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INFLUENCE OF PREPARATION IN SCIENCE CURRICULUM IMPROVEMENT STUDY ON QUESTIONING BEHAVIOR OF SELECTED SECOND AND FOURTH GRADE READING TEACHERS

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BY

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INFLUENCE OF PREPARATION IN SCIENCE CURRICULUM IMPROVEMENT
STUDY ON QUESTIONING BEHAVIOR OF SELECTED SECOND
AND FOURTH GRADE READING TEACHERS

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THE PROBLEM: ITS BACKGROUND AND SCOPE

Introduction

The one factor which all teachers, regardless of teaching assignment, have in common is the necessity to ask questions. Questions have long been the medium for inquiries between teachers and students. Throughout their academic career, students have been queried in both written form and orally. Questions have been posed for such diverse purposes as to motivate, to check memory, to measure the extent of skills learning, to provide opportunities for utilization of information, to determine the acquisition of isolated bits of knowledge and to obtain information about students. Thus, there has been a wide range in both the use of and quality of questions.

Sanders stated:

> The teachers most talented in questioning are usually deep and continuing scholars. Good questions recognize the wide possibilities of thought and are built around varying forms of thinking. Good questions

> are directed toward learning and evaluative thinking, rather than determining what has been learned in a narrow sense.[1]

Over fifty years ago, Thorndike defined reading in a terse way by stating "reading is thinking."[2] Though much has been done in an effort to define critical reading-thinking skills it seems that very little has been done to teach thinking abilities through the reading content medium. Smith asserted that "reading content is one of the most productive mediums to use in developing thinking abilities."[3] By conducting discussions at a level which is too low, in most instances, to stimulate real thinking on the part of students, teachers of reading are not making the fullest use of this medium for teaching and developing thinking abilities. Smith made the general indictment that teachers are, too often, simply asking students to repeat, parrot-like, what is said in the book rather than guiding discussion in ways which will encourage them to probe for deeper meaning and to evaluate critically.[4] Smith further asserted that:

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[1] Norris M. Sanders, Classroom Questions: What Kinds? (New York: Harper and Row, Inc., 1966), p. ix.

[2] Edward L. Thorndike, "Reading as Reasoning: A Study of Mistakes in Paragraph Reading," The Journal of Educational Psychology, VIII (June, 1917), 323.

[3] Nila Banton Smith, "Levels of Discussion in Reading," Education, LXXX (May, 1960), 518.

[4] Nila Banton Smith, Reading Instruction for Today's Children (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963), p. 265.

> Guidance directed toward literal comprehension is the lowest rung on the ladder of possibilities insofar as stimulation of thinking is concerned.[1]

Austin and Morrison suggested that teachers seem to equate reading-thinking skills with the most narrow of literal comprehension skills. They stated:

> Teachers too frequently turn to the manuals which accompany basal reading series where they can find sample questions to ask children to promote critical reading, but teacher's manuals often do not provide "ready made" questions for every unit. Many teachers devote the major part of each reading class to the first three activities (preparation for reading, guiding silent reading, and oral reading), testing comprehension of silent reading by requiring answers which can be found in the text rather than those which call for reflective thinking on the part of the reader.[2]

In The Torch Lighters, the authors recommended that teachers must be better prepared to guide children in the development of critical thinking and reading skills.[3]

Austin and Morrison also made this assertion:

> Critical reading is closely related to critical thinking. Effective comprehension requires of the reader not only an understanding of printed symbols but also an ability to "read between the lines," to make references and draw conclusions, and to anticipate the author's meaning. Moreover, the good reader thinks about what he is reading, recalls personal experiences which substantiate or disprove

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[1]Ibid.

[2]Mary C. Austin and Coleman Morrison, The First R: The Harvard Report on Reading in Elementary Schools (New York: Macmillan Company, 1963), pp. 40-41.

[3]Mary C. Austin et al., The Torch Lighters: Tomorrow's Teachers of Reading (Cambridge: Harvard Graduate School of Education, 1961), p. 141.

