AN ANALYSIS OF TEACHER QUESTIONING PATTERNS

A Thesis

Submitted to

the Department of Biology and Graduate Council

Kansas State Teachers College, Emporia, Kansas

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Gwendolyn Grindstaff

August, 1971

Approved for Major Department

Approved for Graduate Council

ACKNOWLEDGEMENTS

I wish to express my gratitude to Dr. B. R. Menhusen, my major advisor, for her kindness and patience in assisting me in the following study. Likewise, I wish to thank the remainder of my supervising committee: Dr. E. B. Kurtz and Dr. Scott Irwin.

ABSTRACT

An Analysis of Teacher Questioning Patterns
Gwendolyn Grindstaff
Thesis in Partial Fulfillment
for the Degree of Master of Science
Department of Biology, Kansas State Teachers College

Since this study was of an analytic nature, the investigation desired primarily to examine and describe teacher questioning patterns as a function of grade level. A secondary aspect of the study was to evaluate student response patterns as related to grade level.

During the fall of 1970 a workshop was conducted in Shawnee Mission, Kansas, for elementary school teachers utilizing Science-A Process Approach. Videotapes were made of the 44 teaching participants; 20 videotaped lessons were selected, at random, for assesment. Ten experimental variables were assayed by means of Instrument for the Analysis of Science Teaching and Classification of Teacher Questions.

Data indicated that of the total lesson time a mean frequency of 28.6% was expended in teacher questioning in kindergarten, 17.3% in first grade, 17.3% in second grade, and 15.3% in third grade. Convergent (closed) questions of the cognitive-memory type were of the highest frequency; divergent (open) questions were of the lowest frequency. Patterns of student response paralleled teacher questioning. Wait-time was short.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Questions have always been a major stock in trade for teachers. At all levels, students are plied with different kinds of inquiries. Throughout his academic career, questions, both oral and written, exert a major influence upon the student. Aschner (1961) calls the teacher "a professional question maker" and claims that the asking of questions is "one of the basic ways by which the teacher stimulates student thinking and learning."

Certainly teachers ask numerous questions during an average school day. Over a half-century ago, Stevens (1912) estimated that four-fifths of school time was occupied with question-and-answer recitations; Stevens found that a sample of high-school teachers asked a mean number of 395 questions per day. High frequencies of question use by teachers were also found in recent investigations: 10 primary-grade teachers asked a mean of 348 questions during a school day (Floyd, 1960); 12 elementary-school teachers asked an average of 180 questions in a science-lesson (Moyer, 1966); and 14 fifth-grade teachers asked an average of 64 questions in a 30-minute social studies lesson (Schreiber, 1967). Furthermore, students are exposed to additional questions via

textbooks and examinations.

Without doubt questions are useful tools. They are relatively easy to construct and they can be used with almost any type of educational materials --- they are flexible. Although experimental research on questions is not a virgin area we still don't know a great deal about how they work. What educational objectives can questions help students to achieve? What are the criteria for an effective question? How can effective questions be identified? How can teacher's question-framing skills be improved? Until researchers find answers to questions such as these, hopes for a viable behavioral technology of teaching will remain unrealized.

The forthcoming study will focus upon teacher-questioning patterns and student-response patterns as they operate at various grade levels in the elementary classroom. This study was designed to serve in the description of teacher-student interaction. It is hoped that such an inquiry will assist educators in obtaining and establishing the kind of knowledge they seek as a means to lasting improvements in the theory and practice of the teaching of science.

REVIEW OF THE LITERATURE

Although textbook and examination questions undoubtedly contribute to the learning process, this review will be limited to studies of spoken questions which occur during regular classroom instruction. The ensuing citations are representative of the related literature.

The Classification of Questions by Type

Many researchers have attempted to describe the types of questions asked by teachers. To qualify their descriptions, some have found it beneficial to develop sets of categories into which teachers' questions can be classified. At least twelve classification systems have been proposed in recent years (Adams, 1964; Aschner, 1961; Bloom, 1956; Carner, 1963; Clements, 1964; Gallagher, 1965; Guszak, 1967; Kleinman, 1965; Moyer, 1965; Pate and Bremer, 1967; Sanders, 1966; Schreiber, 1967).

Several systems, such as Bloom's, consist of a limited number of general categories which can be used to classify questions irrespective of context. Most of the question-

classification schemes are composed entirely of categories based on the cognitive process required to answer the question. Categories representing various question-classification systems are shown in Table I; the categories have been organized to show similarities between systems. It appears that Bloom's Taxonomy of Questions best represents the commonalities that exist among the systems. Bloom's categories of thinking are presented in Table II.

A detailed classification system developed for a specific curriculum is preferable to a limited number of general categories. Three categories of a 32-category system (Hall, 1970) are specifically devoted to types of questions posed by teachers; Hall's entire 32-category system was designed to analyze verbal and nonverbal behaviors observed in elementary classrooms where Science - A Process Approach was being taught.

Studies of Teachers' Questioning Patterns

Probably the first serious study regarding teacher-questioning patterns was done by Stevens (1912). She 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 textbook information. Two decades later, Haynes (1935) found that 77% of teachers' questions in sixth-grade history classes called for factual answers; only 17% were judged to require students to think. In Corey's study

TABLE II.

