THE EFFECTS OF INSTRUCTING PRESERVICE TEACHERS IN QUESTIONING SKILLS UPON LEVELS OF QUESTIONS ASKED BY ELEMENTARY PUPILS

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CHAPTER I

INTRODUCTION

Nature and Statement of the Problem

Educators are concerned about the quality of education that is being provided for children. Accompanying this concern is an increasing demand that education be more relevant to the pupils' needs and interests. Accordingly, as the schools move into the mid-seventies, changes in teaching strategies seem inevitable. Thus, a pressing question for teachers of teachers is how to improve the quality of the teaching-learning process.

Formerly, the teacher's role was perceived as that of dispenser of knowledge. It seems that this conception of the teacher has now changed to that of a stimulator of the learner. As a result of this different emphasis, today's teacher expects to obtain a higher level of pupil thinking than mere recall of factual information.

Among the varied instructional innovations being stressed during recent years is the inquiry approach to learning (Carin and Sund, 1970). Inquiry is a process through which the teacher uses motivating devices and thought-provoking questioning techniques to stimulate the learner to assume responsibility for his own learning and to ask high level questions in his quest for understanding.

This study was designed to investigate the effect of training student teachers in questioning strategies on the number and level of questions asked by two groups of sixth-grade pupils assigned to student teachers in different training situations. The investigator provided instruction to two randomly selected groups of preservice elementary student teachers. One group received instruction in questioning strategies. The other group received instruction in material not related to questioning.

The preservice teacher subjects for this study consisted of 21 female and 3 male college students majoring in Elementary Education, enrolled in a regularly scheduled Elementary Methods course during the fall semester of 1972. The elementary pupil subjects were composed of 120 randomly selected and assigned sixth-grade pupils from a middle school in southeastern Oklahoma. After receiving instruction the student teachers met with the pupils for microteaching sessions.

Purpose of the Study

The major concern of this study was to determine whether a difference in question asking patterns of student teachers produced a concommitant effect in the number and levels of questions elicited from pupils in their classrooms. In essence, did student teachers trained in the questioning strategies of the inquiry approach elicit from their pupils a greater number and higher level of questions than did student teachers lacking such training?

Hypotheses

The purpose of the study led to the development of ten hypotheses

to be tested. The .05 level of significance was selected for the testing of each of the following hypotheses.

1a. There is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

1b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

2a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

2b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

3a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

3b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

4a. There is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

4b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

5a. There is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

5b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

Definition of Terms

For clarification, the following terms and definitions are presented.

Teacher Control Group: Twelve randomly selected and assigned preservice elementary teachers who participated in the microteaching but did not receive instruction in questioning techniques.

Pupil Control Group: Sixty randomly selected and assigned sixth grade pupils who were taught in the microteaching sessions by the teacher control group.

Teacher Experimental Group: Twelve randomly selected and assigned preservice elementary teachers who participated in the microteaching but did receive instruction concerning questioning techniques.

Pupil Experimental Group: Sixty randomly selected and assigned sixth grade pupils who were taught in the microteaching sessions by the teacher experimental group.

Microteaching: A scaled-down teaching experience which is modeled after the one developed by Dwight Allen (1966) at Stanford University.

High-level Questions: Questions which are convergent, divergent or evaluation, i.e., modified Gallagher and Aschner classification scheme (Appendix A).

Convergent Questions: Questions that demand the respondent to know certain facts and, in his own words, explain concepts, solve problems, or make comparisons, predetermined by the teacher.

Divergent Questions: Questions that provide a situation which allows for more than one possible answer. These are questions that permit originality as evidenced in the hypothesis one makes in the way he uses his knowledge to solve new problems.

Evaluative Questions: Questions which require judgment, valuing, choosing, or defending. They cause the respondent to organize knowledge, formulate an opinion and thereby take a self-directed position which is based upon evidence.

Cognitive-memory and Low-level Questions: Questions that require the lowest level of thought. These questions demand recall, memory, description of previously obtained factual knowledge, recognition or observation.

Instruction in Questioning Techniques: The instruction provided to the teacher experimental group is a technique using a modification of the Gallagher and Aschner classification scheme (see Appendix A).

Scope and Limitations of the Study

1. This study consisted of: (a) a random selection of 24 preservice elementary teachers, (b) all preservice elementary teachers

attended the same college, (c) each preservice elementary teacher was randomly assigned to sixth-grade pupils, (d) the 120 sixth-grade pupils were randomly selected and assigned, (e) all the pupils attended one middle school composed of sixth, seventh and eighth grades, (f) the study took place in the fall of 1972.

2. The reliability of the conclusions is limited to the reliability of the measuring criteria used in the study.

3. The limited time of the study may have influenced the degree to which the hypotheses under question could be adequately tested.

Assumptions of the Study

For the purpose of this study the following assumptions were posited:

1. That the levels of questions asked by the preservice elementary teachers and the pupils during their microteaching experience could be determined by the criteria cited in the study.

2. That preservice elementary teachers do not ask a high percentage of high level questions.

3. That all other variables affecting the classroom behavior of children can be controlled by random selection.

Significance of the Study

The value of focusing on teachers' questions is that they are the underlying unit of most methods of effective classroom teaching (Manson and Clegg, 1970; Anderson, et al., 1970). With this in mind, the study of pupils' responses merits strong support in that a contribution can be made in assessing the quality and productivity of instruction with

respect to questioning strategies that college students are exposed to in methods classes. The results of this study could serve as a guide for instruction in future preservice and inservice programs for teachers.

This study could also serve as a stimulus to further studies directed toward the overall goal of determining whether being able to change teacher behavior makes any difference in what pupils do with their minds.

CHAPTER II

REVIEW OF LITERATURE

Introduction

"Good questioning is considered the heart of good teaching" (Anderson, et al., 1970, p. 76).

How people learn, and the conditions under which they learn, are matters that have been investigated by several generations of American and European psychologists. Human skills, appreciations, and reasonings in all their great variety, as well as human hopes, aspirations, attitudes, and values, are generally recognized to depend for their development largely on the process called learning. According to Gagne (1970), the factors that influence learning are chiefly determined by events in the individuals' living environment. Gagne defines learning as "a change in human disposition or capability, which can be retained, and which is not simply ascribable to the process of growth (p. 3)." He further states that learning is an event that happens under certain observable conditions that can be altered and controlled.

Research on learning has generated several models, or prototypes, which are frequently referred to by writers on the subject. They include the conditioned response, trial-and-error learning, insight, and other models which are often used to communicate basic similarities and contrasts among situations in which learning occurs.

The elements of the learning event must include a learner, who is in this instance a human being. A single event must take place called a stimulus. The action resulting from the stimulus is called a response. A learning event takes place when the stimulus situation affects the learner in such a way that his performance changes from a time before being in that situation to a time after being in it. The change in behavior leads one to conclude that learning has occurred (Gagne, 1970).

One of the oldest patterns of thinking about learning derives from British associationist psychologists, who formulated a number of theories about how ideas are associated (Mill, 1969). These theories hold that learning takes place by associating ideas. Edward L. Thorndike (1898) was an American pioneer in his efforts to understand animal learning by the trial-and-error approach. In Russia, I. P. Pavlov (1927) determined the conditioned response in his ability to cause a dog to salivate at the sound of a buzzer alone. The German psychologist, Hermann Ebbinghaus (1913), experimented with verbal associates. More recent research has shown that verbal association represents a very limited range of actual learning situations due to interference of both outside and inside forces (Gagne, 1970).

The Gestalt tradition stresses insightful learning. According to Gestalt theory (Katma, 1940; Wergheimer, 1945) learning typically takes the form of an insight, which is a suddenly occurring reorganization of experience, as when one has a new idea or discovers a solution to a problem. This theory accounts for some common learning, but in such areas as reading or mastering a foreign language, insightful learning is difficult to identify. The reinforcement theory with which Hull

(1943), Spence (1956), and Miller (1959) are associated ascribes learning to the direct satisfaction of a motive. Skinner (1938) defined reinforcement as a particular arrangement of stimulus and response conditions that bring about the establishment of a new association.

The importance of questioning in the teaching-learning process has long been recognized in American education. It is reflected in methods textbooks written since the latter part of the 1800's (Whit, 1886; Strayer, 1912; Odell, 1924; Burton, 1929). Davis (1970) accords questioning a fundamental role in the learning situation:

> The kinds of questions teachers ask, the way they ask them, and the way they react to pupil responses, has a great deal to do with the kind of instructional environment that exists in the classroom. More importantly, the way teachers handle questions and questioning skills, their own and pupils; has much to do with the quantity and quality of the learning underway in the classroom (p. 76).