> those described by the author, compares different sources of information about the same topic, and forms valid conclusions. All of these skills must be taught and should be included in the elementary school reading program.[1]

Since its publication the Taxonomy of Educational Objectives: Handbook I: Cognitive Domain[2] has been the guide for a few research studies which have dealt with the types of questions teachers ask. Sloan and Pate[3] used the categories suggested by Bloom to determine the extent of difference between questions asked by teachers trained in the "new" mathematics and those not trained in the "new" mathematics. These researchers found that recall questions were used by significantly more teachers of traditional mathematics than teachers of the School Mathematics Study Group (SMSG) program. This result was significant at the 5 per cent level of confidence. Additionally, they reported that in the use of comprehension questions and analysis questions, significantly more teachers of the "new" mathematics ranked above the median.[4] Based on their findings, Sloan and Pate suggested that the proportion of questions

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[1] Austin, The First R, pp. 42-43.

[2] Benjamin S. Bloom (ed.), Taxonomy of Educational Objectives: Handbook I: Cognitive Domain (New York: David McKay Company, Inc., 1956).

[3] Fred A. Sloan and Robert T. Pate, "Teacher-Pupil Interaction in Two Approaches to Mathematics," The Elementary School Journal, LXVII (December, 1966), 161-167.

[4] Ibid.

at the cognitive memory level might well be reduced in favor of questions of greater depth; questions that require analysis and synthesis and the higher cognitive processes.[1]

Wilson[2] used the hierarchy of questions presented in the *Taxonomy*[3] to determine if there were significant differences in the types of questions asked by teachers educated in the Science Curriculum Improvement Study (SCIS) method of inquiry-discovery teaching and those not educated in this approach to science instruction. Wilson reported the following findings:

1. Questions considered in the *Taxonomy* to be lower level questions, recognition and recall, were recorded a significantly larger proportion of times for the traditional science teachers group than for the SCIS-educated teachers.

2. Questions considered higher level by the *Taxonomy*, analysis and synthesis, were recorded a significantly larger proportion of times for the SCIS-educated teachers group than for the traditional teachers group.

3. The demonstration of skill (application) type of question was recorded a significantly higher proportion of times in favor of the SCIS-educated teachers.

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[1] *Ibid.*

[2] John H. Wilson, "Differences Between the Inquiry-Discovery and the Traditional Approaches to Teaching Science in Elementary Schools" (unpublished Ed.D. dissertation, College of Education, University of Oklahoma, 1967).

[3] The *Taxonomy of Educational Objectives: Handbook I: Cognitive Domain* will be referred to many times in this study. Henceforth it will be referred to as the *Taxonomy* and will not be footnoted.

4. The comprehension type of question was recorded a significantly higher proportion of times in favor of the traditional teachers group.

5. SCIS-educated teachers asked forty-nine per cent more questions than the traditional science teachers.[1]

In a summary of his study, Wilson stated that "the teachers using the inquiry-discovery approach to teaching apparently are encouraging use of the learners' higher cognitive powers because of the nature of the questions asked in this classroom."[2]

The Taxonomy was used by Guszak[3] in a study which tabulated the percentage of questions in six areas of the Taxonomy asked by reading teachers. In this study of teacher questioning behavior in grades two, four and six, Guszak found that reading teachers spent the greatest portion of their questions on the literal comprehension realms of recall and recognition and concluded that his observations tended to support the contention that elementary reading teachers dwell on literal comprehension of material read by elementary school students.[4]

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[1] Wilson, op. cit., p. 66.

[2] Ibid., p. 69.

[3] Frank J. Guszak, "Teacher Questioning and Reading," The Reading Teacher, XXI (December, 1967), 227-234.

[4] Ibid., p. 230.

In his suggestions for further research Wilson[1] pointed out the desirability of a study designed to determine whether teachers educated in the inquiry-discovery approach to science teaching were using questions that demand higher cognitive powers in the teaching of other content-centered subjects. Results of this research should reveal whether teachers are transferring to other disciplines any of the higher level questioning techniques encouraged by the inquiry-discovery approach to science teaching as supported by the findings of the Wilson study.

Statement of the Problem

The purpose of this study was to determine whether differences exist between the types of questions and quantity of questions asked while teaching reading by teachers educated in a specific method of inquiry-discovery science instruction and teachers of reading not educated in this "new" science instructional approach.