Taxonomy of Questions (from Bloom, 1956)

1. Memory: The student recalls or recognizes information.
2. Translation: The student changes information into a different symbolic form or language.
3. Interpretation: The student discovers relationships among facts, generalizations, definitions, values, and skills.
4. Application: The student solves a lifelike problem that requires the identification of the issue and the selection and use of appropriate generalizations and skills.
5. Analysis: The student solves a lifelike problem in the light of conscious knowledge of the parts and forms of thinking.
6. Synthesis: The student solves a problem that requires original, creative thinking.
7. Evaluation: The student makes judgement of good or bad, right or wrong, according to standards he prescribes.

(1940), three observers classified all questions asked by teachers in a one-week period in a laboratory high school; the observers classified 71% of the questions as factual and 29% as those which required a thoughtful answer.

Studies conducted in the past several years indicate that teachers' questioning practices are essentially unchanged. Floyd (1960) classified the questions of 40 teachers in elementary classrooms; specific facts were called for in 42% of the questions, and 20% of the questions asked required thoughtful response on the part of the students. In two other studies conducted at the elementary-school level (Guszak, 1967; Schreiber, 1967), similar percentages of fact and thought questions were asked.

The findings in studies on teachers' questioning patterns are fairly consistent. It is reasonable to conclude that in a half-century there has been no essential change in the types of questions which teachers emphasize in the classroom. Gall (1970) states, "about 60% of teachers' questions require students to recall facts; about 20% require students to think; the remaining 20% are procedural."

Class Time Spent in Teachers' Questions

From a study by Furst and Amidon (1967) teacher questions represent 18% of the total lesson time in first grade, 16% in second grade, and 15.5% in third grade. In fourth grade, the

time used by teachers in questioning increased to 17% and dropped to 13% in fifth grade. In an analysis of teacher-student interaction, Newport and McNeill (1970) found a mean of .20% of total lesson time spent in asking questions; the elementary teachers of this study utilized lessons from Science - A Process Approach. (Note: This percentage is abnormally low; possibly a printing error.) In another study from suburban schools in Ohio (Kean, 1968), 19.40% of total second-grade teacher verbalization was spent in asking questions; only 16.95% of total fifth-grade teacher verbalization was spent in the posing of questions.

Wait-Time and the Effect of Teachers' Questions on Student Response

Teachers' questions are of insignificant value unless they have an impact on student behavior. Yet only a few researchers have explored the relationship between teachers' questions and student responses.

Aschner (1961) traced relationships between teacher questions and pupil responses with respect to the amount and kinds of productive thinking that certain types of questions promoted on the part of the pupil; he hypothesized that by careful timing and apt phrasing of questions, the teacher can cultivate the pupils' inventiveness and fertility of thought.

> I have observed that the number of questions asked (number of questions per unit time) reflects the type of questions. A high question density usually means many memory questions. It seems reasonable that if higher level questions were asked, questions in which more thinking is involved and which require more than a few words to answer, there will be a lower question density.

Rowe (1970) observed that all but a very few teachers move at rapid paces, allowing children an average time of only one second in which to formulate an answer to a question. She postulated that if wait-times were increased from the average of one or two seconds to an average of five seconds over a fifteen minute classroom session that student response would increase and that teacher questioning patterns would become alterated. When wait-time was increased to approximately five seconds, she states that, "the length of student responses increased; child to child comparing also increased." She further adds:

> The total number of teacher questions decreases per a fifteen minute interval. This follows from the fact that student responses become longer and the incidence of unsolicited responses increases. The number of questions that call for reflection and that ask for clarification of meaning increases. In short, the net variability in teacher questions increases after a teacher has been on a longer wait-time schedule.

In view of the previously described literature, several questions are presented: Do teachers of one grade level pose differing types of questions than do teachers of another grade

level? Do teachers of one grade level pose more divergent questions than do teachers of another grade level? Do teachers of one grade level pose more convergent questions than do teachers of another grade level? Of the total lessontime, does teacher questioning time vary with grade level? Does grade level effect student response resulting from varying teacher-posed questions? Can grade level be correlated to wait-time? One reasonable problem for further investigation becomes evident: What influence does grade level have upon teacher-questioning patterns and student-response patterns?

THE STUDY

The primary purpose of this study was to investigate the interrelationships of grade level to teacher-questioning patterns. An additional aspect of the study, with reference to grade level, was to analyze student-response patterns accompanying teacher-questioning patterns.

Description of the Sample

From September through December of 1970 a workshop was conducted in Shawnee Mission, Kansas, for inservice elementary teachers of Science-A Process Approach. Forty-four teaching participants were involved; during the course of the workshop at least one videotaped lesson per participant was made. Of these forty-four videotaped lessons, twenty lessons, approximately 20 minutes each in length, were randomly selected for assessment.

