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THE USE OF FILM-MEDIATED MODELS TO PROMPT CHILDREN'S SCIENTIFIC PROCESS ACTIVITIES: A PILOT STUDY*

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ABSTRACT

In a pilot study designed to determine whether fourth grade students can acquire a set of behaviors related to performing certain laboratory activities, 22 students were randomly assigned to either a film-mediated modeling treatment or a control. Students in the treatment viewed a videotape model showing peer leaders engaging in the steps of an experiment and verbalizing their acts. The control students did not view the model. Subsequently, the students of both groups conducted the same experiment in class while trained raters observed their behavior. (Inter-rater Reliability was between .87 - .97) Although both groups of students received preliminary verbal instructions regarding how to conduct the experiment, those students who viewed the model after the directions produced significantly more positive behaviors ($p < .05$) and fewer negative behaviors ($p < .05$) than the control group that did not view the model but had an equivalent time to practice the directions prior to, and during, the laboratory session.

INTRODUCTION

An objective of many elementary science curricula is to involve students in experimental procedures which provide opportunities for process skills to be acquired, performed, practiced, retained and transferred. One task the teacher has when moving towards these objectives in a curriculum such as Science - A Process Approach is that of teaching procedural techniques prior to a lesson. If the students fail to understand the procedure as verbally described by the teacher, the objectives of the experiment, being contingent upon technique, are doomed from the beginning. A substantial portion of science lesson time is devoted to this aspect of teaching. By employing a more efficient method for teaching procedures, the lesson emphasis could shift to its original objective, the experiment and concommitant process skill acquisition.

The purpose of this study was to test observational learning as a means of teaching experimental procedure using a peer group as the model of appropriate experimental behaviors. Members of the class upon observing the model should be able to better understand and perform the experiment as it has been modeled. An extension of this approach would be to model component parts of exploration activities to assure that all students become involved with the process skills and materials in productive ways.

PROBLEM AND THEORY

Bandura (1963, 1969a, 1971) has presented considerable evidence to suggest that children's behavior, as indeed adults' behavior, can be influenced by live, film-mediated and symbolic models. This research has been extended to both counseling (Krumboltz and Thoresen, 1969) and teacher education (Koran, M. L., 1971, Koran, J. J., Jr., 1972). In all of these studies subjects are exposed to a model performing certain clearly defined behaviors and the learner acquires the observed behaviors without having to either overtly respond to them or be reinforced for performing them during acquisition. The implication of this research for science learning is that models of scientific process activities, either live or film-mediated, either teacher or student, can be devised to prompt children to engage in observing, classifying, inferring, predicting, hypothesizing, experimenting, gathering data, interpreting data, and communicating results (Koran, J. J. Jr., 1972c).

Three sets of conditions affecting the modeling process are: the characteristics of the subject, the characteristics of the stimulus act and the characteristics of the model (Bronfenbrenner, 1970; Bandura, 1971).

Characteristics of the subject: Subjects must be able to perceive the stimulus act and perform the same acts as those modeled (Bandura, 1971). In studies with children concerning differences in receptiveness to modeling treatments that are related to age (Denney, 1972; Leifer, et al, 1971; Leibert, et al, 1969) one finding is that upper elementary children respond better to models than lower. This finding must be considered in terms of task and method variables.

Sex also seems to make a difference in terms of model effectiveness. Masters and Morris (1971) report that males tend to imitate models more readily and more widely than females. In one study, males modeled an agressive female model more effectively than a neutral male counterpart.

Finally, culture seems to play a role in modeling effects. Portuges and Feshback (1972) report that when advantaged and disadvantaged third and fourth graders were used as subjects in a study to explore the acquisition of incidental behaviors through filmed models, advantaged girls modeled the positively reinforced white teacher significantly more than advantaged white boys. Disadvantaged girls and boys displayed fewer of the modeled behaviors than advantaged subjects of both sexes. Incidental behaviors in this study were defined as gestures or remarks not essential to the communication. Folding the arms during questioning, clasping hands, encouraging students with remarks such as "think hard" were considered incidental behaviors.

Characteristics of the Stimulus Act: Complex behaviors may be more easily learned through modeling if they are divided into smaller components (Bandura, Brusec, and Menlove, 1966). The relation of one act to the next in a sequence exhibited by the model becomes obvious and component behaviors are acquired more efficiently when the model divides the complex behavior into small components, labeling each component in sequence.