The study was designed to determine whether the teachers who have been instructed in the Science Curriculum Improvement Study (SCIS) program of science instruction ask a larger proportion of divergent questions as well as a greater number of questions than those not so educated. Divergent questions are aimed at more than remembering and recalling knowledge and include thinking, problem solving, and creating.

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[1] Wilson, op. cit., p. 79.

The Teacher Population

One group of teachers included reading teachers who had received instruction in the SCIS methods and who were familiar with the materials developed by that and other similar groups. The second group included a like number of elementary school teachers of reading who had not received instruction in the SCIS methods and materials, nor any other "new" approach to elementary school science.

The study was designed to assure that the two groups of teachers were similar in as many aspects as possible. Each group contained a like number of teachers from second and fourth grades. All teachers were members of the same school system and, as nearly as possible, had the same number of years of elementary school teaching experience and were of the same educational level. Teachers who received instruction in the SCIS program were participants in workshops, university courses or in-service courses, all under the direction of the same instructor.

The Hypotheses

Second and fourth grade teachers educated in the Science Curriculum Improvement Study (SCIS), inquiry-discovery approach to teaching science will ask a greater proportion of divergent questions teaching reading which will be significantly different from second and fourth grade teachers of reading not so educated. The pattern of questions will be different in the following ways:

1. SCIS-educated teachers will ask a greater number of questions while teaching reading.

2. The proportion of divergent questions asked in two reading lessons will be proportionally greater for the SCIS-educated teachers.

To test these general problem hypotheses necessitates the testing of the following specific statistical hypotheses:

Ho_1 There is no significant difference in the proportion of recognition questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_2 There is no significant difference in the proportion of recall questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_3 There is no significant difference in the proportion of demonstration of skill questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_4 There is no significant difference in the proportion of translation questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_5 There is no significant difference in the proportion of interpretation questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_6 There is no significant difference in the proportion of analysis questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_7 There is no significant difference in the proportion of synthesis questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_8 There is no significant difference in the proportion of opinion questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_9 There is no significant difference in the proportion of attitude questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated.

Ho_{10} There is no significant difference in the proportion of <u>recognition</u> questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{11} There is no significant difference in the proportion of <u>recall</u> questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{12} There is no significant difference in the proportion of <u>demonstration of skill</u> questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{13} There is no significant difference in the proportion of <u>translation</u> questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{14} There is no significant difference in the proportion of <u>interpretation</u> questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{15} There is no significant difference in the proportion of analysis questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{16} There is no significant difference in the proportion of synthesis questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{17} There is no significant difference in the proportion of opinion questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{18} There is no significant difference in the proportion of attitude questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated.

Ho_{19} There is no significant difference in the proportion of recognition questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{20} There is no significant difference in the proportion of recall questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{21} There is no significant difference in the proportion of demonstration of skill questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{22} There is no significant difference in the proportion of translation questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{23} There is no significant difference in the proportion of <u>interpretation</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{24} There is no significant difference in the proportion of <u>analysis</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{25} There is no significant difference in the proportion of <u>synthesis</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{26} There is no significant difference in the proportion of <u>opinion</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Ho_{27} There is no significant difference in the proportion of <u>attitude</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated.

Teacher Question Inventory

The *Teacher Question Inventory*[1] was used in this study as a guide for tabulating the various types of questions asked by the reading teachers. These categories were adapted from Bloom's *Taxonomy* and follow a hierarchical order from the simplest "recognition" type question to the more difficult "synthesis" type question. The authors, Harris and McIntyre, also included two categories of questions of an affective nature. These categories were considered particularly valuable in this study as many questions asked by elementary school reading teachers are centered around a student's beliefs and opinions or require the student to make a value judgment of one form or another. An adaptation of the *Teacher Question Inventory* has been made in the category of *comprehension*. The authors of the *Taxonomy* pointed out:

> The use of the term "comprehension" in this book is somewhat more limited than the meaning usually associated with the term "reading comprehension," since comprehension is not made synonymous with complete understanding or even with the fullest grasp of a message. Here we are using the term "comprehension" to include those *objectives*, *behaviors*, or *responses* which represent an understanding of the literal

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[1]The *Teacher Question Inventory* is included in Appendix A.

