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ABSTRACT

Research investigated the effect that the uses of simulation-gaming techniques have upon the acquisition and cognitive retention of facts, concepts, and principles. Two hundred and ninety-five students in public secondary schools in Indiana participated in the project; these were divided into experimental and control groups which received instruction in United States History. The former employed the simulation-Gaming techniques, the latter the lecture-discussion method Posttest results showed that both groups performed equally well with respect to cognitive achievement, but that students in the experimental group performed significantly better on a delayed interval posttest measure of cognitive retention. It was thus concluded that the simulation-gaming techniques represented a pedagogical tool which significantly enhanced learning. (Author/PB)

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A COMPARATIVE STUDY OF COGNITIVE RETENTION USING SIMULATION-GAMING AS OPPOSED TO LECTURE-DISCUSSION TECHNIQUES

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by

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Introduction

The use of simulation-gaming techniques as attempts to foster more active student participation in the learning process has increased in recent years. These techniques are still suspect, however, by many who hold the opinion that students' cognitive achievement and retention suffer from their use. Therefore, the main objective of this study was to endeavor to compare the effect of the use of simulation-gaming techniques with that of lecture-discussion techniques on students' cognitive achievement and retention of facts, concepts and principles.

Other researchers have examined the effect of simulation-gaming on cognitive achievement and/or retention with mixed results. Baker (1968), in a study involving eighth grade U.S. History students, compared the effects of the use of simulation with the use of the textbook-discussion approach. He concluded that simulation was more efficient than the textbook-discussion approach as a method of teaching historical facts, concepts and attitudes to junior high school students.

A study by McKenney and Dill (1966) investigated the use of simulation in the MBA curriculum at the Harvard Business School. Their findings indicated that more important than the use of simulation was the emphasis faculty members gave to topics of study when cognitive retention was the goal of instruction.

Garvey and Seiler (1966) studied the effectiveness of different methods of teaching international relations to high school students, including the use of simulation. In their study, students exposed to the use of simulation did not score as well as control group students in terms of

cognitive achievement at the end of the experimental period, and slightly, but not significantly, higher following a delayed interval testing eight weeks later.

Examining the effectiveness of the simulation-game in teaching specifically defined behaviors related to consumer credit, Anderson (1970), compared simulation-gaming with conventional classroom techniques using as subjects two hundred-eighty high school seniors in one school. His findings suggest that simulation-gaming was as effective as the conventional classroom approach in producing the desired results.

Heinkel (1970), compared the use of simulation-gaming with lecture-discussion in a study involving sixty-seven junior college political science students. He reported no significant differences in cognitive learning when the two methods were compared. In his judgement, the criticism that students do not learn as much through simulation as through other means was not supported by his study. On the other hand, Wentworth and Lewis (1973) found that junior college students exposed to simulation in an introductory course in economics scored significantly lower on a measure of cognitive achievement when compared with students not exposed to simulation.

Cherryholmes (1966), in a review of research on the effectiveness of educational simulations, observed that there was little evidence to support the claim that simulation participants will learn more facts and content principles than will students learning by more traditional means.

Noted during the review of the literature cited were a number of weaknesses in research design. Among them were: 1) use of relatively untried games of the researchers' designs, 2) small samples of subjects, 3) use of dependent measures of undetermined reliability, 4) little attempt

to control for the teacher variable, 5) relatively short periods of experimental treatment, and 6) restriction of experimental treatment to one type of geographical and social environment.

Believing that the problem merited further study and that weaknesses noted in the earlier research could be minimized in a more rigorous research design, the investigators postulated and examined the following null hypotheses for purposes of this study:

1. At the conclusion of a five week (25 classroom hours) experimental treatment period, there will be no significant difference between the control group (lecture-discussion format) and the experimental group (simulation-gaming format) on a measure of cognitive achievement.
2. Following a delayed interval of ten weeks, after the conclusion of the experimental period, there will be no significant difference between the control and experimental groups on a measure of cognitive retention.

Methodology

The experimental treatment period consisted of five weeks (25 classroom hours) during which the control group studied United States Domestic History (1870-1915) by means of the traditional lecture-discussion format while the experimental group studied identical material by means of simulation-gaming techniques.

The subjects in the study were students enrolled in twelve intact United States History classrooms in five public high schools located in three different types of geographical and social environments in Indiana. Six classes each were randomly assigned to the control and experimental groups.

