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RICHARD B. COHEN
and
ROBERT H. BRADLEY
University of Arkansas at Little Rock

Teaching Superordinate Concepts with Simulation Games

The effectiveness of simulation games as a method for teaching superordinate concepts was examined in this study. The simulation involved instruction in map skills and was structured in keeping with Case's (1975) discussion of how to integrate developmental and hierarchical aspects of learning in instructional design. One hundred and eighty-three fifth- and sixth-grade students participated in the week-long experiment. The simulation group demonstrated superior performance on map skills and concepts on the delayed posttest, but not the immediate posttest. Members of this group also showed significant improvement in performance from posttest to delayed posttest. Results were interpreted as supporting the hypothesis that simulations can be a useful way of presenting superordinate concepts so as to facilitate learning of lower level skills. Results also appear to corroborate Case's analysis of effective instructional designs. (Dr. Cohen is Coordinator of Laboratory Experiences and Assistant Professor in the Department of Elementary and Early Childhood Education, and Dr. Bradley is Associate Professor of Educational Foundations and Research Associate at the Center for Child Development and Education, at the University of Arkansas at Little Rock.)

One of the most significant contributions to the analysis of the learning task has been the development of theories about the hierarchical structure of knowledge (Ausubel, 1963; Gagne, 1970; Taba, 1967; and Bloom, 1956). Conceiving knowledge as hierarchical has enabled educators to analyze tasks according to level of learning and to prescribe a sequence of educational activities which provides the necessary prerequisites for acquiring information at any given level.

Several theorists have argued that when individuals know a superordinate concept, it is easier for them to learn subordinate concepts and facts. Ausubel (1963) advocates the use of advance organizers presented at a higher level of abstraction as a means of facilitating learning at lower levels. However, advance organizers apparently do not always provide the kind of subsumer that facilitates the learning of subconcepts and specific facts (Barnes & Clawson, 1975). This outcome may partially reflect a limited consideration of the developmental aspects of learning in Ausubel's theory. Case (1975) contends that most learning hierarchies do not provide an adequate analysis of learning tasks, particularly for children. He presents evidence that any analysis of a learning task must take into consideration that young children are more likely than adults to respond intuitively in problem-solving situations. They rely on innate response tendencies which prevent them from adequately evaluating phenomena. To accomplish certain tasks children must learn to respond logically rather than intuitively. Case (1975) feels that to be successful, instruction for young children should deal directly with

> both the correct response and the incorrect response. . . . In terms of a hierarchical learning theory such as Gagne's, one would say that the child who participates in the successful training acquires a superordinate skill (or "concept," "plan," or "structure") for attacking the problem which allows him to integrate and discriminate two competing lower-order procedures for attacking it. After training he can succeed consistently, not merely because the correct response has been strengthened, but because response competition has been eliminated. Similarly he can transfer what he has learned, but because any new situation that elicits the incorrect response will also elicit the superordinate or mediating structure into which it has become embedded. Finally, he can retain what he has learned, since he has ample opportunity to apply it (at the supper table, for example, or at play) and little opportunity to confuse it with any other response. (p. 74)

Instructional strategies which consider the developmental nature of learning and which are aimed at teaching superordinate concepts offer a potentially useful way to facilitate the learning of subordinate concepts and facts. One method which can provide a framework for acquiring numerous subskills is simulation games. Simulation games may be defined as an activity in which participants who are attempting to achieve specific goals interact within an artificially produced environment which recreates some aspect of social reality. For the purpose of reality, players assume the roles of individuals or groups who exist in the particular social system being simulated. Bruner has argued that simulation games with their emphasis on participation, informed guessing, hypothesis making and conjectural procedures "go a long way toward getting children involved in understanding language, social organization, and the rest; they also introduce . . . the idea of a theory of these phenomena" (Bruner, 1966, p. 92).

