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ABSTRACT

This study determined the effects of teaching prospective teachers Gagne's conditions for rule learning. Forty-eight students in the Social Sciences Methods Course for Elementary Teachers at Auburn University were randomly arranged in two groups. Both groups learned to develop a teaching unit to teach concepts, while only the experimental group received the conditions for rule learning treatment. This treatment consisted of a multi-level program called PROMOD. Following the treatment, the subjects in both the experimental and control groups were asked, as a posttest, to teach a child a social science concept from the "Man: A Course of Study" curriculum. Finally, videotapes of the teaching performances were analyzed by a team of observers. The major conclusions were that 1) there was a significant relationship between teaching prospective teachers the conditions for rule learning and their rule teaching behavior at the .01 level of significance, 2) there was not a significant relationship between the conditions for rule learning and the rule teaching behavior of prospective teachers who are not taught the conditions, and 3) there was not a significant relationship between the achievement level of prospective teachers as determined by grade point average and rule teaching performance. (Author/MBM)

ABSTRACT

THE EFFECTS OF TEACHING PROSPECTIVE TEACHERS THE CONDITIONS FOR RULE LEARNING IN THE SOCIAL SCIENCES

Randy F. Elmore

The purpose of this study was to determine the effects of teaching prospective teachers Gagné's conditions for rule learning. In the study, forty-eight students in the Social Sciences Methods Course for Elementary Teachers at Auburn University were randomly arranged into two groups. Both groups learned to develop a teaching unit to teach concepts, while only the experimental group received the conditions for rule learning treatment. This treatment consisted of a multi-level program called PROMOD. Following the treatment, the subjects in both the experimental and control groups were asked, as a posttest, to teach a child a social science concept from the Man: A Course of Study curriculum. Finally, videotapes of the teaching performances were analyzed by a team of observers.

The major conclusions were as follows:

1. There was a significant relationship between teaching prospective teachers the conditions for rule learning and their rule teaching behavior at the .01 level of significance.

2. There was not a significant relationship between the conditions for rule learning and the rule teaching behavior of prospective teachers who are not taught the conditions.

3. There was not a significant relationship between the achievement level of prospective teachers as determined by grade point average and rule teaching performance.

Final Report

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THE EFFECTS OF TEACHING PROSPECTIVE TEACHERS THE CONDITIONS FOR RULE LEARNING IN THE SOCIAL SCIENCES

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U.S. DEPARTMENT OF
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I. INTRODUCTION - REVIEW OF PREVICUS STUDIES

The classroom teacher has long been recognized as the most influential component in the learning environment of public education. What he decides relative to verbal communication, content, media choices, group-size, and learning space arrangements, determines largely what a student learns in school. These decisions are made constantly both extemporaneously and by predesign. Yet on what basis are these decisions made? Suggested procedures, based upon empirical findings, have existed for some time, yet there is no evidence that teachers use these.[1] It is the responsibility of teachers, not just to teach as they were taught, but to interpret and apply research findings so that learning can be arranged as effectively and pleasantly as possible.

In 1965, Dr. Robert M. Gagné, in a response to a need expressed by learning psychologists, delineated eight types of learning.[2] These were arranged hierarchically from signal learning at the simplest level upward to problem solving at the most complex level. For each type of learning, he elaborated conditions under which they could best be learned.

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[1]Robert M. Gagné, The Conditions of Learning (New York: Holt, Rinehart and Winston, Inc., 1970), p. 324.

[2]Arthur W. Melton, Categories of Human Learning (New York: Academic Press, 1964, p. 338.

Near the top of the hierarchy was listed rule learning. Rule learning is the type of learning which many teachers refer to as "concept" and "generalization" learning. Gagné defines rule learning as ". . . an inferred capability that enables the individual to respond to a class of stimulus situations with a class of performances, the latter being predictably related to the former by a class of relations." The steps which he lists to use in teaching rules are as follows:

Internal conditions*

1. Describe the terminal behavior
2. Decide and indicate the relevant concepts

External conditions**

1. Inform the learner about the form of the performance to be expected when learning is completed.
2. Question the learner in a way that requires the learning and reinstatement (recall) of the concepts that make up the rule.
3. Use verbal statements (cues) that will lead the learner to put the rule together, as a chain of concepts, in the proper order.
4. By means of a question, ask the learner to demonstrate one or more concrete instances of the rule.

*Internal conditions refers to the conditions within the learner, i.e., the degree to which the learner has prerequisite concepts in his repertoire.

**External conditions refers to conditions in the learning situation i.e., the verbal instructions.

5. Provide feedback to the learner when he demonstrates rule learning.

In planning and conducting observational research on teacher effectiveness, two systems identified by Medley and Mitzel, as the category and sign systems are usually used.[3] These approaches assume that the categories that are used as criteria are exemplars of "good teaching." These are derived logically from theory and from expert opinion.

According to Allan C. Ornstein, ". . . Atkin (1967-68), Glaser (1963), Giff (1960), and Stake (1967) believe that teacher behavior varies with the nature of goals; however, according to this investigator, most studies fail to take this into account, and therefore are misleading."[4] With this thought in mind, would it not make more sense for one to investigate teacher effectiveness by first defining the type of learning involved and determining, from research findings, the best procedures for that type to be learned? Then, using these as the appropriate criteria, one would attempt to measure whether or not the teacher could use the procedures.

The Statement of the Problem

The purpose of this study was to determine whether there is a significant difference between the number of adequate learning deci-

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[3]Donald M. Medley and Harold E. Mitzell, "Measuring Classroom Behavior by Systematic Observation," Handbook of Research on Teaching, ed. by Nathaniel Lee Gage (Chicago: Rand McNally and Company, 1963), p. 253.

[4]Allan C. Ornstein, "Systematizing Teacher Behavior Research," Phi Delta Kappan, III (1971), p. 554.

sions made by prospective teachers, students in the Social Sciences Methods Course at Auburn University, who learn the conditions for rule learning and prospective teachers who do not learn the conditions for rule learning as determined by videotape analyses of the teachers' performances in teaching social science rules to individual learners.

The Research Design

This study was planned to enable the determination of relationships between Gagné's conditions for rule learning and actual rule teaching patterns. Basically, the design consisted of a treatment for the experimental group followed by posttests for an experimental and a control group.

First of all, forty-eight prospective teachers were ranked from high to low according to grade point average. Then, using the median score, half the subjects were placed in a high achievement group and half were placed in a low achievement group. Following this, names were randomly drawn from the two groups to form the experimental and control groups. The design and assignment of subjects was as follows:

	Experimental Group	Control Group
High achievement	12	12
Low achievement	12	12

The Hypotheses

1. It is a hypothesis of this study that teaching prospective teachers, students in Social Sciences Methods Classes for Elementary Teachers, the conditions of rule learning will be related to their rule teaching behavior according to appropriate statistical criteria.

2. It is a hypothesis of this study that the conditions for rule learning will be related to the rule teaching behavior of prospective teachers who are not taught the conditions for rule learning according to appropriate statistical criteria.

3. It is a hypothesis of this study that the rule teaching behavior of prospective teachers will not be related to their achievement level, as determined by grade point average, according to appropriate statistical criteria.

The Importance of the Study

Step by step procedures for rule learning have been suggested by the learning psychologist, Robert M. Gagné. Further, other psychologists, such as John P. DeCecco and Leslie Briggs support the use of the procedures. For example, in The Psychology of Learning and Instruction: Educational Psychology, DeCecco elaborates Gagné's procedures and cites research which substantiates their use.[5] Briggs also points out that the conditions should be incorporated in arranging effective instruction.[6]

Much is said about "teaching methods,""teaching strategies," and "teaching techniques." However, it is difficult to know what

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[5]John P. DeCecco, The Psychology of Learning and Instruction: Educational Psychology (Englewood Cliffs: Prentice-Hall, Inc., 1968), pp. 419-424.

[6]L. J. Briggs, Sequencing of Instruction in Relation to Hierarchies of Competence (Palo Alto: American Institutes for Research, 1967), pp. 53-62.

these terms mean. It is even more difficult, once "method" is defined, to determine the effect of its use on learning.

Gagné's procedures are different from the conventional meaning of method in that the type of learning must be identified first, then the procedures for arranging conditions for that type of learning are used. An important point is that these procedures are derived from learning research (See Review of Literature). This is in contrast to the former situation where a set of logical assumptions are applied to various types of learning without guidance from research.

