this testing procedure.

Recommendations

Additional research is needed in other classroom settings to see if consistent findings about cognitive performance, time requirements and attitude are achieved. Further, instructors who use this medium to administer classroom examinations should be certain students can use the technology effectively since subjects for this study used microcomputers throughout a semester-long course.

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