Two hundred ninety-four students participated in the study. These students, for whom the mean I.Q. was 106, were grouped as general ability students. One hundred fifty-eight students were females, while the males numbered 136. One hundred forty-two students were enrolled in the six control classes, and 152 were enrolled in the six experimental classes.

In order to obtain a geographically and socially diverse mix in the student sample, three different school populations were selected. Four classes were selected from an environment categorized as rural-small town. Four classes were selected from an environment categorized as medium size city, that is they lived in a city with a population of 85,000. The remaining four classes were located in a city of more than 170,000.

To control for the teacher variable, each of the six volunteer teachers participating in the study taught one control and one experimental class. Prior to the beginning of the experimental treatment period, each teacher received instruction in the use of the three simulation-games. The instruction included working through the procedures for playing the games, the goals of each simulation exercise, and the utilization of debriefing sessions at the conclusion of each simulation.

Three commercially available simulation-games were utilized in the experimental classes. They were: "The Game of Farming," High School Geography Project: Manufacturing and Agriculture, published by the MacMillan Co. in 1969; "Promotion," American History Games published by Abt Associates, Inc. in 1970; and The Cities Game published by Communications, Research, Machines, Inc. in 1970.

The teachers were instructed to assign the students in the experimental and control classes the normal textbook readings. The lectures in the

control classes were derived from readings and textbook material. The procedure was the pattern for the control classes during the five weeks. The experimental classes spent the entire period using the three simulation-games and debriefing them. Following the conclusion of the experimental period of five weeks, each teacher was instructed not to utilize the simulation-gaming techniques, but to return to their normal classroom instructional procedures during the ten week delayed interval.

A forty-four item instrument was developed to be used as a measure of cognitive achievement-retention. Following a pilot study using the measure, fourteen items were found non-reliable and deleted from the instrument. The remaining thirty items, for which a reliability factor of .7942 or greater was obtained, were deemed usable for the study. A panel of three Laboratory School social studies faculty judged the content of the measure to be valid. The measure was administered as a pre-, post- and delayed interval post-test.

Statistical analysis of the data was obtained by the use of the "Univariate and Multivariate Analysis of Variance and Covariance," a prepared program developed at the State University of New York at Buffalo. Pre-test scores and I.Q. scores were employed as covariates in attempts to control for possible differences in pre-treatment funds of knowledge held by students and in intellectual abilities.

Findings

As can be seen in Table 1, the differences between the control and

TABLE 1

ADJUSTED MEAN SCORES ON POST-TEST MEASURE OF COGNITIVE ACHIEVEMENT

Control			Experimental		
F	M	Combined	F	M	Combined
16.78	15.68	16.23	16.15	16.43	16.29

experimental groups on the post-test measure of cognitive achievement were negligible. The adjusted mean scores for boys and girls alike in both the experimental and control groups reflect a correct response for about sixteen out of the thirty items.

The analysis of covariance for the data, as reported in Table 2, revealed no significant differences between the experimental and control groups for the variables of treatment and sex or for the interactions

TABLE 2

ANALYSIS OF COVARIANCE TABLE SHOWING THE RESULTS OBTAINED ON THE POST-TEST: COGNITIVE ACHIEVEMENT INSTRUMENT

Source	SS	DF	MS	F	P
Treatment	0.0661	1	0.0061	0.0005	0.9824
Sex	0.7219	1	0.7219	0.0583	0.8095
Teacher	233.1900	5	46.6380	3.7648	0.0027*
Sex by Treatment	0.0603	1	0.0603	0.0049	0.9445
Sex by Teacher	83.9895	5	16.7979	1.3560	0.2417
Treatment by Teacher	179.5825	5	35.9165	2.8993	0.0147*
Sex by Treatment by Teacher	29.2610	5	5.8522	0.4724	0.7967
Error	2923.568	236	12.388		

*Significant at .05 level or beyond.

of sex by treatment, sex by teacher and sex by treatment by teacher.

There was a significant difference between the two groups for the variable, teacher. The control group students of two teachers performed better on a measure of cognitive achievement than did the experimental group students of the same teachers. On the other hand, the experimental group students of four teachers performed better on the measure of cognitive achievement than did their control group students.

In addition, the data reflect the fact that the interaction, treatment by teacher was significant. That is, teachers' efforts were marked by differential results according to whether they were using the experimental or control group mode of instruction.

Ten weeks following the post-test measure, the same instrument was administered as a delayed interval measure of cognitive retention. The adjusted mean scores for that administration of the instrument appear in Table 3.