Specifically, this study attempted to determine the effects of teaching the conditions for rule learning to prospective teachers. Rule learning was selected because it is the most frequent type of learning which occurs in formal schooling.[7] Rule learning is also the type of learning which most nearly parallels what people in the social sciences call "concepts" and generalizations... Gagne has said that the "most difficult of all (rules) are likely to be abstract concepts like family and legislature of the type that make up the disciplines of the social sciences."[8] Carroll (1964) discusses relational concepts (rules) which are difficult to learn since the concept is not inherent in the attributes but in the relationships among the attributes.[9]

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[7]Gagné, The Conditions of Learning p. 189.

[8]Ibid., p. 107.

[9]J. B. Carroll, "Words, Meanings, and Concepts," Harvard Educational Review, XXXIV (1964), p. 187.

This study was important in its point of view on determining "teacher effectiveness." Traditionally, research on teaching effectiveness has attempted to evaluate too many variables or variables that were defined in terms too general to really produce meaningful results. Further, these studies have been based upon such criteria as expert opinion and most frequently occurring behavior of a "good" teacher.

Finally, this study will differ in that effectiveness will be determined for only one type of learning. The criteria for successful teaching of this type will be based upon procedures determined by learning research.

The Definitions of Terms

Rule Learning.--Rule learning is defined as in "inferred capability that enables the individual to respond to a class of stimulus situations with a class of performances, the latter being predictably related to the former by a class of relations."[10]

Social Science Rule.--The term social science rule was used to refer to a rule taken from one of the social science disciplines. Traditionally, teachers have called rules "concepts" and "generalizations."

Adequate Learning Decision.--For the purposes of this study, the term adequate learning decision referred to the degree to which prospective teacher's decisions, as expressed in verbal communication to learners, are related to Gagné's conditions for rule learning.

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[10]Gagné, The Conditions of Learning, p. 191.

Videotape Analysis.--Videotape analysis was used to describe the process of observing taped performances of prospective teachers teaching social science rules to individual learners to determine the degree of adequacy based on Gagné's conditions.

PROMOD--PROMOD is an acronym for program module. In this study the term is used to describe the materials used with the experimental group.

Review of Previous Studies

The Studies Related to the Conditions for Rule Learning

The following is a review of studies which are related to the conditions for rule learning.

The first phase of the conditions is concerned with the internal conditions. Two steps, involving specifying and analyzing the behavior to be learned, are given. What are the implications from learning research for using these procedures? Gagné and his associates have done several studies related to this aspect of instructional design.

Gagné arranged learning tasks into hierarchical arrangements which the learner learned by transferring previous learning. Each higher level task was described as being qualitatively different from the lower tasks.[11] From this work several studies were done by Gagné and Paradise, 1961;[12] Gagné, Mayor, Garstens, and Paradise,[13] 1962;

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[11]Robert M. Gagné, "The Acquisition of Knowledge," Psychological Review, LXIX (1962), p. 355-365.

[12]Robert M. Gagné and N. E. Paradise, "Abilities and Learning Sets in Knowledge Acquisition," Psychological Monographs, LXXV (1961), no. 526.

[13]Robert M. Gagné, J. R. Mayor, H. L. Garstens, and N. E. Paradise, "Factors in Acquiring Knowledge of a Mathematical Task," Psychological Monographs, LXXVI (1962), pp. 1-19.

Gagné and Staff, University of Maryland Mathematics Project, 1965.[14] The findings of these studies were in agreement with the theory that Gagné had suggested--that a given capability is more easily learned if the prerequisite competencies have been previously acquired.

In 1969, Virginia Weigand, in a study of problem solving in science, found that "the learning of initially missing subordinate skills produces marked positive transfer in the learning of a complex problem solving task in science.[15] James R. Okey, and Gagné, in 1968, found that a learning program on a science topic was taught more effectively when it was revised according to an analysis of the learning hierarchy involved.[16]

There is also research to support the use of the external conditions. For example, the work of J. Marvin Cook in studying the effects of presenting a learner with the expected terminal behavior indicates that the use of step one of Gagné's external conditions for rule learning results in increased resistance to forgetting.[17]

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[14] Robert M. Gagné and Staff. University of Maryland Mathematics Project, "Some Factors in Learning Non-Metric Geometry," Monograph of Social Research on Child Development, XXX (1965), p. 42-49.

[15] Robert M. Gagné, Basic Studies of Learning Hierarchies in School Subjects, United States Department of Health, Education, and Welfare, Office of Education (Washington: Government Printing Office: April, 1970), p. 27.

[16] Ibid., p. 52.

[17] J. Marvin Cook, "Learning and Retention by Informing Students of Behavioral Objectives and Their Place in the Hierarchical Learning Sequence" (unpublished Doctoral thesis, Maryland University, College Park), p. 110.

Step two of the conditions for rule learning suggests that the teacher assist the learner to recall relevant concepts (and rules). Use of this step is built upon the behavioral analysis performed during the internal conditions or planning phase discussed above. Gagné's work on learning hierarchies supports the use of this step. Also, in 1954, the work of Kendler and Vineberg on teaching the component concepts of "size" and "shape" offers supportive evidence. In this experiment, rule learning occurred more easily for the subjects who had been taught relevant concepts than for those whose treatment had been irrelevant concepts.[18]

For support in using step three of the external conditions, to assist the learner to sequence the concepts to form the rule, Gagné and DeCecco use the research on contiguity. Gagné states that "contiguity appears to be an important condition applicable to the time interval between the recall of component concepts (step 2) and the verbal cuing of the rule with these parts properly sequenced."[19] DeCecco states that "In this step you also provide contiguity for the proper relationship of the concepts."[20]

Evaluation is the purpose for step four which is to ask the learner to demonstrate rule learning. This reveals to both the teacher and the learner what the learner knows relevant to the rule to be

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[18]John P. DeCecco, The Psychology of Learning and Instruction: Educational Psychology (Englewood Cliffs: Prentice-Hall, Inc., 1968), p. 419.

[19]Gagné, The Conditions of Learning, p. 202.

[20]DeCecco, The Psychology of Learning and Instruction, p. 423.

learned. The importance of using this step is emphasized by Gagné using the rule (work = force x distance).

> I do not mean to imply by this (demonstration) a single measure of performance such as the question which verbally says to the student "demonstrate work in the following situation" and then describe the situation. Instead, it seems to me that there are a number of different questions that might be asked in order to determine whether a student has learned a principle, one might say, "What is the work done in pushing a body of 1000 grams a horizontal distance of thirty centimeters?" or "Show how to calculate the work done by a force of fifty pounds pushing a truck along a floor for ten feet." Any of these questions may be considered to reflect what is meant by "demonstrate."[21]

Finally, step five is to provide feedback following rule learning. The research on reinforcement theory is used as support for this step.[22]

The Studies Related to Rule Learning

In his book The Conditions of Learning, second edition, Robert M. Gagné discusses learning defined concepts and rules. Rule learning is the inclusive subject and the defined concept is one kind of rule. Dr. Gagné differentiates among an object concept, a defined concept, and a rule. First, he points out that an object or "thing" concept is identified by a response to a class of stimuli.[23] These concepts can usually be denoted by pointing at them or by observing them.

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[21] Robert M. Gagné, "The Learning of Principles," Analysis of Concept Learning, ed. by H. J. Klausmeier and C. W. Harris. (New York: Academic Press, Inc., 1966), p. 86.

[22] Gagné, The Conditions of Learning, p. 202.

[23] Gagné, The Conditions of Learning, pp. 171-172.

Secondly, he points out that defined concepts are learned by definition and are therefore labeled defined concepts. These, he says, are often called abstract. They are also called relational because they relate simpler concepts. The concept "diagonal" is an example of a defined or relational concept.