Recent trends in education focus upon the problem-solving facets of teaching, the development of creativity in the child, and the critical thinking skills (Schmalzreid, 1972). It is readily apparent that the act of questioning by the teacher plays a vital role in the implementation of these as goals in the classroom (Pate, 1969).

The importance of questioning in contemporary American education is reflected in much of the literature related to teacher behavior in the classroom, studies of teachers' questioning practices, effect of teachers' questions on pupil behavior, microteaching and pupils' questions. The following review of literature includes the principal contributions of researchers in these areas from 1888 to the present time.

Teacher Behavior in the Classroom

In this section data will be presented to show that teachers' classroom behavior is uneven, with different students receiving differential teacher treatment. Good and Brophy (1973) feel that such behavior occurs because teachers are not aware of their behavior, or because they do not realize the consequences of their behavior.

Evidence indicates that students are not as free to act as teachers believe them to be. Jackson and Wolfson (1968) indicate that the number of constraints that interfere with the wants and needs of nursery-school pupils is excessive. Even though not all of the constraints they report are due to teacher behavior, they nevertheless placed the number of constraints placed upon the behavior of nursery-school pupils at 20 constraining episodes each minute in a group of 97 children.

When teachers do allow students to speak, which ones do they call upon? Jackson and Lahaderne (1967) indicate that pupil contact with the teacher varies greatly within the same classroom. Observing four sixth-grade classrooms for approximately ten hours each, they found that teachers interacted with some students as few as five times and with others as often as 120 times. Jackson and Lahaderne also noted that the sex of the student affects the quantity and quality of the communication patterns students share with teachers in each classroom. They found that boys have more interaction with teachers than girls do, but that the magnitude varies with the nature of the communication, being greatest for disciplinary exchanges and smallest for instructional messages. That the sex of students is a major factor in the

elementary classroom has been shown by a number of researchers who have found males to be more salient to the teacher and receive much more criticism than females (Meyer and Thompson, 1956; Lippitt and Gold, 1959; Jackson and Lahaderne, 1967).

There is some evidence that the achievement level of the pupil, as well as his sex, figures considerably in whether or not the student gives frequent responses. Kranz et al. (1970) and Good (1970) found that high-achieving elementary-school age pupils received more teacher questions and teacher praise than did their low-achieving counterparts. Good, Sikes, and Brophy (1972) report that low-achieving males in junior high classrooms received inferior treatment, whereas high achieving males received more frequent and more favorable contact with the teachers. Rowe (1969) found a significant difference in the time allowed for more capable students than for less apt students before giving the answer or calling on another student. Slower students, in order to avoid losing their turn, had to respond more quickly. Rowe also reported that the teachers were not aware that they were behaving in this fashion.

Brophy and Good (1970) found that teachers of four first-grade classrooms were much more likely to praise high-achieving students than they were to praise low-achieving pupils. In these classrooms, when high-achieving pupils gave a right answer, they were praised 12 percent of the time, while low-achieving pupils were praised only six percent of the time following a right answer. Similarly, high-achieving pupils were found to be less likely to receive teacher criticism for a wrong answer than were low-achieving pupils. After an incorrect response, high achievers were criticized six percent of the time and

low-achieving pupils were criticized 18 percent of the time. They further found that teachers were more likely to provide clues, repeat the question, or ask a new question for the high-achieving pupils when they said "I don't know," answered incorrectly, or made no response. In contrast, the teachers were more likely to give the answer or call on another pupil when low-achieving pupils gave similar responses.

The way a teacher groups his pupils can influence the flow of communication in the classroom. Adams and Biddle (1970) discovered what they termed an action zone. This action zone consisted of the pupils who sat in the front row and middle aisle seats. These pupils were allowed to talk and participate more than the others in verbal exchanges. Adams and Biddle felt that this might have been due to the fact that the teachers tended to stand in front of their classes and that their attention was focused on the pupils in immediate view. The fact remains, however, that pupils seated in this section of the classroom received more teacher attention.

Rist (1970) presents a case study of pupils progressing from kindergarten through second grade. He told how teachers created a caste system, and discusses ways in which high-status pupils reflected the behavior of their teachers and how the teachers also communicated disrespect for the low-status children. It seemed that the students who needed the most teacher help, that is, the children who were shy and not very verbal, were seated in the back of the room when they began kindergarten. This arrangement apparently made it more difficult for these children to have contact with the teacher. It was pointed out by Coleman et al. (1966) that pupils will learn from their classmates when given the opportunity to do so. This would lead us to

believe that rigid grouping patterns would prevent low-achieving students from learning from their classmates.

Studies of Teachers' Questioning Practices

An early study of teacher questioning practice done by Stevens (1912) found that, for a sample of high-school classes varying in grade level and subject area, two-thirds of the teachers' questions required direct recall of information found in the textbook. Twenty-three years later, Haynes (1935) found that 77 percent of teachers' questions in sixth-grade history classes called for factual answers while only about 17 percent were judged to require students to think. In Corey's study (1940), three judges classified 29 percent of the questions asked as those which required a thoughtful answer, while 71 percent were considered factual.

Research conducted for the past 13 years indicates that teachers' questioning practices are essentially unchanged. Floyd (1960) categorized the questions of a sample of 40 "best" teachers in elementary classrooms. Specific facts were called for in more than 42 percent of the questions. A summation of Floyd's percentages of questions in categories which appear to have required thoughtful responses from students accounted for about 20 percent of the questions asked. In other studies conducted at the elementary-school level (Guszak, 1967; Schreiber, 1967), similar percentages of recall of fact and thought questions were asked. At the high-school level, Davis and Tinsley (1965) and Gallagher (1965) classified the questions asked by teachers of gifted pupils. Their study showed that more than half of the questions asked were judged to test the pupils' ability to recall factual

information.

The findings in studies on teachers' questioning practices are consistent enough to conclude that in more than a half-century there has been little change, with few exceptions in the types of questions which teachers use in their classrooms. About 80 percent of teachers' questions require pupils to recall facts or are procedural, while about 20 percent require pupils to think (Gall, 1970).

One explanation of why teachers' questions have led to recall of facts is that although higher cognitive objectives are valued in American education, teachers need to ask many fact questions to bring out the data which pupils require to answer thought questions or do independent thinking. Perhaps this explanation has merit, but it can be argued that instruction in facts is best accomplished by techniques such as programmed instruction. The teacher's time would be better spent in developing pupils' thinking and communication skills during discussions which take place after the pupils have demonstrated an acceptable level of factual knowledge on a written examination.

A second explanation of the continuation of questioning for facts is that although educators have advocated the pursuit of objectives such as critical thinking and problem solving, only recently have these objectives been incorporated into new curricula. The relationship which exists between curriculum change and teachers' questioning practices has been studied in recent research comparing teachers in the School Mathematics Study Group (SMSG) with teachers in a traditional mathematics program (Sloan and Pate, 1966). The researchers hypothesized that the two groups would differ in their questioning styles since the Mathematics program emphasized the objectives of inquiry and

discovery. They found that, compared to the traditional math teachers, the "new math" teachers asked significantly more comprehension and analysis questions and significantly fewer recall questions.

A third reason why teachers have emphasized fact questions for more than a half-century, as indicated in research findings, is the lack of effective teacher training programs. In their study of questions in mathematics teaching, Sloan and Pate (1966) made this observation:

> Although the School Mathematics Study Group teachers' use of questions evidenced their awareness of the processes of inquiry and discovery, these processes had not been fully implemented, as shown by the fact that these teachers used so few synthesis and opinion questions that the pupils were denied the opportunity to develop inferences from available evidence (p. 166).

Consequently, Sloan and Pate advocated training teachers in effective questioning practices.

Investigations of available sources related to the improvement of teacher questioning practices are available which can help teachers in formulating questioning strategies. The work of Guilford (1956) and Bloom (1956) identify cognitive processes in a hierarchical complexity which can be used by teachers for planning, implementing and evaluating their questioning behavior. By using Guilford's (1956) model, teachers can plan and use questions in two ways: (a) those which direct pupils toward the same or similar answers, or (b) those designed to develop a rich variety of acceptable responses (divergent thinking). The taxonomy identified by Bloom (1956) can be used by teachers to plan and measure each question as well as each instructional objective in one of six categories of thinking, from recall to evaluation. Sanders' Classroom Questions: What Kinds? (1966) suggests questions for

discussion and testing which foster the several types of higher order operations. His work can be useful as one means of helping teachers to vary the cognitive emphasis of the questions they compose. Hunkins' Questioning Strategies and Techniques (1972), based extensively on Bloom, offers guidelines for planning and for evaluating questioning strategies.

While not specifically directed toward the use of questions, Mosston (1972) supplies a basis for selecting an appropriate teaching style. His descriptions provide an objective means for analysis of teaching styles and include use of questioning.

