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ABSTRACT

Seven investigations of modeling as a teaching technique are reviewed in this paper. Children in the individual projects varied, but included Anglo-Americans and Mexican-Americans from the kindergarten, and second, third and fifth grades. Modeling effects were examined in the following areas of teaching concern: (1) concept formation, transfer and retention; (2) associative and conceptual rules of learning; (3) amount of organization in teaching a skill or concept; (4) selection of shapes; (5) question-asking behavior; (6) creativity; and (7) conservation. Methods of investigation and results are described individually for each project. Seven recommendations for classroom teaching practices are discussed. These recommendations concern the organization of a learning task, verbal instructions, supplementing overt behavior (modeling) with verbal explanations (symbolic modeling), modeling and physical guidance in a task, viewing a model silently and with discussion, performance of a task after modeling, and corrective feedback. (SDH)

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FEEDBACK: EDUCATIONAL STRATEGIES

by

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Introduction

During the past two school years, you and your students have participated in a number of studies done by Dr. Barry J. Zimmerman of the Arizona Center for Early Childhood Education, University of Arizona. These studies have made important contributions to our understanding of various teaching methods and how they help children learn. In particular, they have increased our knowledge of how modeling can be used as a teaching technique. To share this new information with you, the following report describes the implications and applications that the studies have for teachers in the classroom.

Your help in making these research advances possible is much appreciated. Any questions or suggestions you may have are welcomed, and should be addressed to Dr. Zimmerman at the Arizona Center for Early Childhood Education, 1515 East First St., Tucson, Arizona 85719.

MODELING AS A TEACHING TECHNIQUE

Imagine for a moment that you have never tied a shoe before in your life and that someone has given you a lace for a shoe, telling you to close your eyes. Can you imagine how difficult it would be to follow that person's instructions on how to tie a bow?

That example seems to illustrate the difficulty in learning many of the important skills in our culture. Because of their complexity they are not easily describable simply by using language. There is a great deal of evidence that children learn many concepts before they have very sophisticated language skills. Things are learned in these circumstances in two ways: either through the direct support of the child, such as when a mother holds her child in the upright position when he is learning to walk (proping); or, probably to a larger extent, through children watching other people and how they behave (modeling). There is a lot of evidence that in learning to speak the second child in a family is more capable in language learning than the first child, and it seems plausible that it is because of watching the older child display his verbal skills.

Most of us intuitively use modeling whenever we run into a tough teaching task. Have you ever thought of describing the word "red" to somebody who doesn't know what red is? The only way to show what red means is to show a person responding in a systematic way to a variety of red things.

Many complex skills, both physical and intellectual, cannot be conveyed by simple verbal instructions, or even by active guiding of the child to make the correct response.

Consider the difficulties in trying to teach children simple "conservation" of liquids (or continuous quantity). The problem here is for a child to recognize, for example, that when you pour all the water from a tall, thin glass into a low, wide bowl, you still have the same amount of water, and that you can pour the water into vessels of many shapes without altering the quantity of water. Because of the perceptual orientation of young children, it is obvious that the amount looks different when it is poured into another vessel. It is difficult to reason logically with children about such a concept at an early age, because the words that imply "more than," "less than," and "the same as" are not clearly defined in children's minds. Thus, they have to understand the concept situationally. So, verbal instructions using these terms provide only a marginal amount of information to the child. Instead, the concept must be conveyed situationally, through modeled actions.

Many educators would attempt to teach this type of skill by pouring the liquid back from the odd-shaped vessel into the original glass, thus showing the maintenance of equality in the liquid , and hope that the child could infer the invariance of quantity concept. Such one-shot efforts, as one might expect, have proven to be largely unsuccessful. Instead, we have attempted to show that, when the words "more," "less," and "same" are used correctly (modeled) in many types of situations, with different conservation tasks, the definition of "more," "less," and "same" become clear. In this way, also, the notion that quantity can remain constant despite changes in overt appearance (conservation) is conveyed.

There is one other important point that distinguishes modeling, as we define it, from the type of demonstrations often used in the classroom: demonstration is often used as an inductive teaching technique, in which the correct response is not explicitly shown. The child is left to his own devices to infer what the correct response should be. In modeling procedure, however, an attempt is made to integrate the correct response with the task as an organized, logical sequence. All important information needed for a correct response is provided by this procedure, so that a child whose background has not provided the experiences which would permit him to fill in the gaps of the inductive demonstration is not handicapped in a modeling situation.