The more inclusive type of concept, rule learning, is defined as ". . . an inferred capability that enables the individual to respond to a class of stimulus situations with a class of performances, the latter being predictably related to the former by a class of relations."[24] An example is given of a learner responding to the class of stimulus situations (2+3, 3+4, and 7+5) with a class of performances (3+2, 4+3, and 5+7) that may be predicted by seeing the relation called "independence of order." Further, rule learning is different from concept learning in a number of ways. First of all, demonstrating rule learning is different from concept learning because it requires not a simple identification but, by means of performances, identification of its component concepts and their relations. Secondly, a rule is not just a single mediator but a sequence of mediators each of which is a concept. Thirdly, a difference exists in the conditions necessary for learning rules as compared to concepts. Concept learning involves presenting positive and negative instances of the class and the common response. Rule learning also requires different conditions: (a) the learner should already know the concepts in the sequence, (b) he is required to recall these and to state them in the proper sequence, and (c) to determine

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[24] Ibid., p. 191.

whether learning has occurred, he should be asked to demonstrate one of the rules.[25]

In 1968, John P. DeCecco described three types of concepts called conjunctive, disjunctive, and relational. A conjunctive concept has the appropriate values of several attributes jointly present. The concept "dog" is an example. A dog has attributes such as color, size, shape, texture, and behavior. Disjunctive concepts have the ". . . appropriate values of one attribute or of another attribute present." In this concept, attributes and values are substituted for one another. The concept of "home run" in baseball is an example. The attributes that are present in one example may not be present in another. The disjunctive concept is similar to what Gagné calls a rule for its occurrence. A relational concept is defined as ". . . one that has a specifiable relationship between attributes.[26] Bruner gives an example of income brackets after deductions as relational concepts since these depend on the relationship between the number of dependents and the net income.[27]

In 1965, D. E. Berlyne described two types of concepts. One he called "situational", because it represents certain attributes of a situation. The second he called transformational because it represents a process.[28] In 1965, in a study of defined concepts, Jerome Bruner,

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[25] Ibid., p. 202.

[26] DeCecco, The Psychology of Learning and Instruction, p. 392.

[27] J. S. Bruner, Jacqueline Goodnow and G. A. Austin, A Study of Thinking (New York: Wiley, 1956), p. 43.

[28] D. E. Berlyne, Structure and Direction in Thinking (New York: Wiley, 1965), pp. 128-132.

Jacqueline Goodnow, and G. A. Austin studied the acquisition of conjunctive, disjunctive, and relational concepts. They found that the two latter types of concepts were more difficult to learn than conjunctive concepts and that disjunctive concepts required the learning of rules.[29]

R. N. Shepard, C. I. Hovland, and H. M. Jenkins studied concepts by rule or by definition. They arranged objects having the dimensions of square and triangle, large and small, and colors of black and white in variegated patterns. The subjects were asked to place the objects into piles on the left and on the right depending upon which type they were given. In this manner the difficulty of the tasks could be varied. There were two classifications of difficulty. In Type I, the simplest, the task could be represented by a rule such as "place all squares on the right - all the triangles on the left." In a Type II situation, the more difficult of the two, a rule could be "place the black circles and large triangles on the right and white circles and small triangles on the left."[30] "The results leave no doubt that there are marked differences in ease of learning of a concept of simple Type I sort and those which are more complex."[31]

E.B. Hunt in 1962, came to conclusions which are similar to those of Berlyne in that the key to the differences between the two

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[29]Bruner, A Study of Thinking, p. 168.

[30]N. N. Shephard, C. I. Hovland and H. M. Jenkins, "Learning and Memorization of Classifications," Psychological Monographs, LXXV (1961), pp. 1-65.

[31]Robert M. Gagné, "The Learning of Principles," Analysis of Concept Learning, ed. by Herbert J. Klausmeier and Chester W. Harris (New York: Academic Press, 1966), p. 90.

kinds of concepts, those by observation alone and those by definition, seem to be that defined concepts require both situational and transformational concepts whereas object concepts required only one of these.[32]

There is much interest in the effects of transfer from previous learning to rule-governed behavior as in such studies as those conducted by Piaget. Transfer, in these studies tends to be very specific. In 1965, Beilen, for example, trained kindergarten children to perform conservation tasks on length and number by several techniques such as nonverbal reinforcement, verbal orientation-reinforcement, verbal rule instruction and "equilibration." He found that training occurred primarily by the verbal rule method. Transfer from conservation of length and number to area did not occur.[33] In another study in 1966, Beilen trained first and second grade children to conserve in a quasi-conservation task, by using translocation, interaction, and feedback. Only the feedback procedure was shown to be effective.[34] Beilen, J. Kagan, and R. Rabinowitz used both perceptual and verbal training to train a group of seven year old children in a water level task, in 1966. Training involving perceptual confirmation was more effective than verbal instruction of the water level rule. However,

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[32]E. B. Hunt, Concept Learning: An Information Processing Problem (New York: Wiley, 1962), pp. 178-179.

[33]H. Beilen, "Learning and Operational Convergence in Logical Thought Development," Journal of Experimental Child Psychology, II (1965), pp. 317-339.

[34]H. Beilen, "Feedback and Infralogical Strategies in Invariant Area Conceptualization," Journal of Experimental Child Psychology, III (1966), pp. 267-278.

this was true only when the same jars were used.[35] In 1967 L. Wallach, A. Wall, and L. Anderson trained a group of six and seven year-old children to conserve number by reversibility and addition and subtraction instruction. The prior training on reversibility proved effective while the alternate training had no effect. It is argued that this was true because the training enabled the children to stop using misleading cues.[36]

In a 1967 study of the effects of relevant versus irrelevant stimulation on the conserving of defined concepts such as father, mother, etc., I. Sigel, E. Saltz, and W. Roskind, found that the degree of tolerance for irrelevant stimulation increases with age between ages five to eight. Their findings also indicate that originally, defined concepts are disposed to "Over discrimination.[37]

Also in the area of conservation is a study by R. C. Kingsley, and V. C. Hall who determined the effects of making a specific analysis of a hierarchy of subordinate skills in a conservation task and training each child on his missing skills. They found transfer to weight and length conservation and some transfer from weight conservation to substance conservation.[38]

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[35] H. Beilen, J. Kagan, and R. Rabinowitz, "Effects of verbal and Perceptual Training on Water Level Representation," Child Development, XXXVII (1966), pp. 317-330.

[36] L. A. Wallach, J. Wall, and L. Anderson, "Number Conservation: The Roles of Reversibility, Addition - Subtraction and Misleading Perceptual Cues," Child Development, XXXVIII (1967), pp. 425-442.

[37] I. Sigel, E. Saltz and W. Roskind, "Variables Determining Concept Conservation in Children," Journal of Experimental Psychology, LXXIV (1967), pp. 471-475.

[38] R. C. Kingsley, and V. C. Hall, "Training Conservation Through the Use of Sets," Child Development, XXXVIII (1967), pp. 1111-1126.

In 1968, Gagné suggested that transfer to conservation tasks depends upon subordinate prior learnings, and that transfer will be relatively specific until the cumulative effects of learning many specific skills results in generalization.[39]

In a study by Bem in 1967, three and four year old children were given the task of pressing switches the right number of times in order to turn off one to five lights. Subordinate skills were determined and taught to the children. Their performance, for all subjects, was nearly perfect.[40]

In a study involving switch-light, problem-solving tasks in 1968, by G. Davis, A. Train, and M. Manske, the effectiveness in transfer of previously learned verbal rules was shown. The covert problem solvers who were taught verbal rules prior to the task required fewer switch presses than the overt problem solvers who were not taught the rules.[41]

The 1966 underwater target studies by R. Overing and R. Travers are also relevant. They conducted two studies on hitting underwater targets. Transfer to the task was improved by (1) prior training with irrelevant information, (2) establishing a set to notice certain

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[39]Robert M. Gagné, "Contributions of Learning to Human Development," Psychological Review, LXXV (1968), pp. 177-191.

[40]S. L. Bem, "Verbal Control: The Establishment of Effective Self-Instruction," Journal of Experimental Psychology, LXXIV (1967), pp. 485-491.

[41]G. A. Davis, A. J. Train, and M. E. Manske, "Trial and Error Versus 'Insightful' Problem Solving: Effects of Distraction, Additional Response Alternatives and Longer Response Chains," Journal of Experimental Psychology, LXXVI (1968), pp. 337-340.

features, and (3) by giving verbal rules before the task. Much irrelevant visual information prior to a task did not affect performance. However, subjects trained with a small amount of irrelevant information showed a reduction in transfer in a more complicated task.[42]

In 1967, a subsequent study by Overing and Travers found that transfer was facilitated when the training was more realistic, i.e., when it included all cues including irrelevant ones. The cues in the test situation did not matter and boys were more successful than girls.[43]

D. Foss, in 1968, explored the learning of rules in a miniature linguistic system and their use in learning unfamiliar linguistic items. Their findings show that the subjects learned and were able to apply without error systematic relations among the various units of the system.[44]

J. Gibson, in 1969, investigated the transfer effects of practice variety in rule learning. She found an absence of significant effects of amount of practice on transfer or retention. She suggests

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[42] R. L. R. Overing and R. M. W. Travers, "Effects Upon Transfer of Variation in Training Conditions," Journal of Educational Psychology, LXXVI (1968), pp. 337-340.