The importance of effective teacher questioning is stressed by Tinsley (1973) when he says:

> If questions used in classrooms are significant in developing the cognitive powers of students (and it seems evident that they are) and if a primary goal of education is to develop critical thinking abilities (and we state that it is), then teachers must plan, use, and evaluate classroom questions and questioning to better accomplish these goals (p. 713).

Effect of Teachers' Questions on Pupil Behavior

Teachers' questions have value only if they have a positive impact on pupil behavior. The literature indicated that very few researchers have explored the relationship between teachers' questions and pupil responses.

An important work in this area is the research by Hunkins (1967). The purpose of his research was to determine whether question type bears any relationship to student achievement. Two experimental groups of sixth-grade children worked every class day for a month on questions which were keyed to a social studies text. In one group the questions

stressed knowledge; in the other, high level questions were stressed. Questions were classified in terms of Bloom's Taxonomy of Educational Objectives: Handbook I: Cognitive Domain. Hunkins found that the analysis-evaluation group earned a significantly higher score on a specially constructed post-test than did students who answered questions that stressed knowledge. The performance of the two groups was also compared on the six parts of the test which corresponded to the six main types of questions in Bloom's taxonomy: the analysis-evaluation group did not differ significantly from the comparison group in achievement on tests which emphasized knowledge, comprehension, analysis, and synthesis questions; they scored significantly higher on the tests requiring application of knowledge and evaluation questions.

Limitations of Hunkins' research should be noted. First, the daily sets of questions required the pupils to write out their answers, whereas the pupils responded to multiple-choice questions on the post-test. One may question whether the achievement test provided an adequate comparison of the effectiveness of the two experimental conditions. Second, it seems that to put the questions into a multiple-choice format is a distortion of Bloom's taxonomy, since evaluation questions do not really have a "correct" answer. We may conclude that practice in answering certain types of questions may affect the quality of pupils' responses rather than their correctness. Third, pupils scored their own responses using answer sheets provided with the questions. Teacher monitoring of some of the pupils' responses might have brought about the differences found between the experiment conditions.

A consideration of these methodological limitations would lead us to believe the Hunkins' findings should be viewed as only suggestive. It seems reasonable that if a group of pupils is exposed to certain types of questions and if their responses are monitored to improve their quality, they will be able to answer similar types of questions better than pupils who have not had this exposure.

Microteaching

Microteaching is a recently developed procedure in teacher education which offers a model for the improvement of teaching (Perlberg, 1972). It reflects a current interest in the effectiveness of various teaching techniques on which the quality of education ultimately rests. Its effectiveness in improving the teaching ability of preservice teachers was reported by Davis and Smoot (1969). Preservice teachers given the opportunity to microteach, receive feedback, and reteach exhibited changed behaviors and developed an increased variety in their verbal teaching.

Microteaching was developed by a team of teacher-educators and educational researchers at Stanford University in 1963 (Allen and Ryan, 1969; Cooper and Allen, 1971). It was designed to overcome some of the shortcomings of traditional teacher education programs, and increase our understanding of the teaching-learning process.

According to Perlberg (1972):

> Microteaching is a laboratory technique in which the complexities of normal classroom teaching are simplified. The trainee teaches a class of three to five students. The lesson is reduced to five or fifteen minutes and is used for the practice of one particular teaching skill--lecturing, questioning, leading a discussion, or using instructional aids, etc. The lesson is recorded on videotape and the

> trainee hears and sees himself immediately after the lesson. The analysis and suggestions of a supervisor, who attended the lesson or observed the videotape, and other sources of feedback assist the trainee in restructuring the lesson. Assessment and feedback lead to further improvements when he teaches again, either immediately after or several days later. The microteaching sequence is practiced usually in a microteaching laboratory in a teacher training institution, or an inservice training programme in regular schools (p. 549).

An important feature of microteaching is the "microelement" which attempts to simplify the complexities of the teaching process. Underlying this is the proposition that before one attempts to understand and effectively perform the task of teaching, one should first master the component skills of that task. Short lessons, as used in microteaching, concentrate on one skill. Component skills can then be combined with other mastered skills in longer lessons. The short microlesson, by reducing the subject matter to be covered, eases the training process (Allen and Ryan, 1969).

A repertoire of teaching skills which can be improved upon is another important feature of microteaching. These include such skills as lecturing, questioning, or leading a discussion (Berliner, 1969). For example, Allen, et al. (1969) categorize teaching skills under the general headings of response, questioning, increasing student participation, creating student involvement, and presentation, with three or four skills within each category.

Another important feature of microteaching is the "feedback" element. In many cases, "feedback" in the supervision of preservice teachers is frequently based on a supervisor's recall and selective note-taking. His impressions provide the basis for analysis of the preservice teacher's performance. But subjective factors may enter

into his assessment, and, in the absence of objective criteria, the preservice teacher may covertly or overtly oppose the supervisor's evaluations and suggestions (Perlberg, 1972).

One way of obtaining accurate feedback, which is important to the improvement of teaching (Fuller and Baker, 1970), is through audiotape recordings of classroom activities. An obvious shortcoming to audiotape is that they are limited to verbal interaction in the classroom.

An alternative to the audiotape is videotape recording. A portable videotape recorder, a small camera, and a small television monitor comprise the basic videotape recording unit.

The effectiveness of videotape recordings and playback techniques has been conformed in a number of studies on teacher training (Fuller and Baker, 1970), counsellor training and counselling (Ivey, et al., 1968; Ivey, 1972), psychotherapy (Geertsman and Mackie, 1969) and human relations (Stoller, 1968).

There is evidence that the use of microteaching is increasing in teacher education programs. Ward (1969) found that 141 of the 442 NCATE accredited colleges and universities were using microteaching in their education programs, and about 50 reported its use in inservice training programs. In a national survey of student teaching programs in the United States, Johnson (1968) found that 44 percent used some form of microteaching.

Among the alternatives that have been adopted by colleges and universities in introducing microteaching procedures into the teacher education program is the original Stanford microteaching laboratory model. This is a model in which the preservice teachers are required to practice to acquire proficiency in certain teaching skills (Allen,

1969). Another alternative has been to incorporate microteaching procedures into methods courses. With this procedure teaching skills and classroom interaction are illustrated with tapes of "model teachers." Tapes of classroom interaction are brought before the group for analysis. The resulting "improved" versions are taped and then viewed for further discussion. According to Perlberg (1969) microteaching procedures provide the methods courses with new dimensions of audio-visual reality and experimentation. He further points out that microteaching could greatly enhance the effectiveness of student teaching.

The present status of microteaching was summed up by Allen and Ryan in 1969 and still relevant today (Perlberg, 1972):

> The questions that are raised by microteaching, at least at this point in its evolution, far exceed the answers it has been able to supply. Microteaching currently has the same promise and the same dangers that newly-devised research and training techniques have always had: the promise of opening new avenues, prospectives and alternatives to human exploration; the danger of locking too early on the first alternative which arose purely out of chance and convenience (p. iii).

Pupils' Questions

Some educators feel that attention should be brought to bear on questions asked by pupils rather than on teachers' questions (Garner, 1963; Wellington and Wellington, 1962). It seems a worthwhile educational objective to increase the frequency and quality of pupils' questions in the context of classroom interaction if it can be shown that their levels of questions improve their thinking skills. However, research studies consistently show that pupils have a limited opportunity to raise questions.

Houston (1938) observed 11 junior-high school classes and found that an average of less than one question per class period was

initiated by pupils. Corey (1940) reported all talk in six junior-high and high school classrooms for a period of one week. The ratio of pupil questions to total questions varied considerably between classes. In two English classes, pupils accounted for one percent of the questions asked. Seventh-grade science students asked 17 percent of the questions, while their counterparts in the ninth grade accounted for only 11 percent of the questions asked. At the primary grade level, Floyd (1960) found that pupils' questions averaged 4.17 percent of the total number of questions asked during taped class sessions for first, second, and third grade classrooms. A low percentage of pupil questions was also reported for high school English classes (Johns, 1968) and for social studies classes in the upper elementary grades (Dodl, 1966) and senior high school levels (Hyman and Smith, Jr., 1966).

According to Gall (1970) the most important task in investigating pupil questions is to identify the types of questions which the pupils should be encouraged to ask. Finley (1921) noted that when introducing a new topic for study, teachers should probably ask their pupils what they want to know about it. He found that elementary school pupils had an average of nearly five questions each when shown an unfamiliar animal in class. Another situation in which pupil questions should be elicited occurs when a teacher has introduced a new subject.