Previous research has demonstrated that simulation games are effective in teaching factual knowledge and concepts. However, Coleman, Livingston, Fennessey, Edwards, and Kidder (1973) explain that simulations tend to be weak in that many participants do not generalize from the particular experiences provided in the game to a general principle applicable in other circumstances. They concluded that learning in school might be made considerably more effective by the "appropriate mix of experiential and information-processing modes of learning" (p. 6). Therefore simulations that incorporate both the symbols helpful for generalization and the actions useful for application to particulars may be the most effective.

A model which may be particularly useful for teaching superordinate concepts with simulation is Taba's instructional model. Taba (1969) identifies three cognitive tasks involved in the thinking process. The first, concept formation, involves organizing information into a system of classes or groups. In this phase it is sufficient that the facts be introduced and that the learner become somewhat familiar with them. The second cognitive task is interpretation of the data. To do this the learner must relate various kinds of information given and determine cause and effect relationships. Time must be taken to develop concepts, to develop strategies for coordinating lower level concepts and facts, and to make decisions among various alternatives based on the information available. The third cognitive task is problem solving. The learner must be able to apply what he knows, facts and generalizations, to the solution of a problem. This final phase requires additional coordination of facts and concepts, and the development of new strategies for evaluating them.

The purpose of the present study is to examine the effectiveness of simulation as a means of teaching superordinate concepts necessary for the acquisition of subordinate skills. If Case (1975) is correct, then students should demonstrate a knowledge of subordinate concepts when tested at the completion of training on superordinate skills. The encounter with subskills on the test should also constitute a kind of learning trial for the learner. Thus, when tested a second time, student performance should be better. Improved performance would not be expected from students who learned the subskills without benefit of learning the superordinate concepts initially. Previous research on retention indicates that such students are in fact likely to forget some of what they have learned.

Method

Subjects

Fifth- and sixth-grade classes from two Kansas City, Kansas elementary schools were utilized for this investigation. The eight classes participating in this experiment were randomly assigned to experimental and control groups. The total number of students in the sample was 183, including 91 in the experimental group and 92 in the control group.

Treatment

The investigator met with the experimental and control teachers one week prior to beginning the treatment. At this time both groups received the same instructions on the purpose of the study and testing procedures. Experimental and control group meetings were conducted separately.

Teachers in the control group were instructed to teach a map skills lesson which included both facts and concepts in the way they usually teach. Their instructional approaches involved teaching the facts and concepts directly rather than teaching superordinate concepts. The lesson used for the sixth grade was from the textbook *Exploring Regions of the Eastern Hemisphere* and for the fifth grade the lesson was from *Exploring Regions of the Western Hemisphere,* both published by Follett. The lesson was to be taught in four consecutive sixty-minute time periods. Time was allowed after the presentation for discussion and questions.

In the preparation meeting with the experimental group teachers, the game *Phantom Submarine* was played since it has been found that teachers do a better job of teaching a simulation if they have first played it themselves. At this time the teachers became familiar with the game, discovering the rationale, techniques, and procedures.

The systematic approach of Bruner's and Taba's theories for learning and the approach used with the simulation game *Phantom Submarine* are very similar. It provides opportunities for the teacher to expand pupil participation through the use of peer interaction, role-playing, and decision-making. The primary emphasis is on the need for active rather than passive participation in order to have a meaningful learning experience. The active participation leads to intrinsic motivation that Bruner and Taba mentioned as an important factor in helping children develop greater interest in a subject, which, in turn, leads to longer episodes for learning.

After a lengthy discussion about the game, the timetables were established as follows: (a) On the first day the students in the simulation treatment used the sixty-minute period allowed to familiarize themselves with the game and divide into 5-person groups. Each member of the group had a data card telling some physical characteristic of the floor of the Atlantic Ocean. The simulation began by the group compiling factual knowledge about the floor of the ocean and its currents. This was accomplished by a member of the group showing and reading his card to the rest of the group. As each member read his card, the other members recorded this data on their outline maps. (b) The second day, students were presented a problem which required them to make a decision about where some good places might be to try to bring the submarine up from the bottom of the ocean. They were instructed to use the information included on the maps and consider such factors as water depth, mountain ridges, etc. In considering alternative solutions, certain cause and effect relationships for physical features were discussed. Solutions were discarded or approved on the basis of the relationship among these factors. (c) On the third day, students were presented a final problem: What should be done with the submarine? Students were given roles to play in the context of a meeting at the United Nations. The roles involved a consideration of various economic, political, and ecological concerns. Several general questions were posed to the students in the form: What would happen if? To deal with the questions, students had to apply knowledge of the maps and the generalizations they had formed from the previous two tasks. (d) The fourth day was allowed for completing any unfinished tasks and for discussion of all decisions made by the groups.