[43] R. L. R. Overing and R. M. W. Travers, "Variations in the Amount of Irrelevant Cues in Training and Test Conditions and the Effect upon Transfer," Journal of Educational Psychology, LVIII (1967), p. 62-68.

[44] D. J. Foss, "An Analysis of Learning in a Miniature Linguistic System," Journal of Experimental Psychology, LXXVI (1968), pp. 450-459.

that care should be taken in generalizing findings about amount of practice from one type of learning to another.[45]

In 1968, Gagné and Weigand studied factors related to the learning and retention of concrete rules in children. The results were that children who previously learned well both thing concepts and action concepts later learned rapidly (every 15 seconds) up to five new concrete concepts by reading and recording each once. After three days retention tended to be about 20%.[46]

These studies indicate that it is important to use Gagné's conditions for rule learning. More specifically, it seems evident from the literature that it is important to determine subordinate skills in attempting to facilitate transfer in rule learning. According to Gagné

> "Learning verbal associates typically receives much positive transfer from prior discrimination learning, stimulus coding, and response integration; concept learning from prior learning on dimension discrimination; rule learning from prior learning of relevant rules. The implication of such generalizations for the design of instruction seems clearly to be that specification of efficient instruction must include consideration of the sequence of learning events."[47]

In this chapter, the problem, research design, hypotheses, and importance of the study were presented in the Introduction. The

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[45]Jeanne Gibson, "Transfer Effects of Practice Variety in Principle Learning." unpublished Doctoral dissertation, The University of California at Berkeley, Berkeley, 1969, p. 71.

[46]Gagné, Basic Studies of Learning Hierarchies in School Subjects, pp. 66-68.

[47]Robert M. Gagné, "Instructional Psychology," Annual Review of Psychology, XX (1969), p. 409.

Review of Previous Studies contained a review of research related to the conditions necessary for teaching rules and to rule learning as a particular type of learning. Chapter two elaborates the procedures that were used in conducting the study.

II. METHOD AND PROCEDURES

The purpose of this chapter was to present the various methods and procedures which were developed and implemented during the course of the study.

The Treatment and Experimental Variables

Previous research suggests that if teachers use Gagné's suggested procedures to teach rules, learning will be more effective. In this study a multi-level program module (PROMOD) was designed to teach a group of prospective teachers these suggested procedures (see Appendix A). Prior to the beginning of the quarter, the forty-eight students enrolled in the two Social Science Methods classes for Elementary Teachers were ranked from high to low on the basis of grade point average. Then, using the median score a high-achievement group and a low-achievement group were formed. Following this, names from each of the two groups were randomly selected to form the experimental and control groups. The variables in the design and the assignment of subjects were as follows:

	Experimental Group Taught PROMOD Program	Control Group Not Taught PROMOD Program
High Achievement	12	12
Low Achievement	12	12

All subjects learned to prepare a teaching unit for social science

concepts. The experimental group had the additional task of working through a program to learn the conditions for rule learning.

The variables in the design then, were the PROMOD (for rule learning); the instruction on unit development; and the achievement level (high and low by grade point average).

The Subjects

The students in this study were all university seniors, majors in elementary education, taking Social Science Methods for elementary teachers. All were white females except for one white male. The original total population was fifty-four. However, four who had pre-registered did not appear for the courses and two were randomly removed in order to balance the groups. These two participated in the study but their scores were not included. No cases were lost during the study.

The Role of the Experimenter

The experimenter's role in this study was one of organizing and guiding. He organized the experiment, designed the PROMOD for the experimental group, and trained the observers. During the experiment, two instructors were in charge and the role of the experimenter became one of a monitor. After the videotapes were collected, the experimenter viewed the performances with the subjects and answered their questions. Finally, he supervised the analyses of the videotapes by each of the four observers and computed the total scores for the various groups.

The Materials for the Experiments

All the subjects were involved in preparing to teach social science concepts to a group of thirty fourth grade pupils from a local elementary

school. These pupils came to the university for a period of two weeks from May 3-14, 1971. In order to teach the elementary pupils concepts from the Man: A Course of Study[1] curriculum, all prospective teachers in the study were given a week of instruction on the development of teaching units. This was presented through lecture and discussion by the two professors in charge of the classes.

Following the week of instruction on unit construction, all students were given a week to prepare units to be taught to the elementary pupils.

The following steps in the development of a teaching unit were included in the instruction: (a) Choose a topic (concept or generalization) from one of the social science disciplines; (b) Develop objectives for teaching the concept; (c) Develop or locate teaching activities; (d) Select instructional materials; (e) Develop sample evaluation items; and (e) and List, in a bibliography, the books and materials to be used. During the week provided for preparation of units, the subjects in the experimental groups were given a program consisting of a print multi-leveled module and a film of a teacher modeling the procedure for teaching rules.

The Rationale for the Program

The decision to use the module and film was due to the fact that carefully designed and validated instruction is effective. One can predict that there will be significantly high achievement. According to Leslie Briggs

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[1] Man: A Course of Study. Social Science Course for Elementary Schools. (Cambridge: Education Development Center, 1969).

> "The better the instructional program the designer develops, the more likely the resulting scores will be characterized by: (a) highly skewed distributions, (b) small variance, and (c) low correlation with I.Q. This contrasts with practice in the classroom with standardized tests, usually yielding normal distributions, greater variance, and moderate or high correlation of performance with I.Q."[2]

Secondly, even though the subgroups were arranged by randomization, a difficult situation to control remained. Both the experimental and control groups were distributed between two separate methods classes taught by two professors. If the primary mode of learning were the program, then the probability would be greater that two groups would be exposed to the same treatment variables.

In order to determine the design for the experimental treatment, the following program variables were considered: (1) pacing; (2) step size; (3) knowledge of correct response; (4) response mode; and (5) mode of instruction (software or hardware).

On the issue of pacing, it was determined that while some studies have found no significant difference between self-paced learning and externally paced learning,[3] others such as Fry, found that self-pacing took less time.[4]

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[2]L. J. Briggs, "Improvement of the Instructional Program (Memorandum to the EDR Faculty and graduate students at Florida State University, Tallahassee, 1970), p. 4.

[3]L. P. Greenhill, A Review of Some Trends on Instructional Films and Instructional Television, In D. W. MacLennan and J. C. Reid (Eds.), Abstracts of Research on Instructional Television and Film: An Anotated Bibliography. Stanford University, 1964. pp. 1-32. (Mimeographed.)

[4]C. H. Fry, "Group versus Individual Pacing in Programmed Instruction," Oregon State System of Higher Education, 1963.

It is difficult to know what researchers mean when they use the term "step-size." It is used to describe different sizes of material from chapters to linear frames. Molstad reviewed a study by K. Hall at Pennsylvania State University, who varied the size of step in a commercial program.[5] He found that the levels varied with the ability level of the learner. High-I.Q. students performed better with large steps; low-I.Q. students did better when working in small steps.

Studies regarding "knowledge of correct response" are also conflicting. According to Briggs, "most studies have found that providing students with immediate knowledge of results at frequent intervals enhances learning (Schramm, 1964)." Other studies by Glaser and Taber,[6] in 1961, and Moore and Smith, in 1962, obtained no significant differences when feedback was not immediate.[7] However, in each case the experimenters stated that their programs seemed to be quite easy for the subjects.

Most studies indicate, concerning the question of response mode, that constructed responses do not cause significantly greater gains in learning. However, some studies such as one by Goldbeck and Campbell,

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[5] J. Moldstad, "Summary of A. V. Research," Audiovisual Instruction, IX (1964), pp. 492-497.

[6] R. Glaser, and J. I. Taber, Investigations of the Characteristics of Programmed Learning Sequences (Pittsburg: Programmed Learning Laboratory, University of Pittsburg, 1961).