Of prime importance in the ability of pupils' questioning is the kind of training their teacher underwent (Gall, 1970). For example, would teachers elicit the same kinds of questions from pupils when they read a poem, a social studies textbook, or a science lesson? Perhaps the shaping of pupil questioning skills has been a feature that

has been neglected in the classroom. There has been increasing attention given to pupil questioning since discovery and inquiry methods of teaching became prominent. Cronbach (1966) and others point out that research and training in these methods remain limited by the failure to focus on specific questioning skills in various classroom situations.

Recently a program was developed at the Far West Laboratory for Educational Research and Development (Borg, et al., 1970) to help teachers improve their questioning behavior. This program, called a minicourse, is a self-contained, inservice training package which requires about 15 hours for completion. The minicourse uses techniques of modeling, self-feedback, and microteaching (Allen and Ryan, 1969) to effect changes in teacher questioning styles. In a field test with 48 elementary-school teachers, the minicourse produced several significant changes in teachers' questioning behavior, as determined by comparisons of pre- and post-course videotapes of 20-minute classroom discussions. These changes included an increase in frequency of redirection questions and in the frequency of probing questions (questions which require students to improve or elaborate on their original response). There was also a reduction in frequency of poor questioning habits: repetition of the pupils' own questions; repetition of pupils' answers; and answering of the pupils' own questions.

Other programs for improving teachers' questioning practices have been developed. Shaver and Oliver (1964) worked with teachers in the use of questioning methods appropriate to discussion of controversial issues in social studies classes. Suchman (1958) identified inquiry skills for science classes and found that training teachers in their use resulted in a significant increase in the number of questions asked

by pupils.

In social studies, Taba (1966) and her co-workers (1964) developed a system of teacher education which centered around questioning strategies. These strategies were viewed as techniques which teachers could use to develop their pupils' abilities in forming concepts, explaining cause-and-effect relationships, exploring implications, and in asking high level questions.

If both the teacher and the pupils are to ask more and higher level questions, the initiative must come from the teacher since classroom management is almost the sole prerogative of the teacher. Thus, it would seem that much, if not all of the responsibility for determining the most effective means of using them must also be assumed by the teacher. What then may teachers do that will promote increased effectiveness in the use of questions?

A necessary first step in making appropriate decisions about the use of classroom questions is in the area of lesson planning. The formats of typical lesson plans do not include this role which is frequently performed by the teacher. Key leading questions should be central to the lesson plan. Tinsley (1973) emphasizes this when he says:

> - - - - Planning and developing a potential sequence of key questions and activities that ask students to focus their thinking in a specific direction establish a framework for the kinds of verbal behavior the teacher will perform in actually teaching a lesson.
>
> Moreover, a sequence of questions, planned toward a specific objective, will enable the student to perceive and organize his learning in a purposeful way and will encourage him to pose questions of his own which increase his learning. The level of thought reached by the student is directly related to the questions asked by both teacher and student. Establishing the level or levels of thought to be reached by

> the student, then planning questioning strategies and activities for accomplishing this goal, are prerequisite steps for effective teaching and for learning as well (p. 710).

Summary

A survey of research shows that considerable work has been done, especially in the social sciences, to develop teachers' ability to ask high level questions, but that little has been done to improve the number of questions and type of questions asked by the pupil. The purposes of this investigation are to determine: (1) if preservice teachers are given instruction in questioning skills, will they ask more questions and higher level questions, and (2) as a result of their preservice teachers' training, will pupils ask more questions and higher level questions.

CHAPTER III

METHOD

Introduction

The purpose of this study was to determine whether preservice teachers trained in asking higher-level questions were more successful in eliciting higher-level questions from their pupils than were preservice teachers with no training in questioning techniques. The study included whether preservice teachers trained in questioning would elicit a greater number of higher level questions from their pupils.

The methodology used was randomly to select 24 preservice teachers from a regular class in Science Methods for Elementary Teachers of Science at Southeastern State College, Durant, Oklahoma. The 24 preservice teachers were selected by use of a table of random digits. These 24 were randomly assigned, also by use of a table of random digits, into two groups of 12 each, group I to be the control group and group II, the experimental group. The control group consisted of preservice teachers who participated in the microteaching but did not receive instruction in questioning techniques. The experimental group consisted of preservice teachers who participated in the microteaching but did receive instruction in questioning techniques.

Using the same method of random selection as that used in selecting the preservice teacher groups, six teams of five sixth-grade pupils were selected from each of four sixth-grade classes in Durant,

Oklahoma, Middle School. Each preservice teacher in the control group and experimental group was assigned (by use of a table of random digits) one of these five pupil groups for the purpose of microteaching by the preservice teachers.

Following the audiotaped microteaching sessions, each of the audio-tapes was collected, transcribed and submitted to three members of the Education Department of Southeastern State College for analysis and classification. These three persons, one of whom was the investigator, judged the questions to determine high or low level. The classifications assigned to each question by each judge were to be analyzed to determine interjudge reliability.

Procedures

The experimental and control groups met with the investigator at the beginning of the fall semester on alternate class periods for a total of six training sessions, three for each group, with 50 minutes in each session. Both groups were cautioned not to communicate with each other concerning the instruction received. During the seventh class period the Test Over Levels of Questions (Appendix A) was administered to both groups. The experimental group had a mean score of 24.3 on this test while the control group had a mean score of 11.5.

During the eighth class period both groups met with the investigator for training in microteaching techniques. The model for microteaching was the one developed by Allen (1966).

During their three training sessions, the control group received instruction in science education. Because of the nature of the investigation any discussion of levels or types of questions was

intentionally avoided. The experimental group received training in questioning techniques. The Trial Program used in the training of the experimental group of preservice teachers is found in Appendix A. A brief description of the materials used in training both groups of preservice teachers, as well as a description and rationale of the materials used in the microteaching sessions, is presented in the following section.

Description of Pedagogical Devices Used in Study

The treatment presented to the experimental group was a written instructional program designed to instruct in the use of the Gallagher and Aschner (1969) system of classifying questions.

This instrument is one in which levels of questions are separated into four categories which are determined by the levels of cognitive response they elicit. The categories are, in order of low to high, (1) cognitive-memory, (2) convergent, (3) divergent, and (4) evaluative thinking. The investigator defined category (1) to be low level and (2), (3) and (4) to be high level in this investigation. These categories concur with Schmalzreid (1972). According to the Trial Study Program, which is reproduced in its entirety in Appendix A, "Basic to this scheme is the assumption that a question asked at a given level will elicit a response that can be identified with that same level."

The preservice teachers in the experimental group were allowed to study the instrument between class meetings. It was then read aloud in class, after which they were allowed to discuss the instrument with each other and with the teacher. Following the discussions, the preservice teachers practiced writing different levels of questions which

were evaluated by other members of the group. The preservice teachers were then informed that they would be tested over the instrument and were instructed to study it further in preparation for the test which was to be administered at the following class period.

The instruction presented to the control group was taken from Session 3 "Observing" and Session 5 "Behavioral Objectives" found in the Guide for Inservice Instruction, Science: A Process Approach (1967). This approach to elementary science instruction is one that is based upon teaching science as a process rather than with emphasis on science per se. This program is aimed at developing skills which include:

> . . . discovery, invention, inquiry to develop the process of observation, classification, communication, number relations and measurement, space-time relations, prediction and inference . . . . , processes of formulating hypotheses, making operational definitions, controlling and manipulating variables, experimenting, formulating models, and interpreting data (Wolfe, p. 73).

In Session 3 the preservice teacher control group was instructed in naming and identifying the senses and in distinguishing between observations and inferences. Session 5 was concerned with instruction in identifying and writing behavioral objectives. Time in class was allowed for practice in the writing and critiqueing of behavioral objectives.

The lesson used in the microteaching laboratories was adapted from Seminar 11 of Man: A Course of Study (1970). This is a course that is multimedia, using inductive films, records, filmstrips and other materials. Learning methods in this particular program include the following: (1) inquiry, investigation, problem-defining, hypothesizing-informed guessing, observation, interviewing, literature searching,

and summarizing and reporting; (2) sharing and evaluating of interpretations; (3) accumulating and retaining information; (4) exchange of opinion and defense of opinion; and (5) exposure to diverse aesthetic styles.

Seminar 11 was used because it is one of a series of lessons that attempts to develop analytic thinking as a step-by-step, carefully reasoned process. This unit, however, does not assume nor necessitate any prior lessons in the series. It introduces through a 16mm film, "At the Caribou Crossing Place, Part II," what Man: A Course of Study considers to be the favored and most successful caribou hunting techniques of the Netsilik Eskimo, the hunting of caribou with kayaks and spears. Several of the Eskimo men are shown chasing the herd into water where others wait with kayaks to spear the animals. The method used in killing, the religious ritual, and the preparation of the animal for preservation are of great interest to most pupils (Man: A Course of Study, 1970).