Instruments

On the fifth day of the experiment, both the experimental and control groups were administered the posttest, the map portion of the Iowa Test of Basic Skills to measure map skills. Two weeks after the posttest a delayed posttest was given to both groups to measure retention.

Results

Means and standard deviations for the Iowa Test of Basic Skills are presented in Table 1. One-way analyses of variance were used to examine differences in the mean performances of experimental and control groups on the Iowa test. No significant difference between groups was observed on the

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR IOWA TEST OF BASIC SKILLS

	Posttest	Delayed Posttest
Treatment (n = 91)		
Mean	16.82	17.58
SD	4.73	5.23
Control (n = 92)		
Mean	16.19	15.59
SD	5.42	6.23

TABLE 2
SUMMARY TABLE OF ANALYSIS OF VARIANCE FOR
IOWA TESTS OF BASIC SKILLS POSTTEST

Source of Variation	Sum of Squares	df	Mean Square	F
Between	18.0726	1	18.0726	.8279
Within	3950.9384	181	21.8284	
Total	3969.	182		

TABLE 3
SUMMARY TABLE OF ANALYSIS OF VARIANCE FOR
IOWA TESTS OF BASIC SKILLS OF DELAYED POSTTEST

Source of Variation	Sum of Squares	df	Mean Square	F
Between	182.17	1	182.17	5.512*
Within	5982.43	181	33.05	
Total	6164.60	182		

* significant at the .05 level.

posttest (See Table 2). However, a significant difference was observed between experimental and control groups on the delayed posttest (See Table 3). Furthermore, the experimental group tended to improve from the posttest to the delayed posttest while the control group tended to decline — albeit neither trend was statistically significant.

Discussion

Results from the study indicate that the simulation game was an effective way of presenting superordinate concepts so as to facilitate learning of lower level map skills. Performance on the posttest and delayed posttest indicated that learners in the simulation group not only learned as much as learners utilizing more traditional information-processing approaches, but they continued to improve after completion of the training. This subsequent improvement resulted in superior attainment on the delayed posttest. The findings in this study, which showed that learning superordinate concepts facilitates the learning of subordinate facts and skills, are similar to findings reported by Case (1975) when he trained children to do maze tasks. After training on superordinate concepts, these children tended to improve upon additional encounters with the maze tasks. Children whose training involved only being rewarded for correct approximations to solving the maze task showed no significant advance once the training was terminated. Thus, the present findings tend to corroborate Case's analysis of effective instructional strategies and expand his findings to the learning of several related subordinate concepts.

Educators have not typically espoused the use of simulation games as a means of teaching facts and basic concepts. It seems, however that simulatons which involve some aspects of information-processing strategies can be effective in facilitating these types of learning. These types of simulations may serve as useful advance organizers. While utilizing symbols, they are not dependent on written materials. Like other types of experiential learning they involve actions, actions which appear helpful for applying concepts to particulars. Subordinate concepts will not only become "meaningful" in relation to the subordinate concepts presented, but also in relation to the affective response emitted during the actions. As part of a total instructional strategy, simulations offer teachers a useful addition to a repertoire of instructional designs. They provide a change of pace and have been shown to improve attitude toward learning (DeKock, 1969; Cohen, 1969).

Research needs to be aimed at the long-term effects of simulations in facilitating subordinate facts and concepts. In addition, research is needed to examine how simulations might be more effectively integrated into a total instructional approach for a curricular area. Such questions as what types of simulations are needed, how long should they last, how frequently should they be employed and what other types of instructional procedures do they best integrate will need to be considered. Additional research also needs to be done on simulations as advance organizers.

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