[7] J. W. Moore and W. I. Smith, "Knowledge of Results in Self-Teaching Spelling" (in Programmed Learning: Theory and Research, ed. by W. I. Smith and J. W. Moore. Princeton: D. Van Nostrand Company, Inc., 1962). p. 150-162.

in 1962, suggest that the effects of response mode may vary with the complexity of the subject matter.[8]

Generally, the research on the effects of instruction by "hardware" and "software" are inconclusive. Many comparisions between print, film, audio, and live presentations have been made and typically no significant differences are found. For example, Carpenter and Greenhill, in 1963, presented algebra to students by teaching machines, programmed texts, and filmstrips.[9] The results indicate no significant differences among the three treatments. However, a study by M. E. Orme comparing learning from a print presentation and from a film model indicated that learning increases significantly as a result of including modeling.[10]

The PROMOD Program

With this information in mind, a search was made for a design which incorporated the most appropriate principles according to the research findings. The design chosen is called PROMOD: Programming.[11] The research indicated an advantage for self-pacing. PROMOD enhances this since it requires that information be presented to the learner at his highest level of understanding. Thus, the learner avoids working through irrelevant information. The first level of PROMOD presents

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[9] C. R. Carpenter and L. P. Greenhill, Comparative Research on Methods and Media for Presenting Programmed Courses in Mathematics and English (University Park, Pennsylvania: University Divisions of Instructional Services, Pennsylvania State University, 1963.

[10] M. E. Orme, "The Effects of Modeling Feedback Variables on the Acquisition of a Complex Teaching Strategy." (unpublished Doctoral dissertation, Stanford University), 1966.

[11] Joseph C'de Baca and Clifton B. Chadwick, "PROMOD: A New Approach to Multi-level Programming," N.S.P.I. Journal, VII (1968), p. 8-10.

information in terse summary form. Examples are given but the learner is not required to make an overt response. A brief evaluation follows this and each of the phases of the program. These techniques are consistant with the research. The terse statement can be supported by the work of David Ausubel on the idea of an advance organizer. In that situation, previous training provides ideational anchorage for later learning.[12] The learner is also not required to make an overt response at this level.

The evaluation, which follows each level, helps the learner to determine whether he has learned the specified behavior or if he should work further. If he moves to level two, he will find the same information as that of level one, but in level two more examples appear. There is sufficient redundancy for overlearning and questions are inserted for evaluation for those learners who need more "control." This level breaks the information down and the presentation is in paragraph form. So in the terse statement and in the summary statement material is presented in prose form. This technique should care for the needs of students who find frame sequences boring or otherwise inappropriate. Level two is followed by questions. These questions are similar to the spaced review which Gagné recommends instead of practice.[13]

For those learners who have not learned relevant concepts and rules, a third level follows. This level involves frames presented in

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[12]David P. Ausubel and Donald Fitzgerald, "Organizer, General Background, and Antecedent Learning Variables in Sequential Verbal Learning," Journal of Educational Psychology, LIII (1962), pp. 243-249.

[13]Robert M. Gagné, "Some New Views of Learning and Instruction," Phi Delta Kappan, LI (1970), p. 471.

the T-K-M format.[14] The T-K-M frame leades a learner through a kind of syllogistic reasoning based upon the learners language habits.[15]

The following passage from Tosti and Chadwick explains the process involved in T-K-M frame writing:

> "Consider the definition, A compass rose is a circle. This can be divided into two parts, A Compass rose is and a circle. The unit, a circle, is a highly meaningful component labeled (K) for "Known". The component compass rose, is the "target" or the (T) component. There are many meaningful associations which can be made to the stimulus, circle. It is round, it looks like this, O, it has 360 degrees, etc: These are meaningful response members (M) that already exist in the student's repetoire which may be made in association to the K stimulus. . . . The student runs off the correct chain which might be explicitly verbalized like this: 'Let's see now, does a compass rose have 360° or 480°? Well, a compass rose (T) is a circle (K); and a circle has 360° (M); so a compass rose (T) must have 360° (M)'. . . . Full advantage is taken of this implicit processing response which causes the student to back up and attend to the proper elements in the desired order."[16]

At the fourth level, a frame sequence of prompting and fading is available for the learner who still needs assistance. The PROMOD System Chart which is shown in figure 1 on page 29 illustrates how one progresses through the module. For example, the learner enters the program at level one and is pretested. If he is able to answer most of the questions correctly (90-100%), he moves to the next unit of material i.e. chapter, section, etc. However, if he should not perform

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[14]Donald T. Tosti and Clifton B. Chadwick "Acquisition in Programmed Learning Employing Conditioned Response Sets," (Albuquerque: Westinghouse Electric Behavioral Research Laboratory, 1965), pp. 1-15.

[15]Ibid. p. 5.

[16]Ibid. pp. 7-8.

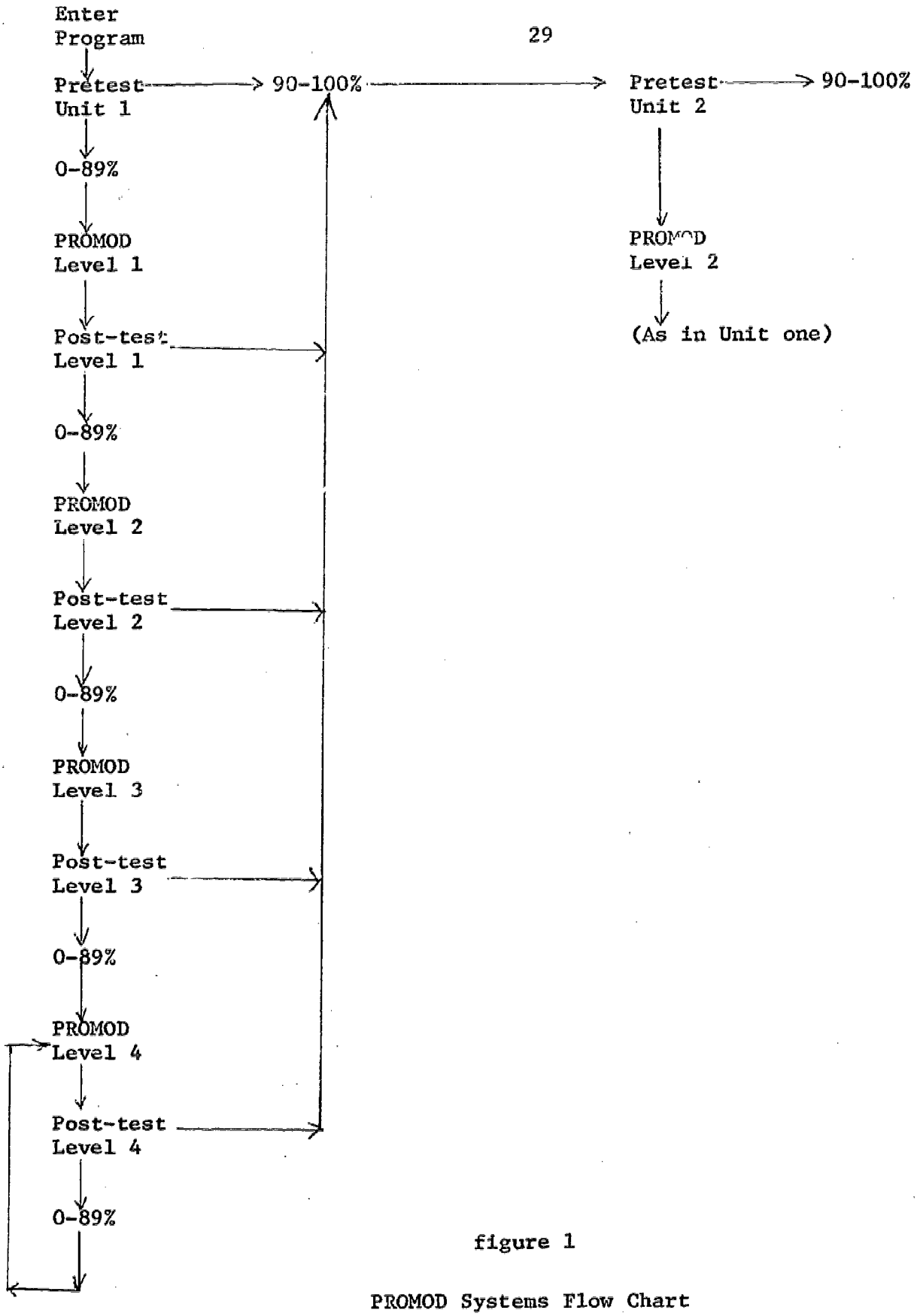

figure 1

PROMOD Systems Flow Chart

successfully on the pretest (scores less than 90%), he would want to move to level one of the first unit. He continues down to "easier" levels until he can perform the objectives. Should he work through all the levels and not be successful, he would cycle back through the levels again or option out.

For the purposes of this study, a modified version of PROMOD was used. At level one, behavioral objectives constituted the briefest presentation. A pretest for the module followed. This test also served as the first progress check. A terse summary made up level two and was followed by a progress check. Level three in this program corresponded to level two in the scheme presented above, because the information presented was detailed and questions appeared frequently. Another progress check followed. At level four, T-K-M frames were used and a posttest followed.