Collection and Statistical Treatment of Data

In the culminating activity both control and experimental groups were shown the film, "At the Caribou Crossing Place, Part II" after which all pupils met with the preservice teachers to whom they were assigned for a 20-minute period of discussion concerning the film. Both control and experimental teacher groups were aware that the questioning techniques were to be analyzed and classified. A total of 24 audiotapes each 20 minutes long resulted from the microteaching experiences. The experimental and control groups each generated 12 tapes.

Transcriptions of the audiotapes were given to three judges who counted the questions asked by both teachers and pupils and classified them as to level.

The three judges who were to classify pupil and teacher questions were given a copy of "Levels of Questioning, Trial Program" (Appendix A) to read and study. Each judge categorized all the questions on all tape transcriptions (approximately 1,000 questions) according to the criteria in the Trial Program. An interjudge reliability check of 0.90 was achieved utilizing the intraclass correlation formula developed by Robert L. Ebel (1951).

The t-test was used to determine whether significant differences existed in the number and level of questions asked by control and experimental groups of preservice and experimental pupil groups. That subject asking the fewest number of questions and that subject asking the greatest number of questions were eliminated and the t-test was used to determine whether the remaining subjects in the control and experimental groups differed significantly. This procedure was used for each hypothesis stated to reduce the effects of extreme values.

CHAPTER IV

ANALYSIS AND TREATMENT OF DATA

The data gathered in this investigation were used primarily for the purpose of testing the following null hypotheses.

1a. There is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

1b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

2a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

2b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

3a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

3b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

4a. There is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

4b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

5a. There is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

5b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

Subjects

Twenty-four preservice teachers were randomly selected from a methods class for elementary science teachers. Most of these preservice teachers were from rural areas and small urban towns of southeastern Oklahoma.

Twenty-four groups of six pupils each were randomly selected and randomly assigned to the preservice teachers for microteaching. The

population of 191 sixth-grade pupils from which the 120 pupil subjects were selected varied only 0.1 in their grade level when compared with the national average on the Stanford Achievement Test, Form X + J. The level of these students at the time of the investigation was 6.1 whereas the national average was 6.2. The median I. Q. for the pupils was 100.4 as indicated by the Otis Lennon Mental Ability Test. This information on pupil subjects indicates that this population is composed of sixth-grade pupils who do not drastically differ from national norms in achievement and I. Q.

Instrument Analysis

The microteaching sessions were audiotaped and a stenographer transcribed the questions that the preservice teachers asked, the pupil responses to the questions, and the questions asked by the pupils. All questions asked were classified by three judges using the criteria found in Appendix A. The teacher questions were further analyzed to determine whether the level of the question changed as a result of the nature of the response by the pupil. The purpose was to determine whether pupil responses change the level of the question from high to low or from low to high. A high level teacher question with a low level response was judged to be low level. A low level teacher question with a high level response was judged to be high level. It was not deemed necessary to calculate an interjudge reliability as the cognitive memory pupil responses were readily identifiable.

The interjudge reliability was 0.9 utilizing the intra class correlation formula developed by Ebel (1951). The number of questions ranged as follows:

Total teacher questions	1 to 76
High level teacher questions	1 to 18
High level teacher questions (reevaluated with respect to pupil response)	1 to 52
Total pupil questions	2 to 37
High level pupil questions	1 to 12

Raw data are found in Appendix B.

The number of teacher questions, high level teacher questions, high level teacher questions reevaluated with respect to response, pupil questions and high level pupil questions were analyzed using the t test.

The structure of the remainder of this chapter will follow the sequence of the hypotheses stated on pages 33-34. The results which answer each of the hypotheses will, in turn, be presented following the statement of the hypothesis itself.

Hypothesis 1a. There is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

TABLE I

SUMMARY OF THE NUMBER OF QUESTIONS ASKED BY THE TEACHER GROUPS

	Control	Experimental
Sum	253	390
N	12	12
Mean	21.1	32.5
Standard Deviation	11.6	14.7

Calculated t = 2.11

Table I indicates a t value of 2.11. Rejection of the null hypothesis at the .05 level of confidence with 22 degrees of freedom requires a t value of 2.074. The null hypothesis was rejected. Teacher subjects assigned to experimental and control groups did differ significantly in the number of questions asked while microteaching. The teacher experimental group asked a significantly greater number of questions.

Hypothesis 1b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

TABLE II

SUMMARY OF THE NUMBER OF QUESTIONS ASKED BY THE TEACHER GROUPS WITH HIGH AND LOW VALUES REMOVED

	Control	Experimental
Sum	207	296
N	10	10
Mean	20.7	29.6
Standard Deviation	7.51	4.38

Calculated t = 3.14

Table II indicates a t value of 3.14 which is significant at the .01 level. Rejection of the null hypothesis at the .05 level of confidence with 18 degrees of freedom requires a t value of 2.101. The null hypothesis was rejected. With the high and low values removed the experimental group asked a greater proportion of questions than the control group. The effect of removing these values resulted in an increase in the level of significant differences between the control and experimental groups.

Hypothesis 2a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

TABLE III

SUMMARY OF HIGH LEVEL QUESTIONS
ASKED BY THE TEACHER GROUPS

	Control	Experimental
Sum	64	160
N	12	12
Mean	5.33	13.3
Standard Deviation	3.13	4.73

Calculated t = 4.89

Table III indicates a t value of 4.89 which is significant at the .001 level. Rejection of the null hypothesis at the .05 level of confidence with 22 degrees of freedom requires a t value of 2.074. The null hypothesis was rejected. Teacher subjects assigned to experimental and control groups did differ significantly in the number of high level questions asked while microteaching. The teacher experimental group asked a significantly greater number of high level questions.

Hypothesis 2b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group during microteaching experiences.

TABLE IV

SUMMARY OF HIGH LEVEL QUESTIONS ASKED BY THE TEACHER GROUPS WITH HIGH AND LOW VALUES REMOVED

	Control	Experimental
Sum	50.3	134
N	10	10
Mean	5.03	13.4
Standard Deviation	1.94	3.6

Calculated t = 6.49

Table IV indicates a t value of 6.49 which is significant at the .001 level. Rejection of the null hypothesis at the .05 level of confidence with 18 degrees of freedom requires a t value of 2.101. The null hypothesis was rejected. With the high and low values removed the experimental group asked a greater proportion of questions than the control group. The effect of removing these values resulted in an increase in the level of significant difference between the control and experimental groups.

Hypothesis 3a. There is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

TABLE V

SUMMARY OF HIGH LEVEL QUESTIONS ASKED BY THE TEACHER GROUPS WITH LEVELS ALTERED BECAUSE OF PUPIL RESPONSE

	Control	Experimental
Sum	131	272
N	12	12
Mean	10.9	22.7
Standard Deviation	5.17	10.5

Calculated t = 3.47

Table V indicates a t value of 3.47 which is significant at the .01 level. Rejection of the null hypothesis at the .05 level of confidence with 22 degrees of freedom requires a t value of 2.074. The null hypothesis was rejected. Teacher subjects assigned to experimental and control groups did differ significantly in the number of high level questions asked while microteaching when the questions were judged with respect to pupil response. The teacher experimental group asked a significantly greater number of high level questions.

Hypothesis 3b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the teacher experimental group and the teacher control group when the level is altered because of the pupil response.

TABLE VI

SUMMARY OF HIGH LEVEL QUESTIONS ASKED BY THE TEACHER GROUPS WITH LEVELS ALTERED BECAUSE OF PUPIL RESPONSE WITH HIGH AND LOW VALUES REMOVED

	Control	Experimental
Sum	112	209
N	10	10
Mean	11.2	20.9
Standard Deviation	3.96	4.72

Calculated t = 5.01

Table VI indicates a t value of 5.01 which is significant at the .001 level. Rejection of the null hypothesis at the .05 level of confidence with 18 degrees of freedom requires a t value of 2.101. The null hypothesis was rejected. Teacher subjects assigned to experimental and control groups did differ significantly in the number of high level questions asked while microteaching when the questions were judged with respect to pupil response with the high and low values removed. With the high and low values removed the experimental group asked a greater proportion of questions than the control group. The effect of removing these values resulted in an increase in the level of significant difference between the control and experimental groups.

Hypothesis 4a. There is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

TABLE VII

SUMMARY OF THE NUMBER OF QUESTIONS ASKED BY THE PUPIL GROUPS

	Control	Experimental
Sum	184	168
N	12	12
Mean	15.3	14.0
Standard Deviation	9.36	11.8

Calculated t = -.306

Table VII indicates a t value of -.306. Rejection of the null hypothesis at the .05 level of confidence with 22 degrees of freedom requires a t value of 2.074. Pupil subjects assigned to the experimental and control groups did not differ significantly in the number of questions asked during microteaching.