Procedures

A first set of observations from videotaped lessons utilized Hall's (1970) Instrument for the Analysis of Science Teaching. (See Appendix A.) As observations were made, events

of each classroom lesson were classified approximately every three seconds into one of the 32 categories; the raw data were then transferred to Fortran sheets for sequential preparation of data punch cards. From the cards, a 32-row by 32-column matrix was computed and printed using a computer program designed by Hall (1970). From the tallies of the print-out matricies, the use of teacher questions in the classroom and the cycle of student and teacher behavioral patterns following questioning could be revealed.

Since the time length of each observed lesson varied slightly, the number of tallies per category was converted to a percentage of the total number of tallies. Comparisons could then be distinguished between the teaching participants comprising the four differing grade-level groupings.

The second set of observations from the videotaped lessons was performed via Classification of Teacher Questions, a modified version of Bloom's (1956) Taxonomy of Questions. (See Appendix B.) This particular classification system categorizes teacher questions by type into one of ten categories; therefore, teacher questions were recorded verbatim and placed respectively into one of the ten categories.

Ten response measurements, or experimental variables, were identified as constituents of teacher questioning behavior and/or

student response behavior. Since each of the ten variables are components influencing teacher-student interaction, each variable would serve as an indicator of teacher and/or student behavioral patterns.

A brief description of the ten experimental variables, techniques by which each was measured per grade level, and relevance of the variables to the research problem are as follows:

1. Percentage of total lessontime expended in teacher-posed questions. (Sum of frequencies in categories 3Q, 4C, and 4O; Hall's Instrument for the Analysis of Science Teaching.)

Questions play an important role in teaching behavioral patterns; therefore, what percentage of total lessontime is utilized by teacher-posed questions?

2. Frequency of closed questions posed by the teacher. (4O; Hall's Instrument for the Analysis of Science Teaching.)

3. Frequency of open questions posed by the teacher. (4C; Hall's Instrument for the Analysis of Science Teaching.)

4. Ratio of open teacher questions to closed teacher questions. (4O/4C; Hall's Instrument for the Analysis of Science Teaching.)

The heart of teaching science by the inquiry approach is in questions properly posed; open (divergent) questions stimulate inquiry; closed (convergent) questions terminate in non-critical

thinking. What was the frequency of closed questions posed by the teacher? What was the frequency of open questions posed by the teacher?

5. Frequency of closed student response. (9C; Hall's Instrument for the Analysis of Science Teaching.)

6. Frequency of open student response. (9O; Hall's Instrument for the Analysis of Science Teaching.)

7. Ratio of open student response to closed student response. (9O/9C; Hall's Instrument for the Analysis of Science Teaching.)

If teacher-questioning patterns were of a convergent level, would not student response manifest convergence? Or, if teacher-questioning patterns were of a divergent level, would not student response patterns be of a divergent nature? "Open-ended" teacher questions should, theoretically, promote "open-ended" student responses.

8. Percentage of total lessontime expended in wait-time following teacher-posed questions. (Sum of the frequencies 3Q to 8C + 4C to 8C + 4O to 8C; Hall's Instrument for the Analysis of Science Teaching.)

Divergent teacher questioning patterns should encourage longer wait-time; longer wait-time induces student inquisitiveness. Thus, what proportion of the total lessontime was expended by wait-time?

9. What specific types of questions did teachers pose? (Classification of Teacher Questions.)

10. Percentage of total lessontime expended in posing questions dealing with directions. (1; Classification of Teacher Questions.)

Through proper questioning strategies, teachers can lead students into all kinds of thought processes; what were the varying types of questions posed by teachers comprising the sample groupings?

For each of these ten specified variables the mean scores were computed by grade level. Data was not submitted to sophisticated stastical treatment; therefore, conclusions will be based upon trends presented in the data.

THE FINDINGS

Results from the first experimental variable are presented in Table III. With an increase in grade level being taught, there was a mean decrease in total classtime expended in teacher questioning. The results of variables two through four are indicated in Table IV., Table V., and Table VI. The frequency of closed questions posed by the teacher was highest in kindergarten, lowest in first grade; the mean frequency of open questions asked by the teacher was highest in first grade, lowest in kindergarten. Apparently, neither closed questions nor open questions is a linear function of grade level.

Table VII., Table VIII., and Table IX. show the results of the measured variables five through seven. The mean frequency of closed student response was highest in kindergarten and lowest in first grade; the mean student open response frequency was highest in first grade, lowest in kindergarten.

In Table X., results from the variable dealing with wait-time are denoted; wait-time was greatest in kindergarten and smallest in first grade. With the omission of data from

kindergarten, wait-time increased as a function of grade level; as teacher closed questioning increased, wait-time, likewise, increased.

Results from the variables nine and ten appear in Figure 1. The type of questions posed most frequently by elementary school teachers of this study were of the cognitive and/or memorative type; translation type questions were of the next highest frequency. If one predicts that the total number of questions posed is proportional to the time spent in posing questions, then most questions were of the cognitive-memory and translation types. Questions dealing with synthesis were posed least frequently; evaluative type questions were, also, of a low frequency level. As indicated by the data, complexity of questioning does not seem to be a function of grade level.

TABLE III.