The Development of the Program

During the quarter previous to the quarter of the experiment, the experimenter designed the PROMOD Program. In order to do this a behavioral analysis was performed to determine the objectives necessary for a teacher to learn how to teach rules. The analysis revealed the following purpose and specific objectives necessary for a teacher to learn how to teach rules.

Purpose: The purpose of this module is to enable prospective teachers, in the Social Science Methods Course for elementary teachers, to teach individual learners social science rules.

Specific Objectives for the Module:

Chapter one:

1. Given purposes for Gagné's eight types of learning, the learner will be able to identify a reason for the types by selecting correct responses from a list.

Chapter two:

2. Given a description of the eight types of learning, the learner will be able to classify objectives by writing the type of learning dealt with in the objective.

Chapter three:

3. Given a definition of rule learning, the learner will be able to define and give an example of rule learning.

Chapter four:

4. Given a definition of defined concepts, the learner will be able to define and give an example of defined concepts.

Chapter five:

5. Given information about step one of the internal conditions for rule learning, the prospective teacher will be able to write in behavioral terms, a description of a "desired terminal behavior" for a given rule.

6. Given information about step two of the internal conditions for rule learning, the prospective teacher will be able to perform a behavioral analysis for a given rule by diagramming the concepts involved in the rule.

Chapter six:

7. Given step one of the external conditions for rule learning, the prospective teacher will be able to demonstrate how to use the step for a given rule.

8. Given step two of the external conditions for rule learning, the prospective teacher will be able to demonstrate how to use the step for a given rule.

9. Given step three of the external conditions for rule learning, the prospective teacher will be able to demonstrate how to use the step for a given rule.

10. Given step four of the external conditions for rule learning, the prospective teacher will be able to demonstrate how to use the step for a given rule.

11. Given step five of the external conditions for rule learning, the prospective teacher will be able to demonstrate how to use the step for a given rule.

After the development of the program, the materials were validated through a brief formative evaluation. Twelve subjects, also seniors who were majoring in elementary education, volunteered to work through the program. The program was revised based upon feedback from each individual. The final three of the twelve were able to perform successfully on a written posttest.

Finally, in addition to the print PROMOD, greater flexibility and adaptability were incorporated into the program by including the following alternatives: (1) reading from books in an attached bibliography; (2) using a friend to practice use of the procedure; (3) using practice with videotape for feedback; (4) using the instructor as a resource; and (5) using a videotape of a teacher modeling the procedure for assisting rule learning.

The Rules Used in the Study

The rules (concepts) used in the study were from the Man: A Course of Study curriculum. The list of concepts below is representative of those selected and taught by the prospective teachers.

Aggression
Death
Life
Reproduction
Dominance
Sharing
Reciprocity
Territoriality
Adaptation
Environment

The Instrument Used in the Study

The Conditions of Rule Learning Matrix based upon Gagné's conditions, included two sections (see figure 2, p. 34): (1) a section for analyzing internal conditions; and (2) a section for analyzing external conditions. Section one, Internal Conditions, includes two steps. Step one requires that the terminal behavior to be exhibited (for demonstrating learning of a given rule) be described. Step two requires a behavioral analysis to determine what behaviors (concepts and rules) are relevant to the specified rule to be learned.

In section two, the External Conditions are made up of five steps. The first step asks the teacher to inform the learner of the form of the form of the expected performance. Secondly, it is suggested that the teacher assist the learner in learning and recalling relevant concepts. Thirdly, the teacher is to use verbal cues to assist the learner to demonstrate one or more examples of the rule. Finally, feedback should be provided following the demonstration of rule learning.

The total score for an individual teacher was determined by summing the number of steps which she used. Credit was also given if she used the steps in the sequence suggested by Gagné. As an example, let us assume that a given teacher begins to teach an individual a rule by assisting the recall of relevant concepts. He will be using step two. Then he uses steps three and four and stops. This sequence would be coded by placing a one in the Step Used Column for step two since this is the first "move" he made. Then we would determine the difference between this step and the recommended step. This difference of one would be followed for steps three and four. For each step not used, a

Internal nditions: Planning Phase	Step Used	Step Not Used	Difference
1. Describe the terminal behavior		x	
2. Decide and indicate relevant concepts		x	
External Conditions: Implementation Phase			
1. Inform learner of form of expected performance			5
2. Assist student recall of relevant concepts	1		1
3. Use verbal cues to assist learner to sequence concepts	2		1
4. Ask learner to "demonstrate" one or more concrete examples of the rule	3		1
5. Provide feedback to the learner			5
Column Total following demonstration of rule learning			13
		Total Score	12

Formula: Sum (1 Step - Order 1) = Total Score
Total possible points = 25.

figure 2

Conditions for Rule Learning Matrix

score of five is indicated in the Difference column. Next, the Difference column is summed. Finally, this score is subtracted from the total possible to arrive at a total score.

The Training of Observers

In the weeks before the experiment, five observers, also undergraduate prospective teachers, were trained to analyze rule teaching behavior. This was accomplished by the following steps: (1) the observers worked through the Program Module on rule teaching; (2) they discussed the task with the experimenter; (3) and they practiced scoring sample videotapes with feedback from the experimenter. Finally, inter-observer reliability was obtained using the Binomial Test[4] and the Kendall Coefficient of Concordance: W.[5] The Binomial Test was used with the observers scores on the dichotomous first section of the Rule Learning Matrix. Here the two steps involved in planning for the internal conditions are scored either "used" or "not used." The five observers separately scored five teachers rule teaching behavior. For step one of the internal conditions the observers, agreement on 24 of 25 observations was significant beyond the .01 level (Z = -4.6). For step two of the internal conditions, the observers' agreement on 23 of 25 observations was significant beyond the .01 level (Z = -4.2).

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[4]Sidney Siegal, Nonparametric Statistics for the Behavioral Sciences, New York: McGraw-Hill Book Company, 1956. p. 36.

[5]Ibid., p. 229.

Table 1

Binomial Test for Interobserver Reliability
for the Internal Conditions for Rule Learning

Step no.	Z score	Level of Significance
Step one	-4.6	.01
Step two	-4.2	.01

For steps one through five of the external conditions phase of the Rule Learning Matrix, the observers' sample scores were tested by the Kendall Coefficient of Concordance: W. The following table shows that there was a significant amount of agreement among the observers on each of the five steps for all five of the teachers who were observed.

Table 2

Kendall W. Test for Interobserver Reliability Among
Steps in the External Conditions for Rule Learning

Step no.	S Score	W Score	Level of Significance
Step 1	142.00	.77	.05
Step 2	133.50	.65	.05
Step 3	147.00	.79	.01
Step 4	176.00	.88	.01
Step 5	175.00	.88	.01

The Analysis and Scoring of the Tapes

During the experiment, the subjects each taught a child a social science rule. These teaching performances were videotaped. After all the tapes were collected, the observers analyzed them using the Conditions for Rule Learning Matrix. Since there were forty-eight taped

sessions, twelve episodes were randomly assigned to each of four of the observers and the fifth observer served as an alternate. When each observer had analyzed his tapes, the experimenter totaled the scores for all subjects.

In summary, there were two types of instruction in the experiment. First, everyone in the two classes was taught the elements of a teaching unit. This was accomplished by the professors in charge of the two classes through lecture and discussion. Secondly, the experimental subjects learned the conditions for rule learning by working through the PROMOD Program. Some subjects learned from the print module alone. Others used the various options available, i.e., viewing the film model, talking to the instructor, and practicing in various ways. The researcher did not attempt to determine the degree to which the subjects used the various options available in the program.

The following week, as a posttest, all subjects selected a fourth grade pupil from the group with which they were working and taught the child a social science rule. These teaching performances were videotaped in a normal classroom setting. The tapes were then analyzed by trained observers. Because of scheduling difficulties the prospective teachers did not receive immediate feedback. However, during the two following weeks, all were able to view their tapes with the experimenter and to receive feedback from him.

In conclusion, this section has presented a description of the following: the treatment and experimental variables; the subjects in the study; the role of the experimenter; the materials for the treatment (including the rationale and procedures for development); the rules used

in the study; the instrument used in the study; the training of the observers; and the analysis and scoring of the tapes. Chapter three will present the analysis of the data from the experiment.