Hypothesis 4b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

TABLE VIII

SUMMARY OF THE NUMBER OF QUESTIONS ASKED BY THE PUPIL GROUPS WITH HIGH AND LOW VALUES REMOVED

	Control	Experimental
Sum	149	130
N	10	10
Mean	14.9	13.0
Standard Deviation	7.24	9.64

Calculated t = -.498

Table VIII indicates a t value of -.498. Rejection of the null hypothesis at the .05 level of confidence with 18 degrees of freedom requires a t value of 2.101. By removal of high and low values pupil subjects assigned to experimental and control groups did not differ significantly in the number of questions asked during their microteaching experience.

Hypothesis 5a. There is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

TABLE IX

SUMMARY OF HIGH LEVEL QUESTIONS ASKED BY THE PUPIL GROUPS

	Control	Experimental
Sum	76.3	51.1
N	12	12
Mean	6.36	4.26
Standard Deviation	3.44	3.29

Calculated t = -1.529

Table IX indicates a t value of -1.529. Rejection of the null hypothesis at the .05 level of confidence with 22 degrees of freedom requires a t value of 2.074. Pupil subjects assigned to the experimental and control groups did not differ significantly in the number of high level questions asked during their microteaching experience.

Hypothesis 5b. If the highest and lowest value is omitted from each group there is no significant difference between the mean number of high level questions asked by the pupil experimental group and the pupil control group during microteaching experiences.

TABLE X

SUMMARY OF HIGH LEVEL QUESTIONS ASKED BY THE PUPIL GROUPS WITH HIGH AND LOW VALUES REMOVED

	Control	Experimental
Sum	61.3	38.8
N	10	10
Mean	6.13	3.88
Standard Deviation	2.71	2.60

Calculated t = -1.894

Table X indicates a t value of -1.894. Rejection of the null hypothesis at the .05 level of confidence with 18 degrees of freedom requires a t value of 2.101. With the high and low values removed from each group pupil subjects assigned to experimental and control groups did not differ significantly in the number of high level questions asked during their microteaching experiences.

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Conclusions and Implications

Analysis of the data showed a significant difference favoring the preservice teacher experimental group in the total number of questions asked during the microteaching experiences. The training of preservice teachers in questioning techniques increases their ability to ask more questions than those preservice teachers who have not had such training.

The omission of the subject asking the fewest number of questions and the subject asking the greatest number of questions resulted in an increase in significance from the 0.05 level to the 0.001 level. This would seem to indicate that when the extreme values are omitted the remaining subjects indicated a more positive response to their training in questioning techniques. The removal of the two extreme values further showed that teachers whose numbers of questions were closer to the mean benefitted more from the training program.

Analysis of the data also showed a significant difference favoring the preservice teacher experimental group in the number of high level questions asked during the microteaching experiences. The training of preservice teachers in questioning techniques increases their ability to ask higher level questions than those preservice teachers ask who have not had such training.

The omission of the teacher subject asking the fewest number of questions and the subject asking the greatest number of questions resulted in an increase in the t value of 4.89, which is significant at the 0.001 level to 6.49, with a significance at a level greater than 0.001. This increase would seem to indicate that when the extreme values are omitted the remaining subjects indicated a more positive response to their training in questioning techniques. The removal of the two extreme values further showed that teachers whose numbers of high level questions were closer to the mean benefitted more from the training program.

Question classification generally depends upon the inferred response of pupils to the question. In this study the actual response of pupils to the questions was used to reclassify the question. Under these conditions there was an increase from 224 to 403 high level teacher questions when the pupil responses to the teacher questions were used as a criterion for judging the level of the teacher's questions. For the control group this represents an increase of 204 percent with an increase from 64 to 131 and for the experimental group an increase of 170 percent with the number of high level questions increased from 160 to 272.

There were no low level pupil responses to high level teacher questions. When pupil responses were used as criteria for question classification there were no high level questions reclassified as low level.

The increase toward higher levels for modified classification indicates a trend for pupils to respond at higher levels than the level of question asked by teachers. Therefore, the possibility exists that

pupils are better at answering questions than preservice teachers are at asking them.

The omission of the teacher subject asking the fewest number of high level questions and the subject asking the greatest number of high level questions, using the modified classification in both cases, resulted in an increase in t values from 3.47 to 5.01. This raised the level of significance from 0.01 to 0.001. The removal of the two extreme values shows that preservice teachers whose numbers of high level questions were closer to the mean number asked, benefitted more from the training program than did preservice teachers who did not receive such training.

The pupil subjects assigned to the teacher control group asked approximately 0.77 questions per minute while the pupil subjects assigned to the teacher experimental group asked approximately 0.70 questions per minute. Although the difference is not significant at the 0.05 level, the data indicates that the pupil experimental group asked fewer questions than the pupil control group. This might indicate that since the larger number and higher level of questions asked by the teacher experimental group may have tended to reduce the number of pupil responses. It seems reasonable to expect that the experimental teachers' greater number of higher level questions required longer pupil responses and therefore fewer responses.

The omission of the pupil subject asking the fewest number of questions and the pupil subject asking the greatest number of questions resulted in a change in the t-values from -0.498 to -1.529, neither of which is significant at the 0.05 level.

The pupil subjects assigned to the teacher control group asked approximately 0.32 high level questions per minute. The pupil subjects assigned to the teacher experimental group asked approximately 0.21 high level questions per minute. A significant difference at the 0.05 level is not indicated, but there does seem to be an adverse effect on the pupils' ability or opportunity to ask high level questions. This also might indicate that since the teacher experimental group asked so many questions the pupils were not given sufficient opportunity to ask questions.

The omission of the pupil subject asking the fewest number of high level questions and the pupil subject asking the greatest number of high level questions resulted in a change in the t-values from -1.529 to -1.894. Neither of these values is significant at the 0.05 level.

Recommendations

Since this study was conducted with only a small number of preservice elementary teachers, perhaps further study with a larger number of inservice teachers as well as preservice teachers would be advisable.

The treatment in this study proved to be an effective method in training teachers in asking a greater number of questions and greater numbers of higher levels of questions. Therefore, it would be desirable to replicate research of this type with different populations to determine if a higher level of inquiry through questioning could be inaugurated in the early elementary grades.

Another follow-up study would be to determine if improved testing scores would result for the pupils because of improved questioning techniques on the part of the teacher. Furthermore, it should be

determined if there would be any instances of pupils showing increased interest and coming to the teacher with more probing questions after class.

Although this study does not show any significant improvement in pupil questioning, the results might have been completely different if the preservice teachers had been teaching the pupils in a regular classroom situation. Perhaps the microteaching situations provided an environment which modified the pupils' response patterns to the questions asked. Because of these possibilities it is recommended that this study be replicated using regular classroom teachers in a regular classroom situation.

Since the study was conducted with sixth grade children, it could be that the lack of significant differences between experimental and control groups was a reflection of their earlier years of schooling. If this is true, then a need exists for teachers to implement improved questioning strategies in the first and succeeding years of the pupils' school career if we want them to ask questions that are more than requests for recall of factual information.

It is further recommended that a study be conducted to determine if there is a significant difference between the number of high level teacher questions classified using the question as a criterion and the number of high level teacher questions classified using pupil response as a criterion.

It has been suggested that the tendency for pupils to respond at a higher level than that of the questions asked may be the result of the response patterns learned during previous years of schooling. To test this assumption it is recommended that research be directed toward

determining if a shift toward pupils giving higher level responses than that of the question asked decreases as grade level decreases.

The method described in this study of preparing student teachers to ask high level questions and a greater number of questions proved effective. Considering the refinements suggested above it is believed by the investigator that the method of instruction used in this program is effective in preparation of teachers. However, it is necessary to further explore whether this change in teacher behavior makes any difference in the learning environment of young people. Further research studies to ascertain the reasons for the results of this study are suggested.

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APPENDIX A APPENDIX A APPENDIX A

PROGRAM USED TO OBTAIN EXPERIMENTAL GROUP

LEVELS OF QUESTIONING

Trial Program

In recent years educational researchers have focused attention on the environment of the classroom in order to acquire a more naturalistic view of teaching. The reason for this change in focus has been the growing realization that an important step towards the improvement of instruction is the study of teacher behavior. The objective of these studies has been the improvement of the methods and techniques of science instruction. These studies usually entail observation, description, and analysis of the verbal teacher-student interaction. The investigators are continually seeking to find which of the teacher's verbal behaviors most affects the learning of the pupil. Educators have shown increased interest in the relationship between teacher questioning and the amount of thinking that certain levels of questions may or may not promote. Many have advocated that the teacher can guide the thought processes of his students by carefully choosing the questions asked in classroom discussions.