Characteristics of the Model: The third set of conditions seems to have the greatest potential for influencing the modeling process in children (Bronfenbrenner, 1970). Findings in this area indicate that: (1) The potency of the model increases with the extent to which the model is perceived as possessing a high degree of competence, status, and control over resources (Bandura, Ross, and Ross, 1963). (2) The inductive power of the model increases with the degree of prior nurturanche or reward exhibited by the model (Bandura and Huston, 1961; Massen and Parker, 1963). The most powerful models in a child's life are those perceived by the child as major sources of support and control. (3) The most effective models for the child are likely to be those who are the major sources of support and control in his environment. Parents, peers, older children and adults that are important may act as supportive agents and as models (Bandura and Walters, 1959; Hartup, 1969). (4) The inductive power of the model increases with the degree to which the person perceives the model as similar to himself (Rosekrans, 1967; Burnstein, Stotland, and Zander, 1961; Stotland, Zander, and Natsonlas, 1962; Stotland and Dunn, 1962). Children imitate models which are similar to them. Female teachers may produce greater modeling behavior in female students; corresponding results may be noted for male teachers and students. (5) Several models exhibiting similar behavior are more powerful inducers of change than a single model (Bandura in Hoffman, 1967). (6) The potency of the model is enhanced when the behavior exhibited is a salient feature in the actions of a group of which the child already is or aspires to be a member (Bronfenbrenner, 1970). (7) The power of the model to induce actual performance (as distinguished from acquisition) is strongly influenced by the observed consequences for the model of the exhibited behavior (Bandura, 1965a, 1965b; Bandura, Ross, and Ross, 1963; Bandura, 1971).

The foregoing discussion amply demonstrates that observational learning is an important method of modifying behavior. An essential component of this type learning is the attentional process. Simply being exposed to modeled behaviors does not insure that the behaviors will be attented to or retained. While a number of variables may significantly affect the attention of the learner one of extreme importance in characteristics of the model. High status models tend to exert more influence on the learner than those of low status with the primary models in the class being the teacher, and certain influential peers.

By being aware of the social interaction processes in the classroom, the astute teacher, may channel the influence of powerful peers into the learning process. Because children discriminate in choosing models, peer leaders used as models serve as an incentive, motivating other students to focus attention on their modeled behaviors. Thus in a situation where a positive classroom climate exists, the children themselves serve as an essential feature of the learning processes and instructional strategies.

Although research shows modeling to be an aid in the teacher training situation and in studies with young children under laboratory conditions, little parallel research has been done to determine the significance of modeling in the classroom. This study was conducted in the classroom with as few modifications to the normal routine as possible.

One central question was raised in this study. Will students who view a film-mediated peer model generate significantly more desired observable behaviors than a control group who do not view the film?

The following general hypothesis was tested: Students who view a video tape peer model, in addition to regular teacher instruction, will generate a significantly greater number of positive observable behaviors than a control group receiving only teacher instruction regarding a laboratory lesson from S.A.P.A., "Conductors and Nonconductors."

METHOD

Subjects

The subjects were 22 fourth grade students, all approximately ten years old. Participating were 7 white girls, 6 black girls, 4 white boys and 5 black boys. The socioeconomic level of the group was identified as low. Thirteen of the students were receiving federally subsidized lunches and twelve lived in public housing. The school as a whole was considered deprived and falls in the Title I category.

Lesson Procedure

The class was using the AAAS curriculum, Science - A Process Approach. The curriculum was popular with the students, but the experimenter's observations suggested that they frequently misunderstood experimental directions given verbally by the teacher. Normal introductory procedures included verbal discussion of the phenomenon, process instructions and demonstrations of safety rules and complex techniques. Although the teacher was explicit and thorough in her instructions, she usually had to repeat all instructions a second or third time before students could properly perform the experiment. Frequently, during the second instructional period, she used a student to demonstrate the procedures. However, even with this aid the students did not appear to attend to critical stimuli and understand what to do and how to do it. An alternative, more efficient method of introducing laboratory experiences was clearly called for which could attract and hold attention while at the same time reduce the burden on verbal processing. Consequently, a videotape model was tested for its efficiency.

To make the model four students were selected as performers in a microteaching setting using sociometric techniques to select those students having the highest status. To determine the best liked and most powerful students two questionnaires, devised by Fox, Luski and Schmuck, (1966) to diagnose social relationships in the class, were filled out by all members of the class. The questionnaires were entitled, "How I Feel About Others in My Class," and "The People in My Class." The four chosen as models received more than forty-five positive ratings each. With the exception of one boy who received thirty-eight points, all other class members received twenty-one or fewer points. The lowest score was five. The class was not told the complete purpose of the questionnaire until after its completion.