It seems readily apparent that this latter procedure would be the type of modeling one would expect to occur in the "natural" environments of children, in which they have become accustomed to learning all their lives. Often, in real-life situations, parents are not even conscious of modeling for their children but are just going about their daily tasks. Consequently there are no artifically contrived gaps in their performance (to permit "induction"). In the real world the primary focus of most models' behavior is to correct task completion rather than conscious "training," so an observer sees entire activities completed in correct sequence. Generalization comes from observing these organized sequences in a variety of task situations.

The point we are trying to make is not that modeling is an unfamiliar, unused procedure for teachers, but that most teachers tend to use this procedure intuitively on the basis of their own individual experience. Because modeling is not often taught or studied as a teaching technique, there are gaps in our understanding of its use. These gaps can result in inefficient or even inappropriate use of modeling. During the last two years we have attempted to systematically explore some of the subtle issues involved in using modeling as a teaching technique. In the following pages we will describe our most recent studies, and how findings from these studies can be applied in your classroom.

Study No. 1 Show, Tell, or Both? (Teaching Concept Formation, Transfer, and Retention.

Researchers: Barry J. Zimmerman and Ted L. Rosenthal

This study involved teaching middle-class Anglo-American third-graders a game they had never played before and then testing to see how well they had learned the game, how well they could transfer what they had learned to two new but similar games (one given right away, one six weeks later) and how well they could remember the first two games six weeks after they'd been taught.

Three methods of teaching were used:

(1) Modeling only--the model silently went through the whole game, playing correctly.

(2) Rule only--students were told the rule of the game, but did not see it demonstrated.

(3) Modeling and rule--students in this method were told the rule, and also watched a model play the game correctly.

A fourth group, serving as a control, was neither shown nor told how to play the game, but were simply told to do their best at playing the game.

Just as often happens in classroom teaching, no extrinsic reinforcers (candy, prizes, etc.) were promised or given. Results of the study showed that the children who had only observed the model did better than those who had only been told the rule, and that those who had been given both rule and modeling exposure did best of all in concept (rule) acquisition, transfer, and retention.

When the materials were presented again six weeks after initial training, it was found that the order in which the sets of stimuli (original game, "transfer" game, and a new version of the game) were presented did not influence the strength of concept retention. In other words, presenting the new task first instead of the "review" tasks did not make it harder for the students to recall and apply the game rules.

Why: To our knowledge, this is the first demonstration that from observation alone, unaided by other means of conveying information, a concept can be retained and generalized to novel stimuli after a substantial amount of time (six weeks) has elapsed. The results also showed that, when working with third graders under the conditions described, providing a correct and complete verbal rule is a brief and efficient means of producing concept learning, transfer, and retention. Furthermore, it was found that modeling and giving a verbal rule are not "redundant"--each contributes something of its own to the learning experience, so that children who get information through both modes do better than those who are taught by one method only.

This study also contributed some very important information to a theory of how people learn. Because of the way students responded in the generalization phase of the experiment (particularly, the fact that order of presentation of stimuli was unimportant) it seems clear that what was learned was not a series of narrowly-defined S-R (stimulus-response) links but a conceptual paradigm. In other words, children were abstracting and remembering organized relationships, not just responses to visible properties of the stimuli. This lends support to Bandura's social learning theory view on observational learning, a view which states that people use symbolic processes to store and recall behavior patterns they've observed. It also expands on Bandura's theory to show that what is stored is not just a symbolic representation of a situation-specific chain of stimuli and responses but a product of inferential reasoning--a more abstract conceptual rule.

Study No. 2. "Describe What You See" --That's Not a Good Way to Help Children Learn

Researchers: Barry J. Zimmerman and John A. Bell

This study was done with middle-class Anglo-American fifth graders using the same game used in Study No. 1, but with slightly different rules. Some students were taught a rule that had a logical order to it ("conceptual rule"), while others were taught a random rule (called an "associative rule" because each part had to be learned as a separate association, rather than forming part of a larger concept). The children participated in one of three groups:

(1) Those who passively watched a model play the game, using one of the two rules mentioned above (half the group saw the conceptual rule used; half, the associative).

(2) Those who watched the model and described what they saw as they watched.

(3) Those who counted (an "irrelevant verbalization") while they watched.

Children were tested on how well they played the game, how well they transferred what they had learned to a slightly different game, and how well they recalled what they had learned three weeks later.

The findings were that:

(1) Children who had been shown the game with the associative (arbitrary) rule had a much harder time remembering it three weeks later than did the children who'd learned a conceptual (logical) rule, though there was no difference in performance when they were tested on the first day.

(2) Children who just warched passively did better in all phases than did the children who talked as they watched. The children who described what they were seeing did no better than those who counted as they watched!