Recently many science educators have advocated the processes of inquiry as effective entities through which the student may learn science. During this same time the emphasis of teaching science as a body of unyielding facts seems to have been replaced by an emphasis on teaching science as an active, ever broadening search, involving the student as an active participant in the processes of inquiry.

The relationship between questioning and inquiry has been found to be a very direct one. Many researchers have also reported a congruence between the level of teacher questions and students' responses. With these findings as a foundation, efforts have been made to find ways and means to develop the teacher's capacity to ask higher level, inquiry provoking questions and to maintaining this capacity once developed. In spite of these efforts the level of questions asked by teachers has not increased.

A possible explanation for this continual inability to ask higher level questions is that elementary teachers are not aware of the level of thought which their questions can and do elicit in their students.

The nature of this paper is to inform the prospective elementary teacher of the different levels of questioning and to provide practical experience in the identification and writing of questions at the various levels of thought advocated by Gallagher and Aschner (1956). Stated in performance terms the objective of this paper is: Given the four basic categories of the Gallagher and Aschner question classification scheme the reader will be able to identify which level of cognitive thought is required by a question. Minimal acceptable performance will include proper classification of questions into all four of the categories.

Gallagher and Aschner's Classification Scheme

Many attempts have been made to formulate an instrument capable of accurately classifying the thought level required of the child by a teacher's question. One of these systems is that proposed by Gallagher and Aschner. These authors developed a four-category system designed

to suggest the various kinds of questions that elicit responses from the different "cognitive" thought levels. The categories identified are (1) cognitive-memory, (2) convergence, (3) divergence, and (4) evaluative thinking. These categories are arranged in a loosely connected hierarchy which permits the objective and accurate description of the level of thought that is required of the child to respond to the question. Basic to this scheme is the assumption that a question asked at a given level will elicit a response that can be identified with that same level. In other words, a cognitive-memory question (the lowest level) will cause a cognitive-memory response on the part of the child. The categories described by Gallagher and Aschner will be discussed in the following pages.

1. Cognitive-Memory Questions. The first category of the Gallagher and Aschner questions classification scheme is that of cognitive-memory. Questions placed in this category require only the lowest level of thought on the part of the student. Cognitive-memory questions demand recall, memory, recognition, description of previous obtained factual knowledge, or observation. These questions call for predictable responses and often demand one word answers of the respondee. Some cognitive-memory questions are listed below:

* "Did the color of the water change?"
* "What scientific principle is involved here?"
* "What is gravity?"
* "Is there a difference between the two balls?"
* "When I put the water on the paper what happened?"
* "Is this a thermometer?"
* "How many of you say the bubbles come from the boat?"
* "What kind of animal is this?"

Notice once again that all of the questions require a low level of thinking on the part of the student and that responses from all

students would possess a great deal of similarity. In order to help you establish these criteria for cognitive-memory questions firmly in mind, look at the questions listed below and classify each as to whether it is a cognitive-memory question or not. After classifying EACH question read the lettered paragraph indicated at the right of each question.

* "What did you observe in this demonstration?" . . . (refer to paragraph a.)
* "Bob, why does a duck have webbed feet?" . . . (refer to paragraph b.)
* "What do they call the mineral from which iron is made?" . . . (refer to paragraph c.)

a. If you classified this question as a cognitive-memory question you are correct. In this particular question the student is asked only to STATE what he has seen. If he were asked to explain or interpret what happened then it could no longer be correctly classified as cognitive-memory.

b. This question is not a cognitive-memory question. The key word that distinguishes it from a cognitive-memory question is "WHY". This word requires the respondee to carry on a higher level of thought than mere recall, recognition, or reporting. Instead the child is to explain the occurrence of something. To change this to a cognitive memory question one could ask "Bob, does a duck have webbed feet?"

c. If you categorized this question as cognitive-memory using the criteria that it calls for factual information or terminology you are correct. The child is only required to recall and NOT to explain, reason, or evaluate. All of the latter operations require higher levels of thought than does any of the cognitive-memory criteria. Please proceed to the next section entitled "Convergent Questions".

2. Convergent Questions. The second question category of the Gallagher and Aschner system is called convergent. This category includes more broad types of questions that demand putting facts together in order to obtain "ONE RIGHT ANSWER". The child is required to know certain facts and using his own words, to explain concepts and describe their interrelationships, solve problems, or make comparisons.

The respondee must carry on higher levels of thinking in order to state or explain the relationships present. Examples of this kind of question include the following.

* "Why do the plants grow towards the light?"
* "What does the frog do?"
* "How do you explain the word force in your own words?"
* "Explain briefly in your own words what is meant by the word hypotheses?"
* "How is this picture like that one?"
* "How does a magnet affect the iron fillings?"

The convergent question ranks higher in the level of thought required of the child. The questions, even though calling for one answer, still require an explanation or statement of the relationship of previously learned facts or concepts. Below you will find a list of questions. Classify EACH question as cognitive-memory, convergent, or neither. Following the classification of EACH question read the lettered paragraph indicated at the right of each question before going on to the next.

* "What ways might you stop a forest fire?" . . .
  (refer to paragraph a.)
* "Why does the sun appear to move in the sky?" . . .
  (refer to paragraph b.)
* "What are the animals doing in this picture that they are not doing in the other picture?" . . .
  (refer to paragraph c.)
* "What is the name of the force that causes the iron fillings to stick to the magnet?" . . .
  (refer to paragraph d.)

a. If you classified this question as cognitive-memory or convergent you are mistaken. The question does not ask the child to recall specific facts or to provide one correct answer as the result of relating different facts or concepts. Instead it asks the respondee for diverse answers. If you asked "what way" then it would meet the criteria for categorization as convergent.

b. This question should be placed in the convergent category. Instead of asking the child to recall a fact it calls on him to put together some concepts concerning the relationship of the sun and earth as well as the earth's rotation. Of course

in classifying it as convergent we must assume that he has not previously learned the solution to this question.

c. If you categorized this question as convergent you are correct. This question calls for a comparison of two pictures and thus meets one of the criteria of the convergent category.

d. This question is properly classified as a cognitive-memory. It asks the child to identify, by name, the force involved. The child is not required to carry on any higher level of thought other than factual recall. He has not been asked to explain, state, or compare in any fashion; therefore this question does not meet the criteria of the convergent category. Proceed to section 3.

3. Divergent Questions. The divergent category contains those questions which not only provide the student with a new situation, but also allows for more than one possible right answer. These are questions that permit originality by the child as evidenced in the hypotheses he makes and in the way he uses his knowledge to solve new problems. Divergent questions are those that permit predicting, hypothesizing, and/or inferring. Examples of these kinds of questions include the following:

* "What predictions can you make about what is going to happen to the marbles?"
* What do you think would happen if the balls were of a different mass?"
* "If the fish did not have all these body parts, what sort of things might occur when he wanted to move about the fish bowl?"
* "Suppose you were trying to convince someone that air is real, how would you do it?"
* "Suppose you wanted to make a model of the fastest swimming fish in the world, what parts, if any, would appear differently on this fish?" "How would you describe him to me?"

As you can see the above questions encourage divergent or broad responses that are creative and imaginative. Divergent questions require the child to carry on a higher level of thought in what they call for an organization of elements into new patterns that were not

previously recognized clearly. Below you will find a list of questions. Classify EACH question as cognitive-memory, convergent, divergent, or neither. As you categorize each question read the lettered paragraph indicated at the right of each question BEFORE going on to the next.

* "Explain why the red ball did not float." . . .
  (refer to paragraph a.)
* "What are the ways that a fish might live if the water where he is presently living changes?" . . .
  (refer to paragraph b.)
* "What kind of animal is this?" . . .
  (refer to paragraph c.)
* "Which is the best illustration of a predator?" . . .
  (refer to paragraph d.)
* "What would make this plant grow better?" . . .
  (refer to paragraph e.)
* "What are some ways we might group these buttons?" . . .
  (refer to paragraph f.)

a. This question is best categorized as a convergent type. The child is asked to offer ONE correct explanation for the event he observed. Eliminated was the possibility of more than one answer and also the mere reporting of his observations of the ball sinking. These criteria would have categorized the question as divergent and cognitive-memory respectively.

b. If you categorized this question as divergent you are correct. Notice that this question asks for WAYS that a fish MIGHT survive. These and other words such as "may," "could," "what if" are common in this category. These words allow a wide number and kind of responses using new combinations of elements.

c. Classification of this question as either convergent or divergent is an oversight. The question asks the student to NAME something. In other words carry on the lowest level of thought (recall). The child is not required to explain, hypothesize or any of the other criteria that are indicative of the convergent or divergent categories. This question is best classified in the cognitive-memory category.

d. This question is best classified as NOT belonging to any of the three categories here-to-fore discussed. It asks the student to make a judgment of the worth of something. Judgment has not been promoted as a criterion for any category thus far presented.

e. You are correct if you placed this question in the divergent category. This question is likely to produce many different responses from the children. It does not require factual

recall or one right answer, therefore allows the child to function at a higher level of thought than the cognitive-memory or convergent type would.

f. This question is of the divergent type. One would use the same criteria in assessing this question as those discussed in paragraph e. Proceed to section 4 of this paper.