III. ANALYSIS OF DATA

This chapter consists of the presentation of the data collected, the procedures used to analyze the data, and the results of the analyses. The specific areas dealt with were as follows: (a) the analysis of differences between the mean scores for the internal conditions; (b) the analysis of differences between the mean scores for the external conditions; (c) the analysis of variance among the mean scores of the various subgroups; and (d) the comparison of the individual steps in the internal conditions with the mean scores for the external conditions.

The Internal Conditions Scores

The internal conditions phase of teaching rules involved two steps--the specification and analysis of the rule learning tasks. In order to answer the question, "how did the experimental and control groups compare in the degree to which each used these steps?", a frequency count was conducted for each. The Internal Conditions Section of the Rule Learning Matrix was set up in a dichotomous fashion to reveal the frequency with which the various subjects "used" and "did not use" step one and step two. As Table 5 (on page 44) indicates, the frequency with which the experimental group used step one was 18 of 24 times while the frequency with which the control group used step one was zero of 24 times. For step two, the experimental groups frequency of use was 21 of 24 times while the control groups frequency of use was five of 24 times.

The External Conditions Scores

The external conditions phase of teaching rules involved five steps. Scores for the amount of usage of the steps by the experimental and control group were computed from the observers' analyses. The observers indicated whether or not a subject used a step or not and also in what sequence he used the step. The range of the individual scores was from 0 to 25 points. The total score and mean of the experimental group was 480 and 20. The total score and mean of the control group was 102 and 4.25. To determine the amount of difference between the total scores of the two groups, the "t" test[1] was performed. The test indicated a significant difference between the two groups at the .01 level ($t = 8.56$).

Many of the subjects' scores were either zero or five on a scale of zero to five. Since the assumption concerning continuous data, necessary for the "t" test, may not have been met fully, the Mann Whitney U Test, a nonparametric technique, was also performed. It also indicated a significant difference between the mean scores of the two groups at the .01 level ($Z = -4.92$). This confirmed the results of the "t" test.

The Analysis of Variance

The various subgroups in the study were the experimental: high and low achievement groups, and the control: high and low achievement groups. Table 3 shows the posttest scores for the external conditions for these groups.

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[1] John C. Fruend, Modern Elementary Statistics, (Englewood Cliffs: Prentice-Hall, Inc.), p. 225.

Table 3

Posttest Results for the External Conditions for the Various Subgroups

Group	Total Score	Mean Score
Experimental-High	260	21.66
Experimental-Low	220	18.33
Control-High	52	4.33
Control-Low	50	4.18

A Two-Way Analysis of variance[2] was performed to determine the relationships among the mean scores of the groups. More specifically this test was used to determine the following: whether teaching prospective teachers the conditions for rule learning is significantly related to their rule teaching behavior; and whether the fact that prospective teachers are not taught the conditions for rule learning is significantly related to their rule teaching behavior. Table 4 indicates the results of the analysis of variance. It indicates that prospective teachers who learned the conditions for rule learning differed significantly from those teachers who did not learn the conditions at the .01 level. Secondly, achievement level, as determined by grade point average, was not significantly related to rule teaching performance. Finally, there was not a significant interaction between the High-low achievement levels category and the experimental-control category.

[2]Jerome L. Myers. Fundamentals of Experimental Design. Boston: Allyn and Bacon, 1969, p. 67.

Table 4

Two-Way Analysis of Variance Table
for the Scores of the Various Subgroups

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Squares	F
High-Low	1	36.75	36.75	.87
Exp.-Con.	1	2976.75	2976.75	72.50*
High-Low; Exp.-Con.	1	30.08	30.08	.73
Error	44	1806.85	41.06	
TOTAL	47	4850.43		

*p .01

The Comparison of the Internal
and External Conditions Scores

The internal conditions section of the Rule Learning Matrix resulted in binary data because of the dichotomous nature of the two steps. The scores for the external conditions section of the matrix were continuous data. For example, a given subject's scores for the two sections might have been as follows:

Internal Conditions

Step 1 - used

Step 2 - used

External Conditions

Total Score 25

What was the relationship between the scores of the experimental and control groups for the internal and external sections of

the matrix? Was there a correlation between using the steps of the internal conditions and high external condition scores?

In order to determine the answers to these questions, the Point-Biserial r was used.[3] This test was selected since the situation required a technique which would indicate the relationships between continuous and dichotomous data, i.e., section one and section two of the matrix.

The test between the number of times Step one of the internal conditions was "used" and high scores on the five steps of the external conditions indicated a Point-Biserial r of .44. Between the number of times that step two of the internal conditions was "used" and high scores on the five steps of the external conditions, the test indicated a Point-Biserial r of .82.*

Finally, to answer the question, "What steps were used of what frequency by subjects in the experimental and control groups?", a frequency count was made. This count is shown in Table 5. These data indicate similar results to those of the analysis of variance. Prospective teachers who are not taught the conditions for rule learning do not "naturally" use the steps. The step which is an exception is Step two of the external conditions, (to assist recall of relevant concepts), which 71 percent of the control group used.

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*Note: The standard error of the Point Biserial r for both tests was .144. This indicates that 68 percent of the time one would expect true correlations to reside between the limits of .295 and .579.

[3] N. M. Downie and R. W. Heath. Basic Statistical Methods. (New York: Harper & Row, 1967), pp. 189-193.

Table 5
Frequency and Percentage of Use of the Steps in the Conditions for Rule Learning by the Experimental and Control Groups

Step Number	Frequency of Use		Percentage of Use	
	Experimentals	Controls	Experimentals	Controls
Internal Conditions				
Step 1: Describe the terminal behavior	18	0	.75	.00
Step 2: Decide and Indicate relevant concepts	21	5	.88	.21
External Conditions				
Step 1: Inform learner of form of expected performance	20	0	.83	.00
Step 2: Assist student recall of relevant concepts	23	17	.96	.71
Step 3: Use verbal cues to assist learner to sequence concepts	17	4	.71	.17
Step 4: Ask learner to "demonstrate" one or more concrete examples of the rule	21	3	.88	.13
Step 5: Provide feedback to the learner	20	1	.83	.04

The statistical tests performed on the various data and the results obtained were presented in this chapter. Chapter four will contain a discussion of the results, the findings of the study, the implications of the findings, and the recommendations for further research.

IV. SUMMARY, FINDINGS, IMPLICATIONS, AND RECOMMENDATIONS

One basic problem investigated in this study was whether prospective teachers used Gagné's conditions for rule learning as a result of the instruction which they receive in social science methods courses on unit development for concept teaching. A second basic problem was to determine whether prospective teachers can be taught to successfully use Gagné's conditions for rule learning. Other questions were related to effects of the achievement levels of the subjects upon their rule teaching performances.

To begin, forty-eight prospective elementary teachers in the social sciences methods course were taught the procedures for developing units to teach concepts. This was followed by a period in which the teachers prepared units to teach pupils from a local elementary school who visited the university as part of another project. During this preparation, the experimental group worked on the additional task of learning the conditions for rule learning. Following this, all subjects, as a posttest were asked to teach a child a rule. Videotapes were made of the lessons and a team of four observers analyzed these. Total Rule Scores were then computed for the subjects and groups of subjects.

The Effects of Teaching the Internal Conditions

Many studies have shown the effectiveness of analyzing a task to determine the prerequisite competencies that are necessary for mastery.

However, the question has remained, "Do teachers, as a result of their social science methods courses, use this procedure?" This study found that prospective teachers who are not familiar with the two steps of the internal conditions for rule learning do not use them. This means that untrained prospective teachers tend not to specify the terminal behavior necessary for a particular learner to demonstrate rule acquisition. Further, it is logical that if the tasks are not specified they cannot be analyzed. The analysis of the frequency count for the control group for both steps bears this out. The frequency count did indicate, however, that prospective teachers can be trained to use the steps successfully.

The Effects of Teaching the External Conditions

As in the comparison of scores for the internal conditions, the "t" test and the Mann Whitney U Test indicate that there is no significant relationship between mean scores of the external conditions for the Experimental and Control groups. This means that the rule teaching behavior of prospective teachers who are unfamiliar with Gagné's conditions, i.e., who have only the conventional methods course training, is not related to the conditions for rule learning. This study also indicates that there is a significant relationship between the mean scores of the external conditions for the experimental group who are taught by effective instruction and their rule teaching behavior.

The Results of the Analysis of Variance

Much discussion in education centers around the effect of individual difference variables (sex, race, height, etc.) upon learning. This is illustrated by the number of these variables listed in studies on instruction. However, instructional designers such as Leslie Briggs

believe it important to continue to study these, but they stress that if the instruction is designed and tested properly, i.e., using systems analysis and formative evaluation techniques, individual difference variables will have a very small effect.