Percentages of Total Lessontime
Expended in Teacher Questioning
(IAST: 3Q + 4C + 4O)

		% Per Teacher
Kindergarten	A.	26.9
	B.	30.3
Mean		28.6
First Grade	A.	8.8
	B.	20.3
	C.	22.8
Mean		17.3
Second Grade	A.	14.1
	B.	13.5
	C.	23.3
	D.	8.2
	E.	17.4
	F.	4.7
	G.	40.0
Mean		17.3
Third Grade	A.	14.2
	B.	18.8
	C.	13.4
	D.	11.2
	E.	12.0
	F.	15.5
	G.	17.3
	H.	20.0
Mean		15.3

TABLE IV.

Percentages of Total Lessontime
Expended in Teacher Closed Questions
(IAST: 4C)

	K	1	2	3
	A. 26.9	A. 5.3	A. 6.9	A. 9.7
	B. 30.3	B. 5.9	B. 13.5	B. 11.6
		C. 5.7	C. 20.5	C. 13.4
			D. 5.7	D. 4.2
			E. 11.3	E. 11.2
			F. 4.7	F. 14.7
			G. 14.3	G. 13.4
				H. 12.8
Means:	28.6	5.6	11.0	11.4

TABLE V.

Percentages of Total Lessontime
Expended in Teacher Open Questions
(IAST: 40)

	K	1	2	3
	A. 0.0	A. 3.5	A. 6.2	A. 2.6
	B. 0.0	B. 14.4	B. 0.0	B. 6.9
		C. 15.8	C. 2.8	C. 0.0
			D. 1.4	D. 6.5
			E. 4.8	E. 0.0
			F. 0.0	F. 0.7
			G. 8.3	G. 3.7
				H. 5.1
Means:	0.0	11.2	4.7	3.2

TABLE VI.

Ratios of Total Lessontime
Expended in Teacher Open Questions to
Teacher Closed Questions
(IAST: 40/4C)

K	1	2	3
A. 0.0	A. 0.7	A. 0.9	A. 0.3
B. 0.0	B. 2.4	B. 0.1	B. 0.6
	C. 2.8	C. 0.3	C. 0.0
		D. 0.6	D. 1.6
		E. 0.3	E. 0.0
		F. 0.6	F. 0.1
		G. 0.6	G. 0.3
			H. 0.4
Means: 0.0	2.0	0.4	0.3

TABLE VII.

Percentages of Total Lessontime
Expended in Student Closed Response
(IAST: 9C)

	K	1	2	3
	A. 31.1	A. 0.0	A. 13.9	A. 25.6
	B. 30.3	B. 28.2	B. 27.4	B. 21.3
		C. 22.1	C. 38.1	C. 29.9
			D. 8.5	D. 14.7
			E. 20.2	E. 26.8
			F. 9.4	F. 14.0
			G. 56.0	G. 20.7
				H. 23.1
Means:	30.8	16.8	24.8	22.0

TABLE VIII.

Percentages of Total Lessontime
Expended in Student Open Response
(IAST: 90)

	K	1	2	3
	A. 0.0	A. 0.0	A. 11.5	A. 0.0
	B. 0.0	B. 1.0	B. 0.0	B. 2.8
		C. 23.1	C. 0.0	C. 0.0
			D. 3.4	D. 27.7
			E. 1.7	E. 1.1
			F. 0.0	F. 1.0
			G. 1.1	G. 2.0
				H. 22.6
Means:	0.0	8.0	2.6	7.1

TABLE IX.

Ratios of Total Lessontime
Expended in Student Open Response to
Student Closed Response
(IAST: 90/9C)

K	1	2	3
A. 0.0	A. 0.0	A. 0.8	A. 0.0
B. 0.0	B. 0.0	B. 0.0	B. 0.1
	C. 1.0	C. 0.0	C. 0.0
		D. 0.4	D. 1.9
		E. 0.1	E. 0.0
		F. 0.0	F. 0.1
		G. 0.0	G. 0.1
			H. 1.0
Means: 0.0	0.5	0.1	0.3

TABLE X.

Percentages of Total Lessontime
Expended in Wait-Time
(IAST: 8C)

K	1	2	3
A. 5.4	A. 0.0	A. 1.5	A. 1.6
B. 2.3	B. 0.3	B. 1.0	B. 2.5
	C. 1.0	C. 0.6	C. 0.2
		D. 0.3	D. 2.4
		E. 1.2	E. 0.2
		F. 0.0	F. 1.7
		G. 0.0	G. 0.0
			H. 1.2
Means: 3.8	0.5	0.7	1.2