> message contained in a communication. In reaching such understanding, the student may change the communication in his mind or in his overt response to some parallel form more meaningful to him. There may also be responses which represent simple extensions beyond what is given in the communication itself.[1]

To distinguish between these two types of behaviors the categories of translation and interpretation have been used instead of the single category comprehension. In the *Taxonomy*, both of these types of comprehension behavior are defined and exemplified.

Operational Definitions

To distinguish the various categories of educational objectives presented in the *Taxonomy*, as adapted by Harris and McIntyre in the *Teacher Question Inventory*, the following operational definitions are given. Examples of specific questions characteristic of each category are included.

1. Recognition. This type of solicitation asks for a student response which involves a choice between two presented items. It may also require the student to locate information presented in written form. Examples: By looking at the picture can you tell if the boy is awake or asleep? Find the word that tells how old John is. Is father happy to be taking the children to the park?

2. Recall. This type of solicitation asks a student to bring to mind one or more simple facts previously read.

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[1] Bloom, *op. cit.*, p. 89.

This type question emphasizes retrieval of small pieces of factual material. Examples: What was the boy's name in the story? To whom was father talking on the telephone? What is Mark Twain's real name?

3. Demonstration of Skill. This type of solicitation asks a student to demonstrate an understanding of a generalization or principle by applying it to an actual lifelike problem or practical social situation. It may require the identification of the mode of solution and the selection and use of appropriate generalizations and skills. Examples: Locate the story in the Table of Contents. Divide the word apple into syllables. Locate the word hero in the dictionary.

4. Translation. This type of solicitation requires the student to evince literal comprehension by "putting a communication into other language, into other terms, or into another form of communication."[1] This behavior is characterized by literal understanding in that the student does not have to discover intricate relationships, implications, or subtle meanings.[2] Questions calling for translation responses frequently call upon students to change words, ideas, and pictures into different symbolic form as is illustrated in the following outline from the *Taxonomy*:

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[1] *Ibid.*

[2] Sanders, *op. cit.*, p. 32.

> Translation from one level of abstraction to another, e.g., abstract to concrete, lengthy to brief communication. Translation from one symbolic form to another, or vice versa, e.g., pictures of illustrations to verbal descriptions, verbal to dramatizations. Translation from one verbal form to another, e.g., non-literal statements (metaphor, symbolism, irony, exaggeration) to ordinary English.[1]

Examples: Describe what is happening in this picture. Tell the story in your own words. Draw a picture of the accident. Show us what you mean by a 'gesture of defiance.'

5. Interpretation. This type solicitation requires the student to go beyond a part-to-part rendering of a communication to comprehend on a common sense level the relationships between its various parts, to reorder, or to rearrange it in his mind so as to secure some total view of what the communication contains and to relate it to his own background of experience and ideas. The essential behavior in interpretation is that when given a communication the student can identify and comprehend the major ideas which are included in it as well as understand their relationships. Examples: What is the meaning of the word bark in the sentence: The bark of the tree was notched? Do you know another use of the word "scene"? Why was Henry sad because he could not go fishing?

6. Analysis. This type solicitation emphasizes the breakdown of material into its constituent parts and

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[1] Bloom, op. cit., p. 92.

detection of the relationships of the parts and of the way they are organized. It may also be directed at the techniques and devices used to convey the meaning or to establish the conclusions of a communication. Also, it is aimed directly at developing in students the ability to distinguish fact from hypothesis in a communication, to identify conclusions and supporting statements, to distinguish relevant from extraneous material, to note how one idea relates to another, to see what unstated assumptions are involved in what is said, and to find evidence of the author's techniques and purposes. Examples: What is the main idea of this passage? What is the moral of this fable? What did the heroes in all the stories in this unit have in common?