To our knowledge, this is the first conclusive demonstration that an observer's spontaneous verbalizations can interfere with observational rule-learning. From a teacher's point of view, this means that caution should be used in asking students to discuss something while they watch it as the talk can interfere with their learning.

Study No. 3. A Little Disorder is a Good Thing (?)

Researchers: Barry J. Zimmerman and Ted L. Rosenthal

This study used both third- and fifth-graders, who were middle-class Anglo-Americans. The task was the same game used in the first two studies but, once again, the rules were varied slightly. This time the rule had one of three levels of organization:

(1) High organization--this was much the same as the conceptual rule condition in Study No. 2.

(2) Moderate organization--part of the game was presented randomly, part in an orderly fashion.

(3) Low organization--the game was presented with a random "rule," similar to the associative condition in Study No. 2.

Participating children were assigned randomly to one of three experimental conditions:

(1) Guided practice only--the children in this condition had their hadns physically guided through the correct responses of the game.

(2) Modeling only--children here watched a model silently play the entire game correctly.

(3) Modeling and guided practice--these children both watched a model perform and had their hands guided through a correct playing of the game.

The main findings of this study, which held equally for third- and fifth-graders, were:

Modeling was twice as powerful as guided practice (also called "prepping") as a technique for teaching rule learning tasks. This has important implications for teachers who tend to guide a child's hand, rather than model for the student, in such activities as drawing or completing math exercises. It is important to remember that this study dealt with a concept- or rule-learning task; it would be inappropriate to generalize the findings to activities which are primarily or exclusively physical performance tasks.

Chilcren who were presented with the highly organized rule seemed to have "learned" more when tested right after they had been taught the game, but this advantage dropped out when students were tested on their ability to generalize to a slightly different game. While this result is somewhat difficult to interpret, it may mean that, while organization helps initial learning, the introduction of some variability (in this case, actual randomness) during training can help students transfer what they learn to new situations. In other words, rigid presantations--whare everything is "pat"-- may lead to rigid and limited understanding of the concepts being taught.

Study No. 4. Repeat, Repeat, Repeat (and Model, Too)

Researchers: Barry J. Zimmerman and Ted L. Rosenthal

Fifth graders from two Tucson schools in lower-middle-class areas participated in this study: 64 were boys and girls from Mexican-American families, 64 were from Anglo-American homes. They were randomly selected and assigned to experimental groups.

The learning task used here was a game which called for selection of a shape from among several painted on each of 12 cards, according to a rather complicated rule. All the children were told how to play the game, after they had played with the cards once. After that, treatment varied with the group a child was assigned to:

(1) Nonmodeling, repetition group--The experimenter showed the cards over again, one at a time, and repeated the rule with each card.

(2) Modeling, nonrepetition--a model went through each card correctly.

(3) Modeling, repetition--the experimenter said the rule as the model worked through each card.

(4) Nonmodeling, nonrepetition--No further instruction given (control group).

Students were tested on their performance with the same set of cards, and on their ability to generalize the rule to a new, slightly different set of cards. Then all were asked to state the rule for the game. In the performance test, students were allowed several tries with each card, and were told if their answer was correct. (Such information is called "feedback.").

Results showed that both modeling and repetition improved performance. Groups that had had modeling reduced their errors in the performance test faster than those that had had no modeling (the control group is included here). As might be expected, repetition helped students state the rule correctly. As a group, Anglo- outperformed Mexican-American children, but the major results held for both groups.

The similarity of the control condition--in which the rule was stated once, and feedback given during the performance--to "operant" training techniques permits the conclusion that combining modeling or even repetition with oeprant conditioning is superior to using the latter method alone. Also of interest is the fact that, at least with these fifth-graders, verbal repetition (symbolic modeling) can be even more effective than live modeling--particularly for generalization, or transfer of learning to a new but similar task.

Study No. 5. Teaching Question-Asking Through Modeling.

Researchers: Barry J. Zimmerman and Earl O. Pike

The findings of this study, done with disadvantaged Mexican-American second-graders, have given us some important cues on teaching question-asking, and on language learning in general.

In a controlled experiment with children in a small group situation (groups of six), it was determined that questioning behavior was readily modified by an adult who modeled question-asking and praised children's questions. Of the six experimental groups, the two which both observed a model and received praise asked significantly more questions during training and in individual post-testing than did those groups which simply received praise for asking questions or which received neither modeling nor praise (controls).

Question-asking has tremendous practical importance: through questions a child can solicit specific information about ideas and objects. This ability gives him considerably greater control over his world, and probably facilitates learning. The present study shows that the social learning principles of modeling and giving specific praise for appropriate behavior combined are effective in teaching children to use the question-asking forms which help them guide their own learning. What is more, such teacher-child interaction is not limited to the dyad (two-person) relationship, but is effective within a small group setting as well.