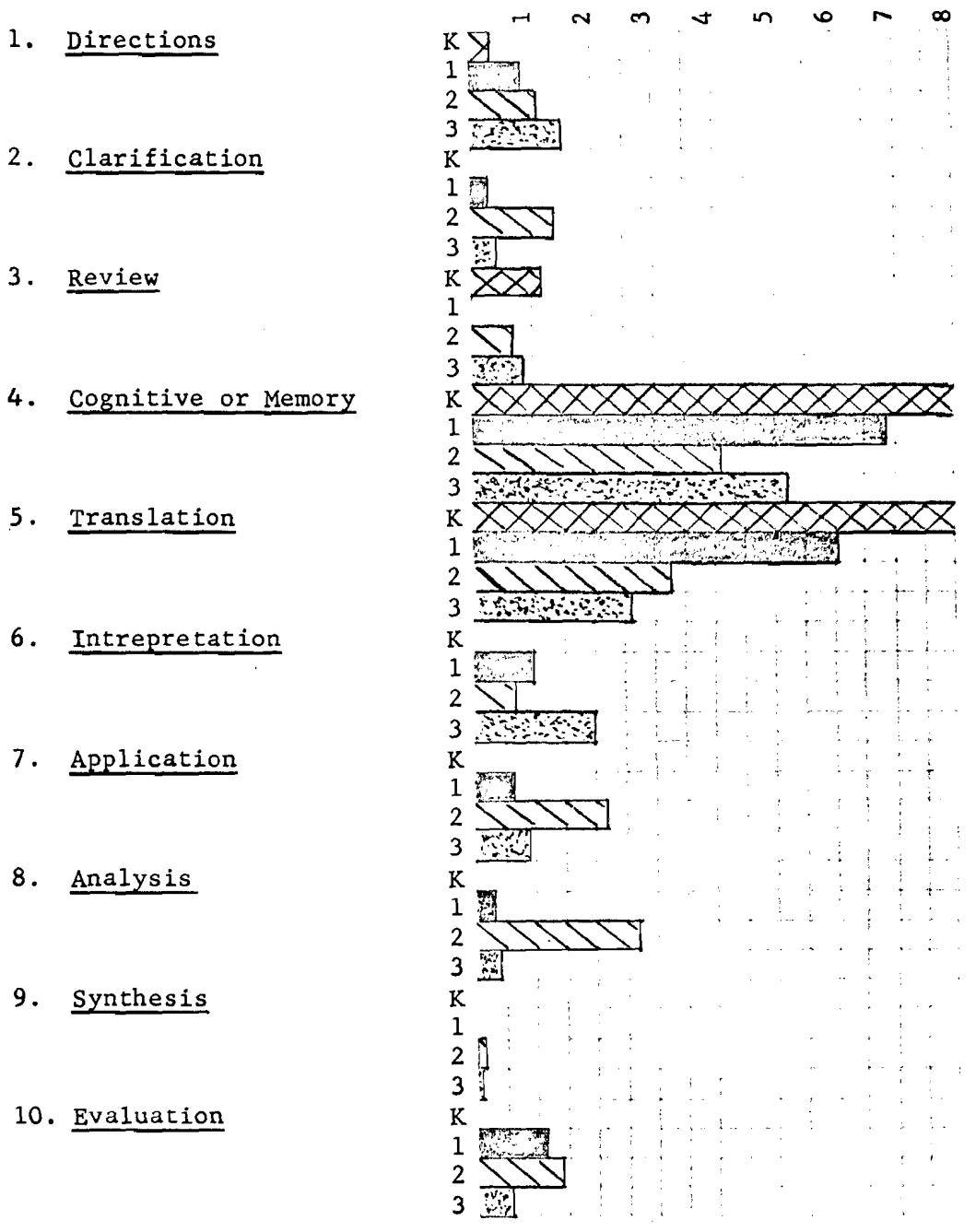

Figure 1. Mean Percentages of Total Questioning Time Expended in Various Types of Teacher Questions. (Total percentages in this figure coincide with mean percentages in Table III.)

TABLE XI.

Mean Number of Teacher Questions Posed Per 20-Minute Science Lesson

	K	1	2	3
Number of Questions	23 (Range: 10-13)	47 (Range: 11-23)	143 (Range: 12-66)	388 (Range: 18-87)
Number of Questions Posed Per Minute	1.2	2.4	7.2	19.4

For each of the ten variables a summation of data follows:

1. Mean percentage of total lessontime expended in teacher posed questions:

K=28.6% 2=17.3%

1=17.3% 3=15.3%

2. Mean frequency of closed questions posed by teacher.

K=28.6% 2=11.0%

1= 5.6% 3=11.4%

3. Mean frequency of open questions posed by the teacher.

K= 0.0% 2= 4.7%

1=11.2% 3= 3.2%

4. Ratio of open teacher questions to closed teacher questions.

K= 0.0% 2= 0.4%

1= 5.6% 3= 0.3%

5. Mean frequency of closed student response.

K=30.8% 2=24.8%

1=16.8% 3=22.0%

6. Mean frequency of open student response.

K= 0.0% 2= 2.6%

1= 8.0% 3= 7.1%

7. Ratio of open student response to closed student response.

K= 0.0% 2= 0.1%

1= 0.5% 3= 0.3%

8. Mean percentage of total lessontime expended in wait-time following teacher-posed questions.

K= 3.8%	2= 0.7%
1= 0.5%	3= 1.2%

9. What specific types of questions did teachers pose?

At all four grade levels, cognitive-memory type questions were posed most frequently; questions of the synthesis category were posed least frequently.