The model group was eager to participate and very cooperative. They were instructed in experimental procedure by the teacher and videotaped by the experimenter. Although film-mediated models have been shown to be as effective as live models in transmitting imitative behavior, in this experiment the videotape additionally acted as a motivating factor. The students were very excited about seeing their friends on "television."

The model group verbalized all their behaviors as they performed the experiment. The particular lesson used in the experiment was, "Formulating Hypothesis 2: Conductors and Nonconductors."

Experimental Procedure

The remaining eighteen students were randomly divided into a control and treatment group of nine each. All eighteen received a fifteen minute session of verbal instruction and demonstration of safety rules and complete procedures. Both the control and treatment group formed three subgroups to run the experiment. Each member of the group had several specific tasks to perform in a cooperative manner.

The two groups separated and the control group began the experiment without further explanation. Upon completion of the experiment, the control group was allowed to view the model tape.

Before beginning the experiment, but subsequent to teacher instruction, the treatment group viewed the model demonstrating the desired behaviors. The treatment group was instructed to watch the model closely because their friends were using desirable experimental behaviors. They then did the experiment.

Prior to the experiment an observation sheet consisting of thirty-two discrete behaviors was constructed by the experimenter. An observation instrument in which an exhaustive number of observable behaviors is listed, or a sign system was used.

During the experiment four raters observed the students and recorded the behavior as having occurred (positive) or as not having occurred (negative). There should be a total of 92 positive and/or negative behaviors recorded for each group per rater. Due to logistical problems not every behavior was able to be observed and therefore was not recorded. For this reason, interater agreement was determined by having each rater observe the video model and rate it. Interater agreement was found to range from .87 to .97.

The data for each group, treatment and control, was totaled for positive and negative scores. This was then computed as a percentage of total observed behavior.

Using the raw data a Contingency Chi Square test was done to see whether the two methods of classification, treatment-control versus positive-negative behaviors, were dependent. The two methods of classification were found to be dependent at the .01 level of significance.

In order to determine whether the dependence was due to treatment, the percentages were standardized to a z scale and compared. The treatment group generated 22% more positive behaviors and 22% fewer negative behaviors than did the control. The null hypothesis (Ho: $P_1 - P_2 = 0$) was rejected at the .05 level of significance.

In accordance with the data the treatment group generated significantly more positive and significantly fewer negative behaviors than did the control group.

DISCUSSION

The purpose of this study was twofold. First the feasibility of conducting modeling research of this type in the school setting explored and secondly, the potential effectiveness of peer models on the acquisition of scientific process related activities was examined. The experimental data and condition indicate that modeling studies can indeed be conducted in the school setting and that the group of children who observed the model acquired and demonstrated significantly more of the experimental behaviors than the control group. Videotaping of a peer model provided an additional incentive to focus attention on the modeled behaviors. However, these findings are only suggestive at this time. For one thing the relatively small sample would indicate that replication might well be in order. At the same time only one AAAS lesson was tested. Hence it would be appropriate to repeat the study with a wide range of laboratory lessons to test the external validity of the findings.

Another problem encountered to some extent was the difficulty on the part of the raters to observe small groups of children simultaneously. However, since all raters experienced this difficulty the effect was randomly distributed over both treatment and control groups, it was felt that its total experimental influence was negligible.

This study does suggest the utility of modeling as a teaching aid in a process approach science class. It is also plausible that modeling would be effective in other realms of science teaching such as in providing visual and aural instruction for low verbal students as an alternative to aural and written instruction alone.

The experiment suggested several hypotheses to be tested in relation to the original one. One situation to be examined would be types of children versus kind of model. For instance, it is suspected that low verbal children would benefit most from a perceptual model whereas high ability children could work with any type model. Research indicates that different models might be more effective at different intellectual and developmental stages.

Another line of research could explore status. In this experiment a high status peer model proved to be very effective. However, it is also possible that the status of unpopular children might be influenced by having the opportunity to serve as peer models.

SUMMARY

Research concerning social learning and modeling as a means of teaching teachers particular skills suggested the hypothesis that modeling would be an effective method for introducing experimental procedures in a process approach class to children. Extentions of this research are planned which include exploration of interaction between student characteristics, different process tasks, and variations in the modeling treatment.

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