7. Synthesis. This type solicitation asks a student to put together the elements and parts of a communication so as to form a whole. It requires the student to combine the elements and parts in such a way as to constitute a pattern or structure not clearly there before. It may also be aimed at permitting a student to get ideas, feelings, and experiences across to others. This is the category in the cognitive domain which most clearly provides for creative behavior on the part of the learner. Examples: Can you imagine how the Wright brothers must have felt? What would it be like to fall off a ladder? What would your reply be if you were asked by a geni to make a wish? Why is it dangerous to ride a bicycle on a sidewalk?

8. Opinion. This type solicitation is directed at a student's beliefs or opinions where he is fully aware of the clues or bases on which he is forming his appraisals. Examples: What is your opinion on this issue? What do you suppose? How do you feel about this situation? What was the most beautiful sight we saw on our trip?

9. Attitudes or Values. These solicitations range from situations where the student is expected to display a particular behavior, especially with a certain amount of emotion (enthusiasm, warmth, or even disgust), to situations in which he might go out of his way to display the value or to communicate to others about it. Example: Should his parents have punished him? Why do you believe that to be right? Would you have helped the old woman? (Why?)

Procedure

Eight second and eight fourth grade teachers who have been instructed to teach by the SCIS, inquiry-discovery approach were selected. These teachers were chosen by the director of the SCIS program from the SCIS-educated second and fourth grade teachers in the Norman, Oklahoma, public school system. A second group of eight second and eight fourth grade teachers were selected by the director of elementary education for Norman's public schools. Teachers chosen had similar teaching experiences, had attained similar educational levels, and were teaching in the same buildings as those chosen from the SCIS group.

A tape recorder was used to record two complete reading lessons for each reading group within a classroom at least one week apart from each of the thirty-two classes. Transcriptions of these lessons and tabulations of the various questions and a classification of these questions were made using an adaptation of the *Teacher Question Inventory* by Harris and McIntyre.[1]

Treatment of Data

The composite of the tabulations made under each category of the *Taxonomy* were used in the statistical analysis of data. The composite figure compiled for each of the nine categories, (recognition, recall, demonstration of skill, translation, interpretation, analysis, synthesis, opinion, and attitude), of the SCIS-educated teachers was compared with the composite figure of its counterpart of the non-SCIS educated teacher group in accordance with the hypotheses.

The z score for comparison of observed data was the statistical treatment used for analysis of data. The confidence level for z was set at 0.05. Guilford[2] gave the following formula for z:

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[1]Ben M. Harris and Kenneth E. McIntyre, "Teacher Question Inventory," (Austin: University of Texas Press, 1964).

[2]J. P. Guilford, *Fundamental Statistics in Psychology and Education* (New York: McGraw-Hill, Inc., 1966), pp. 185-187.

$$z = \frac{P_1 - P_2}{\sqrt{(P_c\ q_c)\ (\frac{1}{N_1} + \frac{1}{N_2})}}$$

where P_1 = proportion in one category

P_2 = proportion in other category

where $P_c = \dfrac{X_1 + X_2}{N_1 + N_2}$

X_1 and X_2 are the frequencies in each category

N_1 and N_2 are the total frequencies for each variable

where $q_c = 1 - P_c$

The normal standardized deviate z score was the selected statistical technique used for the analysis of data since the data represented observed frequencies and such a score was derived for each related category.

CHAPTER II

REVIEW OF LITERATURE

Literature--research and theoretical--relevant to this study can be grouped under three headings: the teaching of reading-thinking skills through the medium of reading instruction; questions and questioning in elementary classrooms; and objectives and characteristics of the inquiry-discovery approach to science instruction.

The Teaching of Reading-Thinking Skills Through the Medium of Reading Instruction

The Educational Policies Commission made the following statement regarding the central purpose of American education:

> The purpose which runs through and strengthens all other educational purposes--the common thread of education--is the development of the ability to think. This is the central purpose to which the school must be oriented if it is to accomplish either its traditional tasks or those newly accentuated by recent changes in the world.[1]

The essence of the ability to think centers around the development of specific rational powers which involve

[1]Educational Policies Commission, The Central Purpose of American Education (Washington, D.C.: National Education Association, 1961), p. 12.