10. Percentage of total lessontime expended in posing questions dealing with directions.

K= 0.4%	2= 1.0%
1= 0.6%	3= 1.5%

DISCUSSION

Essentially, the major finding of the study was that few marked differences appeared in the questioning patterns of teachers comprising the grade levels kindergarten, first grade, second grade, and third grade. The general trend of verbalized questioning patterns paralleled studies previously cited. For example, Furst and Amidon (1967) indicated that 18% of the total lessontime was expended in teacher questions in first grade, 16% in second grade, and 15.5% in third grade. In this study teacher questions represented a mean frequency of 28.6% of the total lessontime in kindergarten, 17.3% in first grade, 17.3% in second grade, and 15.3% in third grade.

Earlier in the study it was suggested (Haynes, 1935; Corey, 1940; Floyd, 1960; Gall, 1970) that convergent (closed) questions dominated science education; this allegation can now be defined with greater precision. Of the sample groupings in this study, closed questions were posed more frequently than were open questions. All questions posed in kindergarten were convergent questions. In first grade approximately one-third of the total percentage of teacher questions were convergent questions; two-thirds were divergent questions. In both second and third grades approximately three-fourths of the total teacher questioning was convergent, while only

one-fourth was divergent. At all grade levels, except first grade, convergent questioning was the predominating trend.

It can be observed from the data that with an increase in convergent questioning there was an increase in wait-time. Hypothetically, wait-time increases as divergent questioning increases. However, in kindergarten wait-time was greatest; likewise, convergent questioning was greatest. One explanation for increases in both wait-time and closed teacher questioning could be that closed questions require exact student responses. Fewer students respond to questions requiring explicite answers; the teacher percieves he has fewer students to call on and, therefore, expends more time in choosing the student he wishes to answer the posed question. Divergent questioning was highest in first grade while wait-time was lowest in first grade. An interpretation to this inverse correlation between wait-time and open questioning could be that student responses are more rapid to open questioning than are student responses to closed questioning. Student response to a divergent question involves less threat to the student; thus, the student is more willing to respond promptly. The teacher observes a greater number of students upraised hands and, thereupon, quickly designates a student to respond.

Since convergent questioning was the general trend, wait-

time was short; fewer of the desired student inquiry behaviors were exhibited. Data presented in Table IV., Table VII., and Table X. substanciate this trend.

Carin (1970) states, "Not only do teachers ask too many questions, they more often than not ask the wrong kind of questions . . . questions requiring only the lowest level of thinking by children --- memorization." Likewise, Cain (1969) says that, "A high question density indicates a majority of memory-type questions posed by the teacher." Patterns of teacher questions and student responses were remarkably alike; the types of questions teachers asked evoked similar responses. Patterns of teacher questioning in the cognitive-memory category stimulated student responses requiring cognitive-memory answers. (See Figure 1). Unfortunately, most questioning was at this level alone.

Efforts to improve existing practices of teacher questioning patterns will probably move in several directions. In the past, researchers have developed taxonomies to describe questions which teachers ask (Note: Table I.); taxonomies need now be developed based upon types of questions which teachers should ask. The results of this study highlight the necessity for development of teacher questioning strategies; emphasis must be refocused on questions resulting in the finding of answers rather than merely on the answers themselves.

Increasing attention must be paid to the definition of desirable educational objectives and to the identification of questions and question sequences which will enable students to achieve these objectives. It was previously pointed out that there were certain advantages to developing systems of question types which were curriculum and/or situation specific. The chief advantage is that teacher training in questioning methods is likely to be facilitated if specific types of questioning patterns rather than general types of questioning patterns are learned.

Some educators contend that our attention should be focused on questions asked by students rather than on teachers' questions (Carner, 1963; Wellington and Wellington, 1962). Certainly, it seems a worthwhile educational objective to increase the quality of students' questions in the context of classroom interaction. Howbeit, research findings consistently show that students have only an extremely limited opportunity to raise questions.

Another task for the future researcher to consider is whether there are effective question sequences. Should teachers begin a discussion by posing recall-type questions to test students' knowledge of facts and then ask questions of a more complex nature requiring the manipulation of these facts? This was the approach taken by Taba (1966), who

attempted to identify questioning strategies that stimulated students to reflect on curriculum materials. In Shaver's model of Socratic teaching (1964), another type of questioning sequence was proposed: the teacher asks the student for a statement of his position on an issue, then asks appropriate follow-up questions to probe the student's stated position.

It is important that teachers' questions should not be viewed as an end in themselves. They are only a means to an end --- producing desired changes in student behavior. Therefore, researchers should give high priority to the tasks of identifying what these desired changes are and of determining whether new questioning strategies have an impact on student behavior which is claimed for them.

In the final analysis, the value of focusing attention on teacher questioning patterns is that they are the basic unit underlying most methods of science classroom instruction. If this is true, then their study deserves the support of continued research.

SUMMARY

Since this study was of an analytic nature, the investigation desired primarily to examine and describe teacher questioning patterns as a function of grade level. A secondary aspect of the study was to evaluate student response patterns as related to grade level.

During the fall of 1970 a workshop was conducted in Shawnee Mission, Kansas, for elementary school teachers utilizing Science-A Process Approach. Videotapes were made of the 44 teaching participants; 20 videotaped lessons were selected, at random, for assesment. Ten experimental variables were assayed by means of Instrument for the Analysis of Science Teaching and Classification of Teacher Questions.