The results of the analysis of variance performed on the scores of the subgroups in this study support the results of the "t" test and the Mann Whitney U by indicating that the treatment for the experimental group had a significant effect. It also produced evidence to support the above thesis that well-designed, effective instruction will teach successfully and that the achievement level of the subjects will not be significantly related to their rule teaching performance.

The Comparison of the Internal and External Conditions Scores

According to Gagné, the steps in the external conditions are derived from the work done in the internal conditions phase. Therefore, it would appear logical that success in using the steps in the external conditions phase would be related to the "use" of the steps in the internal conditions phase. The performance of the subjects in this study supports Gagné. The Point-Biserial r test was used to make this determination. The test results indicate that when prospective teachers plan, by specifying and analyzing the rule learning task, they will also be successful in using the five steps in the external conditions phase.

The Frequency of Use of Individual Steps

One of the questions for the study was, "Do teachers use the steps in Gagné's conditions and, if so, how frequently do they use them?" As Table 5 indicates, all the steps are virtually unused by teachers who are unfamiliar with the conditions. The exception was step two of the

external conditions which 71 percent of the control group used. This indicates that when prospective teachers teach a learner a social science rule, they begin by assisting the learning and recall of concepts. However, by definition rules are learned not only by learning the concepts involved, but also by learning the relationships among them. The experimenter observed that while many of the subjects in the control group began by asking the learner to recall relevant concepts (usually synonyms and examples), they tended to vary as to whether they actually associated the examples with the definition of the rule. For example, in teaching the anthropological rule, "Reproduction means to produce one or more other individuals (of a given kind of animal or plant) by some sexual process," a teacher asked the learner if he knew the concepts of grafting and regeneration. She talked about these processes but never related them to the definition of the rule. This aspect of teaching rules is certainly an area for further study.

The Findings of the Study

Three hypotheses were formulated concerning the problem under study. The findings as they relate to these hypotheses are as follows:

1. It is a hypothesis of this study that teaching prospective teachers, students in the Social Science Methods Classes for Elementary Teachers, the conditions for rule learning will be related to their rule teaching behavior according to appropriate statistical criteria. This hypothesis was substantiated by the results. There was a significant relationship between teaching prospective teachers the conditions and their rule teaching behavior at the .01 level of significance.

2. It is a hypothesis of this study that the conditions for rule learning will be related to the rule teaching behavior of prospective teachers who are not taught the conditions for rule learning according to appropriate statistical criteria. This hypothesis was rejected.

There was no significant relationship between the conditions for rule learning and the rule learning behavior of prospective teachers who are not taught the conditions for rule learning.

3. It is a hypothesis of this study that the rule teaching behavior of prospective teachers will not be related to their achievement level, as determined by grade point average, according to appropriate statistical criteria. This hypothesis was substantiated by the results. There was no significant relationship between the achievement level of prospective teachers as determined by grade point average and rule teaching performance.

The Implications of the Study

Psychologists and educators such as Gagné, Piaget, Glaser, and Taba have recommended various paradigms for teaching concepts (rules).[1] However, there is little evidence that these are used by teachers. The implications from this study for one of these models, Gagné's conditions for rule learning, is that teachers did not learn how to use the steps in the model from instruction in the social science methods course. However, it was shown that these procedures can be taught to teachers by means of effective instruction.

A further implication from this study for instruction is that the achievement level of the prospective teacher tends not to make a difference in his performance when the instruction is previously determined to be effective.

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[1] Martorella, Peter H. Concept Learning in the Social Studies: Models for Structuring Curriculum. (Scranton: Indext Educational Publishers, 1971), pp. 77-81.

The Recommendations for Further Research

A previous study indicated that once learning occurs for a higher level task, i.e., rule learning and problem solving, it tends to be retained. For this reason, tests for retention were not conducted in this study.[2] However, a future study might follow the prospective teachers into the field to determine whether or not, and to what extent, the use of the steps in the conditions for rule learning is continued in the schools.

Secondly, it was assumed, both from the expert opinion of the learning psychologist, Robert M. Gagné and from research, that use of the steps in the conditions would result in effective learning. However, this is still an empirical matter. While determination of teacher effectiveness through a study of learner achievement has not been productive, ways might be found to resolve this issue and make the determination.[3] Programmed instruction, it seems, would be one way to approach this since in this way many more variables can be controlled.[4]

Fourthly, there also needs to be further study to determine the differences caused when a teacher teaches examples of a rule and when she teaches the definition. Finally, investigations are needed to determine the specific effects of the various components of the learning program.

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[2]Jeanne Gibson, "Transfer Effects of Practice Variety in Principal Learning," (unpublished Doctoral dissertation, the University of California at Berkeley, Berkeley, 1969), p. 71.

[3]Donald M. Medley and Harold E. Mitzell, "Measuring Classroom Behavior by Systematic Observation," Handbook of Research on Teaching, ed. by Nathaniel Lee Gage (Chicago: Rand McNally and Company, 1963), p. 248.

[5]Donald T. Tosti and John R. Ball, A Behavioral Approach to Instructional Design and Media Selection. (Albuquerque: Westinghouse Learning Corporation, 1969), p. 2.

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APPENDIX A

LEARNING TO TEACH SOCIAL SCIENCE RULES
(THE PROMOD PROGRAM)

(Note: Appendix A, available from author upon request)

APPENDIX B

SCHEDULE OF EVENTS FOR THE STUDY

The following schedule shows the flow of events during the study:

March 22;	Organized Groups and Subgroups
April 1-30;	Designed and validated PROMOD Program
April 15-30;	Trained Observers
April 26-30;	Class A prepared units and worked through PROMOD Program
May 3-7;	Class A took posttest by teaching children rules
May 3-7;	Class B prepared units and worked through PROMOD Program
May 10-14;	Class B took posttest by teaching children rules
May 17-31;	Observers analyzed videotapes

APPENDIX C

INSTRUCTIONS FOR SCORING

THE CONDITIONS FOR THE RULE LEARNING MATRIX

1. An item can be checked only if a rule (defined concept of generalization) is involved. The rule must be stated. You should not have to infer that there is a rule.
2. Notice what the learner is being asked to recall in step two. Is he being asked to recall concepts in a rule or rules in a problem, or is he learning a concept or verbal associate.
3. It is not enough for the teacher to say we are going to talk about something. This is saying what "beginning" behavior will be and is not a statement of the expected final behavior for the learner.
4. Score on what the teacher in the film thinks happened, not what you think happened. For example, if a teacher accepts a response as a demonstration, then proceeds to provide feedback, then you must score that the child did demonstrate - not that he did it poorly or that he did not really understand therefore he did not demonstrate.
5. Probably the most difficult part of the steps for scoring (and teaching) will be determining sequencing and also making a distinction between sequencing and demonstrating.

   Rule: The teacher's behavior usually determines sequencing and the students reaction usually determines demonstration.

For example, both could occur almost at the same time. The teacher might say, "What is the last part of the rule?" Then the student might state the last part. When he does he might complete sequencing and also demonstrate the rule. The teacher might then provide feedback by saying, "That is right."

6. Remember the demonstration can be a concrete instance or it may be simply a statement repeating the rule.

7. Score feedback after demonstration only.

APPENDIX D

INITIAL INSTRUCTIONS TO THE SUBJECTS IN THE EXPERIMENT

To the Student:

In getting ready to work with the Boykin Children, you have two tasks. First of all, you must work with a group to create a presentation (teaching unit) to be taught next week. This presentation will be based upon the concepts and generalizations in the Man: A Course of Study Curriculum. An example of a unit might be, "The Life Cycle of the Salmon." Secondly, each of you will select a single concept or generalization from the group presentation to teach one child. An example of a single concept might be the work, "Death" (the act of dying; the end of life). The length of this lesson will be five to fifteen minutes. Some of you have a module that you must work through before teaching the single concept. Everyone else will not work through a module, but will use any method you wish to teach the concept. When each person teaches his concept, a videotape will be made. This tape will be analyzed by trained observers who will provide feedback, in a confidential manner, to the teacher.

Another aspect of this preparation is that you must schedule your individual teaching sessions with your instructor. It will be possible

to have about five lessons each morning, so the schedule will look similar to the one below:

	Monday	Tuesday	Wednesday	Thursday	Friday
10:15					
10:30					
10:45					
11:00					
11:15					
11:30					