Study No. 6. "Judge Not"--It May Suppress Creative Fluency

Researchers: Barry J. Zimmerman and Frank D'Alessi

Participants in this study of creative behavior were fifth-graders in two Tucson schools. The tasks used were based on those in Torrence's test of creativity. Students observed a videotape of a model performing one task from the Torrence test; they were then asked to complete a similar task and a task that was somewhat different from the one modeled. Models demonstrated one of four combinations of fluency (number of responses given) and flexibility (number of different response categories used): high fluency, high flexibility; high fluency, low flexibility; low fluency, high flexibility; low fluency, low flexibility. Student responses were also rated in terms of fluency and flexibility.

Preliminary analysis of the results showed:

(1) There was very little mimicry (exact repetition) of responses the models had used.

(2) Observation of a high fluency model led to both high fluency and high flexibility in observers' responses, however

(3) Observation of a high flexibility model suppressed the fluency of observers' subsequent responses.

One likely explanation for finding (3) is that the students, in trying to use many different categories of responses, were taking longer to think about and evaluate their answers--which lowered the total number of answers they gave. People who have used the creative techniques of brainstorming also notice this effect: when participants try to judge or evaluate the responses of others and themselves, they tend to suggest fewer things. One implication this has for teachers is that, if we are concerned with creative production on the part of our students, we should not be too quick to evaluate or criticize if we don't want to hamper their future creative efforts.

One of the tasks in this creativity study was for the children to imagine what it would be like if the whole earth were covered by a dense fog, and all you could see were people's feet. Here are some of their responses:

"People might buy only shoes and socks and not clothing."

"You could put names on your shoes to tell the people apart."

"Learn to read by stepping on Braille writing."

"It would be a world of feet and foot doctors making a fortune."

"People would be putting make-up on their feet."

"We'd wear fancy shoes, if any."

"We wouldn't have to look at pollution."

Study No. 7. Teaching Conservation

Researchers: Barry J. Zimmerman and Ted L. Rosenthal

This study, done with kindergarten children, was concerned with teaching "conservation," the ability to perceive that a change in the external form of something does not alter the amount present. Participating children were assigned randomly to one of three experimental conditions: modeling only, corrective feedback only, or modeling and corrective feedback combined. All children were told the rule of conservation that applied at the start of the exercise. Those in a modeling condition also saw a model perform correctly; those in a "corrective feedback" condition were told the rule again whenever they made an incorrect response.

While data from this study have not yet been fully analyzed, it appears that the combination of modeling and corrective feedback was a more effective training procedure than the use of either method alone. Used singly, corrective feedback may have been somewhat more effective than modeling alone.

SEVEN HELPFUL HINTS

These studies, and others performed in previous years under Dr. Zimmerman's direction, have some clear implications for classroom teaching practices. The following are seven recommendations, based on findings of this research, about using modeling as a teaching technique:

(1) Careful attention must be given to the way a learning task is organized. For example, suppose you want to teach a child the concept "red" by having him learn to pick the red thing from an array of objects or pictures. Even before you model anything, it is important to pick the objects you will use in such a way that all the parameters (such as color, size, shape) vary independently. If you select a red ball, a red loop, and a red bowl only, the students may think that red means round. So care must be taken if the correct generalization or abstraction is to occur.

(2) Any instructions that call attention to relevant aspects of a task will help in abstracting the rule.

(3) It is a good idea to supplement overt behavior (modeling) with a verbal explanation (symbolic modeling), and to repeat the verbalization as you model if it seems necessary. Don't be afraid to repeat yourself--it can help children learn.

(4) In <u>concept</u> learning (as distinguished from motor learning) tasks it is better to show a child by modeling (you perform while he watches) than by guiding his hand through the correct response.

(5) It is better to have children watch a model silently than to have them describe what the model's doing while they watch. There's

one exception to this: with children under five years of age, verbalization seems to help them remember and reapply later what they've seen.

(6) Once a child has observed a model, it's a good idea to ask him to perform what he has seen rather than just to assume that he's learned what was modeled. This provides the teacher with important feedback on how much the child has understood.

(7) Corrective feedback--telling a child the correct answer when he's made a mistake and letting him know when he's correct--can help a child to learn and to remember what he learns.

Modeling is a versatile procedure that seems capable of adapting to a variety of settings: it can be used at home and in both "open" and structured classrooms, with two people or with a group. We hope these suggestions will help you use modeling as an effective teaching technique.