Data indicated that of the total lesson time a mean frequency of 28.6% was expended in teacher questioning in kindergarten, 17.3% in first grade, 17.3% in second grade, and 15.3% in third grade. Convergent (closed) questions of the cognitive-memory type were of the highest frequency; divergent (open) questions were of the lowest frequency. Patterns of student response paralleled teacher questioning. Wait-time was short.

LITERATURE CITED

Adams, T. H. 1964. The Developement of a Method for Analysis of Questions Asked by Teachers in Classroom Discussions. Ph. D. Thesis. Rutgers University.

Aschner, Mary Jane. 1961. The Language of Teaching. In O. Smith and R. Ennis, (ed.), Language and Concepts in Education. Rand McNally and Co., Skokie, Illinois.

Bloom, Benjamin S. 1956. Taxonomy of Educational Objectives. Lognman's, Green, New York.

Cain. 1969. Commentary. Science and Children. 7(2):32p.

Carin, Arthur. 1970. Techniques for Developing Discovery Questioning Skills. Science and Children. 13p.

Carner, R. L. 1963. Levels of Questioning. Education. 83:546-550.

Clements, R. D. 1964. Art Student-Teacher Questioning. Studies in Art Education. 6:14-19.

Corey, S. M. 1940. The Teachers Out-Talk the Pupils. The School Review. 48:745-752.

Floyd, W. D. 1960. An Analysis of the Oral Questioning Activity in Selected Colorado Primary Classrooms. Ph. D. Thesis. Colorado State College.

Furst, Norma and Amidon, Edmond. 1967. Teacher-Pupil Interaction Patterns in the Elementary School. In E. Amidon and J. Hough, (ed.), Interaction Analysis: Theory, Research, and Application. Addison-Wesley, Reading, Massachusetts.

Gall, Meredith D. 1970. The Use of Questions in Teaching. Review of Educational Research. 40(5):708-709.

Gallagher, J. J. 1965. Expressive Thought by Gifted Children in the Classroom. Elementary English. 42:559-568.

Guszak, F. J. 1967. Teacher Questioning and Reading. The Reading Teacher. 21:227-234.

Hall, Gene E. 1968. A Comparison of the Teaching Behaviors of Second Grade Teachers Teaching Science-A Process Approach with Second Grade Teachers Not Teaching a Recently Developed Curriculum. Unpublished Ph. D. Thesis. Syracuse University.

Hall, Gene E. 1970. Personal Correspondence.

Haynes, H. C. 1935. The Relation of Teacher Intelligence, Teacher Experience, and Type of School to Types of Questions. Ph. D. Thesis.

Kean, John M. 1968. Linguistic Structure of Second-and-Fifth-Grade Teachers' Oral Classroom Language. American Educational Research Journal. 5(4):606p.

Kleinman, Gladys S. 1965. Teachers' Questions and Student Understanding of Science. Journal of Research in Science Teaching. (3):307-317.

Moyer, J. R. 1966. An Exploratory Study of Questioning in the Instructional Process in Selected Elementary Schools. Ph. D. Thesis. Columbia University.

Newport, John F. and McNiell, Keith. 1970. A Comparison of Teacher-Pupil Verbal Behaviors Evoked by Science-A Process Approach and by Textbooks. Journal of Research in Science Teaching. 7(3):193p.

Pankratz, Roger. 1967. Verbal Interaction Patterns in Classrooms of Selected Physics Teachers. In E. Amidon and J. Hough, (ed.), Interaction Analysis: Theory, Research, and Application. Addison-Wesley Publishing Company, Reading, Massachusetts.

Pate, R. T. and Bremer, N. H. 1967. Guiding Learning Through Skillful Questioning. Elementary School Journal. 67:417-420.

Rowe, Mary Budd. 1970. Wait-Time and Rewards as Instructional Variables: Influence on Inquiry and Sense of Fate Control. Symposium 1970. Columbia University Publication.

Sanders, Norris M. 1966. Classroom Questions: What Kinds? Harper and Row, New York.

Schreiber, J. E. 1967. Teachers' Question-Asking Techniques in Social Studies. Ph. D. Thesis. University of Iowa.

Science-A Process Approach. 1967. American Association for the Advancement of Science. Xerox Corporation.

Shaver, J. B. 1964. Ability of Teachers to Conform to Two Styles of Teaching. Journal of Experimental Education. 32:259-266.

Stevens, R. 1912. The Question as a Measure of Efficiency in Instruction: A Critical Study of Classroom Practice. Teachers College Contributions in Education. (48).

Taba, H. 1966. Teaching Stratagies and Cognitive Function in Elementary School Children. United States Office of Education Cooperative Research Project No. 2404.

Wellington, J. and Wellington, B. 1962. What Is a Question? The Clearing House. 36:471-473.

APPENDIX

Appendix A

INSTRUMENT FOR THE ANALYSIS OF SCIENCE TEACHING
(IAST), VERSION TWO
(from Hall, 1970)

Description of the Categories

TEACHER BEHAVIORS

1. Teacher accepts feelings: Teacher recognizes and identifies with feeling of students, is empathetic, non-evaluative, encourages student or jokes to relieve tension.