the processes of recalling and imagining, classifying and generalizing, comparing and evaluating, analyzing and synthesizing, and deducing and inferring.[1] The Commission concluded that the rational powers are central to all the other qualities of the human spirit and an individual's ability to achieve his personal goals and to fulfill his obligations to society are dependent upon them.[2]

The school's obligation to develop the ability to think is and has been widely accepted. The Educational Policies Commission reported that the development of rational powers is central among the several important purposes of the school provided for all youth; however, it suggested that the ability to utilize such opportunities for thinking varies considerably.[3] The Commission further asserted that "no particular body of knowledge will of itself develop the ability to think clearly. The development of this ability depends instead on methods that encourage the transfer of learning from one context to another and the reorganization of things learned."[4]

Reading has long been thought to be an excellent medium for developing within individuals the ability to think.

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[1] _Ibid._, p. 5.

[2] _Ibid._, p. 4.

[3] _Ibid._, p. 16.

[4] _Ibid._, p. 18.

Over fifty years ago, Thorndike outlined a classic definition of reading by stating, "Reading is thinking."[1] Since that time many words have been written and much thought has been given to the specifics of how thinking can be enhanced through the medium of reading instruction. There exists, however, little empirical research evidence which suggests how best, or even how, to develop reading-thinking skills.

Although empirical research evidence of reading-thinking skill development is lacking there appears to be considerable comment based upon observation. Gans wrote that "in general, schools are eager to teach children to become comprehending, critical, and selective readers."[2] Smith asserted that "reading content is one of the most productive mediums to use in developing thinking abilities."[3] She reported that classroom practices have been directed primarily at the development of literal comprehension to the exclusion of higher thinking skills that would appear to be more important components in the development of a thoughtful, critical reader. She stated that, "guidance directed toward literal comprehension is the lowest rung on the ladder of discussion possibilities insofar as stimulation of thinking

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[1]Thorndike, op. cit., p. 323.

[2]Roma Gans, "Greater Reading Power Needed Today," Childhood Education, XXXVIII (November, 1961), 104.

[3]Smith, Reading Instruction for Today's Children, op. cit., p. 518.

is concerned,"[1] and implies that teachers of reading are overly concerned with this level of comprehension. She challenged all teachers of reading by querying:

> Are we making the fullest use of this medium for this purpose (developing thinking abilities)? Are we conducting discussions at a level which is too low, in many instances, to stimulate real thinking on the part of boys and girls? Are we, too often, simply asking them to repeat, parrot-like, what is said in the book rather than guiding discussion in ways which will encourage them to probe for deeper meanings and to evaluate critically?"[2]

Smith implied that teachers of reading are not utilizing proper questioning techniques. She suggested that questions calling for literal comprehension require only slight mental activity on the part of the teacher and little or no thinking on the student's part. Though such questions and answers have a place in detailed factual reading, Smith expressed doubt whether this form of questioning helps develop within the student the ability to obtain the types of meaning from the material read that they need to enrich their lives to the fullest extent.[3]

Too frequently, teachers confuse questioning-answering aimed at literal comprehension with thought development. Conceivably students can become so adept at answering questions calling only for recall that their teachers

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[1] Ibid., p. 518.

[2] Ibid.

[3] Ibid.

attribute to them a high degree of competency in the area of comprehension. What is lacking in such situations is the development of significance of meaning which can be gleaned only through the use of mental processes of a higher type.[1]

Gans echoed the Educational Policies Commission central purpose of American education by stating:

> The critical reader who will be able to meet his desire to make competent choices in important matters must be schooled in the ability to think--not only to recognize and recall what he reads but also to grow in his ability to unravel complicated ideas, to analyze them in terms of relevance to the issue at point, to synthesize, to appreciate adequacy and inadequacy of data, and ultimately to evaluate and come to a tentative or final conclusion.[2]

Gans emphasized that such intellectual powers must not be confined to a child's reading only, but must permeate the child's whole everyday environment. For this to occur the classroom atmosphere must be conducive to thinking. This atmosphere must be one where the children feel at ease, are encouraged to think for themselves and to voice their ideas even though they may be divergent from others, and are able to accept help and correction in thinking.[3]

Obviously, then, reading-thinking skills do not appear automatically but must be taught. Often, when the complaint is voiced that students do not think, close

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[1] Ibid., p. 519.