4. Evaluative Questions. The fourth and final category is called evaluative. The evaluative question requires the child to judge, value, choose, or defend. They may be narrow or broad. They cause the respondee to organize his knowledge, formulate an opinion and thereby take a self-directed position. In order to make a judgment the respondent has to use evidence. To use evidence he must use criteria. He makes judgment of good or bad, right or wrong according to standards that either he designates or to standards someone else has established. (This is the highest level of questioning and involves all three of the other levels.) The following are some examples of these kinds of questions:

* "What makes this picture better than that one?"
* "Why are the conclusions that John made about the experiment accurate?" "Why?"
* "Why do you say that this is the best order for arranging these objects?"

Below you will find a list of question fragments. Classify EACH fragment as belonging to one of the four categories previously discussed. After you classify ALL of the question fragments refer to paragraph a. below for a check of your categorization.

* "How do you feel about . . . ?"
* "How many kinds of animals are . . . ?"
* "What do you think about . . . . ?"
* "In your opinion which is the best . . . . ?"

a. All of the above question fragments may be classified as evaluative. All of the other four require the student to integrate his ideas to form an opinion.

Test Over Levels of Questioning

On the pages that follow, you will find a brief test by which you can check to see how proficient you have become in classifying questions into the four categories of the Gallagher and Aschner classification scheme. Answer all of the questions in the space provided.

Classify each of the questions listed below into the appropriate category of the Gallagher and Aschner scheme using the following symbols for each category:

CM . . . cognitive-memory
C . . . convergent
D . . . divergent
E . . . evaluative

1. How does the water act when we put it on newspaper? _____
2. Did the frog jump up and down? _____
3. Did the ball sink fast or slowly? _____
4. When the rock was thrown into the water did the ripples spread very far out into the pond? _____
5. What makes the water decide how big a wet spot it makes on the newspaper? _____
6. Does the shape of the stain on the newspaper change with different sized drops? _____
7. When we put two little drops very close together, what can we see happen? _____
8. Does the same thing happen with two big drops or one big drop and a little drop? _____
9. Do the drops on the newspaper move at all? _____
10. Do the drops on the waxpaper move at all? _____
11. How can we make them move? _____
12. Maybe we have to push them or would they move if we blew on them? _____

13. Where do you think the water will go and what causes it to do this? _____

14. What else can we do to cause the water to come out of the bottle? _____

15. What predictions can you make about what will happen? _____

16. What are some of your ideas about how we can get this water out of the bottle? _____

17. What do you notice about the movement of the air? _____

18. Why do you think that the air moves in the manner that it does? _____

19. What might be some other substances that we could put in the bottle in place of the water so that the air would not go to the top of the bottle? _____

20. In what way might the air bubbles be affected by the different substances? _____

21. Describe what you saw happen when the can was heated. _____

22. What is the explanation of the cause of the can being crumpled? _____

23. In your judgment what would happen if I cooled the glass rapidly? _____

24. What are some ways that scientists solve problems? _____

25. What are the causes for growth to occur in a plant? _____

26. What do you think is the best way to group these pictures? _____

27. How many of you have ever been cool after climing out of a swimming pool? _____

28. Who is credited with the discovery of the cell? _____

29. Of all of the contributions that Louis Pasteur made to science, which do you think serves man best today? _____

30. What are some of the questions you can ask about this demonstration? _____

31. What are some things that you can do with this brick? _____

32. What do you think is the most important part in this machine? _____

33. What is your favorite ice cream? _____

Key for Levels of Questioning

1.	C--M	description
2.	C--M	recall
3.	C--M	recall
4.	C--M	recall
5.	C	requires know facts stated in own words
6.	C--M	recall-observation
7.	C--M	observation
8.	C--M	recall-observation
9.	C--M	observation
10.	C--M	observation
11.	D	no one correct answer
12.	E	requires a judgment
13.	D	allows for originality, permits predicting and hypothesizing
14.	D	hypothesizing
15.	D	definitely predicting
16.	D	allows for creativity
17.	C	observation described in own words
18.	E	requires respondee to organize knowledge and make a judgment
19.	D	permits originality--no single right answer
20.	D	allows predicting and/or inferring
21.	C	requires respondee to phrase observation in own words
22.	D/C	hypothesize, explain a concept
23.	E	self-directed position
24.	D	more than one correct answer
25.	C--M	own expression of a concept
26.	E	personal judgment
27.	C--M	
28.	C--M	one-word response
29.	E	personal value judgment
30.	D	originality
31.	D	
32.	E	judgment
33.	E	personal judgment

APPENDIX B

RAW DATA

TEACHER QUESTIONS--EXPERIMENTAL GROUP

Teacher	Total	Number by Level											
		Judge 1				Judge 2				Judge 3			
				(With respect to response)				(With respect to response)				(With respect to response)	
		High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
A	36	14	22	23	13	17	19	21	15	16	18	22	24
B	28	14	14	19	9	14	14	19	9	14	14	19	9
C	24	5	19	11	13	4	20	10	14	5	19	11	13
D	29	9	20	13	16	8	21	14	15	8	21	14	15
E	29	15	14	20	9	15	14	19	10	15	14	19	10
F	26	13	13	19	7	13	13	19	7	12	14	19	7
G	18	9	9	16	2	10	8	16	2	10	8	16	2
H	35	16	19	26	9	15	20	28	7	17	18	27	8
I	26	8	18	22	4	8	18	22	4	9	17	22	4
J	26	18	8	23	3	18	8	23	3	17	9	26	3
K	76	21	55	51	25	21	55	53	23	21	55	52	24
L	37	17	20	28	8	16	21	29	12	18	19	26	11

TEACHER QUESTIONS--CONTROL GROUP

Teacher	Total	Number by Level											
		Judge 1				Judge 2				Judge 3			
				(With respect to response)				(With respect to response)				(With respect to response)	
		High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
M	14	6	8	7	7	7	7	6	8	6	8	7	7
N	45	13	32	14	31	12	33	11	34	12	33	13	32
O	13	5	10	11	2	2	17	11	2	4	9	11	2
P	14	2	12	7	7	1	18	8	6	1	18	7	7
Q	30	5	25	19	11	5	25	18	12	5	25	18	12
R	11	3	8	5	6	3	8	4	7	3	8	5	6
S	23	6	17	11	12	7	15	10	13	6	17	10	13
T	31	5	26	14	17	7	24	14	17	5	26	14	17
U	1	1	0	1	0	1	0	1	0	1	0	1	0
V	28	8	19	15	13	8	20	15	13	7	21	15	13
W	19	4	15	15	4	5	14	14	5	5	14	15	5
X	24	6	18	17	7	6	18	16	8	7	17	15	9

PUPIL QUESTIONS--EXPERIMENTAL GROUP

Pupils Assigned to Teacher	Total	Number by Level					
		Judge 1		Judge 2		Judge 3	
		High	Low	High	Low	High	Low
A	6	2	4	2	4	2	4
B	1	1	0	1	0	1	0
C	35	11	24	11	24	12	23
D	22	3	19	3	19	3	19
E	17	5	12	5	12	5	12
F	37	10	27	10	27	9	28
G	13	5	8	5	8	4	9
H	7	3	4	3	4	3	4
I	11	6	5	6	5	5	6
J	10	3	7	3	7	3	7
K	5	1	4	1	4	3	7
L	4	2	2	2	2	2	2

PUPIL QUESTIONS--CONTROL GROUP

Pupils Assigned to Teacher	Total	Number by Level					
		Judge 1		Judge 2		Judge 3	
		High	Low	High	Low	High	Low
M	22	8	14	8	14	8	14
N	7	4	3	4	3	4	3
O	10	6	4	6	4	7	3
P	22	7	15	7	15	7	15
Q	33	8	25	7	26	8	25
R	7	2	5	2	5	2	5
S	2	2	0	2	0	2	0
T	18	11	7	11	7	10	8
U	27	13	14	13	14	13	14
V	13	6	7	6	7	6	7
W	7	2	5	2	5	2	5
X	16	8	8	7	9	8	8

VITA 2

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Candidate for the Degree of

Doctor of Education

Thesis: THE EFFECTS OF INSTRUCTING PRESERVICE TEACHERS IN QUESTIONING SKILLS UPON LEVELS OF QUESTIONS ASKED BY ELEMENTARY PUPILS

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