2. Teacher praises: Teacher makes a positive value judgement.

3R Teacher restates or restructures student statement: A verbal or written restatement, including summary on the board.

3Q Teacher questions student statement for clarification: Teacher asks student to restructure his statement.

3S Teacher gives non-evaluative confirmation: Teacher makes short response in acceptance of student's ideas with no value judgement, no expansion or clarification. Examples: "yes," "no," "O.K."

4C Teacher asks closed question: Teacher asks a narrow, specific, channeled question requiring a specific student response. Simple or complex skills are applied to a convergent, memorative or cognitive situation.

4O Teacher asks open question: Teacher asks broad, "think" question providing space for student to be original in his response.

5P Teacher gives procedural directions: Teacher tells student(s) how to do substantive behaviors. This requires immediate response.

5M Teacher gives managerial directions: Teacher gives directions not dealing directly with lesson content. Examples: "Open the door," "Go to the board," "Take your seats."

TEACHER BEHAVIORS

6L Teacher initiates new information (substantive): Teacher lectures, provides facts, performs calculations, etc. Writing new information on the board is included.

6P Teacher initiates background or review information: Teacher gives information from previous lesson or experience. Information covered earlier is restated.

6R Teacher initiates information by reading aloud: Teacher reads aloud from textbook or other source.

7 Teacher rejects or criticizes student's ideas or behavior: Teacher uses self-justification and disciplinary statements that may be critical in a defensive manner, negative value responses to a student's idea, or establishment of authority.

8D Teacher demonstrates silently: Teacher conducts a demonstration before the class without speaking.

8C Teacher-controlled silence: Teacher maintains silence after asking a question and before recognizing a student to answer. This behavior is sometimes slightly disciplinary, as in waiting for the attention of all the students.

8L Teacher silence while looking at notes: Teacher pauses to look at notes or lesson plan.

8E Teacher silence while handling equipment: Teacher prepares, distributes or collects equipment, papers, etc., without speaking.

STUDENT BEHAVIORS

9C Student closed statement: Student makes statement that is cognitive, memorative, or convergent in thought.

9O Student open statement: Student makes statement that is divergent or evaluative in thought.

9R Student reads aloud: Student reads aloud from textbook or other source.

STUDENT BEHAVIORS

10SC Student asks substantive closed question: A precise, explicit question is asked about the subject under discussion. Example: "How many ships did Columbus have?"

10PC Student asks procedural closed question: A question about procedure is asked which requires an explicit answer. Example: "Should we use plain notebook paper?"

10PO Student asks procedural open question: An unstructured question is asked about procedure. Example: "How can I do it?"

11P Student affective response, positive: Students show enthusiam or pleasant surprise. Example: "Yippee!"

11N Student affective response, negative: Students show disdane or unpleasant surprise. Example: "Ugh! Not that again!"

12O Student overt silent activity: Students are involved in lab activities or manipulating materials. They may be raising their hands.

12C Student covert activity (silent): Internalized behavior such as silent reading or thinking prior to verbal response. This behavior must be purposeful.

12G Group overt activity: Behavior of the 12O type when students are working together in groups.

12X "Greek chorus": A simultaneous verbal response by several students.

13 Division of student-to-student interaction: This category is a mark having no time dimension. It is used when students are interacting with one another to indicate when one student stops and another responds.

---

14 Nonfunctional behavior: This behavior does not contribute to the goals of the lesson and is usually disruptive. Examples: horseplay, loud talking.

Appendix B

CLASSIFICATION OF TEACHER QUESTIONS
(Modified Version of Bloom's Taxonomy of Questions, 1956)

Least complex

1. Directions --- Managerial or Procedural: The teacher asks students how to do substantive behaviors, or the teacher gives directions not dealing directly with the lesson content in the form of a question(s). Example: Roger, would you please go to the board?

2. Clarification: The teacher questions student statement for clarification; teacher asks student to restructure his own statement.

3. Review: Teacher poses questions to review background information; questions are asked concerning previous lessons or experiences.

4. Cognitive or Memory: Student recalls, recognizes, defines, names, designates, identifies, or observes information following teacher questioning; likewise, "yes" or "no" responses comprise this category.

5. Translation: The student is asked to change information into a different symbolic form or communicate in parallel forms.

6. Interpretation: The teacher questions student in order that the student will discover relationships among facts, generalizations, definitions, values, and skills; the student explains by comparison and contrast methods.

7. Application: Questions are posed in order that the student will solve a laboratory or lifelike problem that requires the identification of an issue and, thereupon, selection and utilization of appropriate generalizations and skills.

8. Analysis --- Induction or Deduction: The teacher asks questions so that the student solves a problem by means of inductive or deductive reasoning in light of conscious knowledge of the parts and forms of thinking.

9. Synthesis: Teacher asks student to solve a problem that requires original, creative thinking.

10. Evaluation: Questions asked in order that the student makes a judgement, evaluates, or defends according to standards which the student designates.

Most complex