[2] Gans, op. cit., p. 105.

[3] Ibid.

examination of the situation reveals the fact that opportunities for thinking have not been provided. Reading authorities agree that the teacher must so direct the reading of children that they can think critically. She must create the setting for critical reading and thinking.

Gans asserted that:

> Central to the creation of such a thinking classroom is a thinking teacher--one who is free, encouraged, and helped to develop a challenging intellectual classroom atmosphere.[1]

Painter emphasized that for the teacher to give practice in reading-thinking skill development she must be, herself, a critical reader and thinker. She must remember that "critical thinking abilities are difficult and they are slow agrowing."[2] She must help children gain background experiences, encourage critical thinking and be pleased by the questioning of children, not annoyed by it. Painter asserted, as do many others, that too often a teacher asks merely for simple recall, when attempting to develop reading-thinking skills.[3]

Inherent in the thinking classroom environment are well-guided discussions geared to develop high-powered

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[1] Ibid.

[2] David H. Russell, "The Prerequisite: Knowing How to Read Critically," Elementary English, XL (October, 1963), 580.

[3] Helen W. Painter, "Critical Reading in the Primary Grades," The Reading Teacher, XIX (October, 1965), 38.

reading. The hurried short-answer oral or written comprehension check meets some classroom needs but "its use to the exclusion of thoughtful discussion, sharing of divergent views, pausing to consider and reconsider the use of all the other ways of getting into the deeper understanding of an important learning will deny a child the right to develop as a thinker."[1]

Austin and Morrison, in their survey of reading practices, discovered that many elementary students understand and recall the literal meanings of printed materials but are "unable to evaluate their accuracy or to determine their relevancy to a specific problem."[2]

These researchers reported that teachers of the first four grades spend very little time developing critical reading skills. They suggested:

> This is very much in keeping with the prevailing opinion among administrators and teachers that only _older_ children are able to think and read critically. Yet research indicates that reasoning ability begins in children about three years of age and that most children can develop this ability sufficiently by the time they enter school to think critically about simple, life-like problems with solutions that lack complication.[3]

Austin and Morrison concluded that reading-thinking skill development is hindered by an overreliance on the

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[1] Gans, _op. cit._, p. 106.

[2] Austin and Morrison, _The First R_, _op. cit._, p. 39.

[3] _Ibid._, p. 39-40.

teacher's manual for comprehension questions, purposefully avoiding topics of controversial nature even though through them children's thinking might be challenged, and an absence of thinking and critical reading skill on the part of teachers which restrict their ability to assist their students in developing these skills.[1] Therefore, among their recommendations the authors proposed that "a definite program be initiated in which all children are taught critical and creative reading skills appropriate for their development, and that teachers find ways to stimulate thinking beyond the literal meaning of passages read."[2]

In an examination of the nature of the teacher-training programs in the colleges and universities of the United States, Austin and Morrison reported the following as an area of discrepancy between theory and classroom practice most frequently noted by college supervisors and reading instructors:

> Silent reading checks and comprehension questions are founded solely on factual information which fall short of developing the child's higher mental processes of interpreting, reasoning, making judgments, or drawing conclusions.[3]

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[1] Ibid., p. 41.

[2] Ibid., p. 222.

[3] Austin and Morrison, The Torchlighters, op. cit., p. 96.

Austin and Morrison reported the necessity for training future teachers of reading to guide children in the development of reading-thinking skills.[1]

Stauffer voiced an opinion similar to that of Austin and Morrison when he stated that children can read and think critically about matters within their experiences. He amplified his opinion by stating:

> Children bring with them to school many concepts and opinions that can be used while reading. What is required is that the teacher direct reading as a thinking process in order that children may put to work their experiences, making comparisons and judgments.[2]

Stauffer implied that children must be taught to utilize experiences from their own lives to set their own purposes for reading, purposes which permit them to reason while reading and, subsequently, to accept or reject what they read as proof of their speculations. This practice permits students to take full advantage of past learning when reading to accomplish new purposes.[3]

Stauffer suggested that thinking while reading can be well facilitated in group-directed reading activities where:

> . . . the students benefit from shared experiences, estimates, and predictions, thus permitting each

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[1] Ibid., p. 48-50.