TABLE 3

ADJUSTED MEAN SCORES ON DELAYED INTERVAL POST-TEST MEASURE OF COGNITIVE RETENTION

Control			Experimental		
F	M	Combined	F	M	Combined
15.31	14.53	14.84	18.92	18.50	18.71

In this instance, the difference between the control and experimental groups was more noticeable. A spread of almost four more correct items for the experimental group than for the control group was evident. This difference, favoring the experimental group, was significant as is indicated by the data for the treatment variable given in Table 4.

TABLE 4

ANALYSIS OF COVARIANCE TABLE SHOWING THE RESULTS OBTAINED ON THE DELAYED INTERVAL POST-TEST: COGNITIVE RETENTION INSTRUMENT

Source	SS	DF	MS	F	P
Treatment	949.3708	1	949.3708	63.2476	0.0001*
Sex	11.4844	1	11.4844	0.7651	0.3826
Teacher	328.1785	5	65.6357	4.3727	0.0008*
Sex by Treatment	0.0059	1	0.0059	0.0004	0.9843
Sex by Teacher	170.7250	5	34.1450	2.2748	0.0480*
Treatment by Teacher	97.1270	5	19.4254	1.2941	0.2671
Sex by Treatment by Teacher	62.7690	5	12.5538	0.8363	0.5250
Error	3542.360	236	15.010		

*Significant at .05 level or beyond.

The data for the variable, treatment indicated a significant difference between the experimental and control groups on the delayed interval measure

of cognitive retention. Evident, too, was a significant difference for the variable, teacher. The interaction, sex by teacher was also significant.

Students in the experimental groups of all teachers performed better on the delayed interval measure than did their control group counterparts. However, the students of different teachers performed differentially. Thus, there were significant differences associated with the teacher variable for both the post-test and delayed interval post-test measures.

While the sex by teacher interaction was found significant, no interpretation of the finding will be given here since its source and meaning have not been studied by the investigators.

Conclusions

According to the data presented in Table 2 and Table 4, and congruent with the null hypotheses presented earlier, the following conclusions seem warranted:

1. Students in United States History classes who are exposed to simulation-gaming techniques perform as well on a measure of cognitive achievement administered at the conclusion of the experimental treatment period as do students who are exposed to traditional lecture-discussion techniques.
2. Students in United States History classes who are exposed to simulation-gaming techniques perform significantly better on a delayed interval post-test measure of cognitive retention than do students in United States History classes exposed to traditional lecture-discussion techniques.

Discussion

In the world of twentieth century American education, serious questions

have been asked concerning what is worth knowing and what is needed for living an effective life. Teachers in elementary, secondary and college classrooms frequently raise these questions. Their students participate in a dynamic society, one charged with emotion, physical action and imagination. However, many courses of study in the schools place emphasis on abstract and relatively passive learning processes, allowing students few opportunities for active participation in the learning process. This emphasis has created a high degree of frustration among students who feel the need for active participation in the learning process and in societal affairs.

The use of simulation-gaming as a teaching tool has become of increasing importance to teachers, and social and behavioral scientists. Many educators believe that simulation-gaming techniques provide feasible alternatives to the abstractness of traditional lecture-discussion techniques. The data obtained in this study tend to support the views of those educators who are of the opinion that a more active participation by students in the learning process is indeed a feasible alternative to the lecture-discussion pedagogical mode.

While the conclusion that students exposed to simulation-gaming techniques perform as well on a measure of cognitive achievement as do students exposed to traditional lecture-discussion methods of instruction seems well founded, the conclusion that they perform superiorally on a measure of cognitive retention must be tempered by the finding that the students in the experimental group in this study scored higher on the delayed interval post-test than they did on the post-test administered at the conclusion of the experimental period. This finding reflects an educationally desirable outcome, but a statistically disconcerting one. It would normally be expected that forgetting would have taken its toll and that the adjusted

means would have been lower.. This was not the case. To what should the increase then be attributed?

Post-experimental contact with the participating teachers revealed that they reported discontinuing the experimental mode of instruction at the conclusion of the experimental period as they had been instructed to do. Speculation, then, leads us to the interpretation that students in the experimental groups might have become so involved in the active process of learning that they continued to reinforce what they had learned and, indeed, to continue learning, either individually or collectively, during the delayed interval period.

The conclusions derived from this study, then, suggest that simulation-gaming is a pedogogical tool which enhances the learning of those exposed to it when it is compared with traditional lecture-discussion techniques.

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