[2] Russell G. Stauffer, "Children Can Read and Think Critically," Education, LXXX (May, 1960), 524.

[3] Ibid., p. 525.

> student to compare his predictions with the predictions of others to see how different members manipulate story information in order to predict; to compare his conclusions with those reached by others; to evaluate the skills he has used; to note whether or not others used the same skills and why; and to scrutinize the way others extended and refined concepts and generalizations gained through reading. In this way reading-thinking skills can be acquired, sharpened and refined.[1]

In an article concerning the effects of reading, Russell emphasized the inseparability of reading and thinking. In regard to thinking he suggested that: (1) Reading can be a source of thinking material. It can provide the raw materials of thinking--the facts, the images, the concepts, the stimuli to memory that we all need as part of our materials of thinking; (2) Reading can be an aid in selecting and evaluating ideas. By querying students in the right way teachers can help their students distinguish between the relevant and irrelevant, the important and the trivial; (3) Reading can develop into concept formation and problem-solving. By discriminate use of how and why questions teachers can guide students to grasp important concepts, ideas which help form a 'lacework of coherence' in our culture.[2] Russell maintained that the reading program is one of our best opportunities for asking important questions and attacking vital problems. When this occurs creative thinking

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[1] Ibid.

[2] David H. Russell, "Reading for Effective Personal Living," Proceedings of the International Reading Association, III (1958), 15.

grows out of reading. He stated that "in this process the reader adds something of himself to the words--he reads between the lines; he goes beyond the superficial facts, explicitly stated, to do some relational thinking which produces fresh outcomes."[1]

Guilford reported that teachers of reading have a wealth of opportunities to teach the child to think. He warned, though, that the teacher who has only a very general and rather vague objective of "teaching the child to think" is not likely to do justice to this task.[2] Guilford, writing to familiarize reading teachers with the system known as the structure of intellect, pointed out that:

> Some relatively recent developments in research on the analysis of intelligence indicate that there are a great many different thinking abilities. If we look upon each of these thinking abilities as a distinct kind of thinking skill, and if we know what kind of skill it is, we have a much more definite objective at which to aim in teaching how to think.[3]

Guilford further emphasized that good teachers of reading have always utilized opportunities for the student to exercise his thinking equipment. He suggested that:

> Even when the reading material does not itself obviously induce desirable types of thinking exercises, the alert teacher who is not a stranger to ingenuity will invent ways of turning that material

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[1] Ibid.

[2] J. P. Guilford, "Frontiers in Thinking That Teachers Should Know About," The Reading Teacher, XIV (February, 1960), 176.

[3] Ibid.

> to good use as the basis for thinking exercises. Skillful questioning would do the trick, as all good teachers know.[1]

The evidence amassed in the preceeding pages suggests the importance of developing thinking in today's children. It has also alluded to the fact that reading has been considered for many years to be an excellent and appropriate medium through which thinking can be developed. Conspicuously absent have been comments that specify how the thinking process is involved when the child reads a story. Though there is no brief, concise answer to the question, several comments by authorities are considered appropriate and informative.

Thorndike, from his study of errors which elementary school children made in reading single paragraphs, concluded that reading a single paragraph with understanding involves many elements of thought, including the weighing of words in terms of the context, the organization of each element in its proper relation to others, the selection of certain connotations of words, and the rejection of others. He said that in effective reading the mind selects, softens, emphasizes, correlates, and organizes--all under the influence of the right mental set or perspective. He compared the processes required in comprehending a paragraph to those of solving a problem in mathematics.[2]

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[1] Ibid., p. 179-180.

[2] Thorndike, op. cit., p. 329.

Beery, in commenting on the skills mentioned by Thorndike, suggested the desirability of teaching these skills together rather than in isolation. She stated that:

> A flexible reader shifts from one skill to another as he gains insight into the nature of the problem, the difficulty of the reading matter, and its development by the author and as he develops or rejects 'hunches' he has concerning the best solution. Not only does the understanding of what is read involve many of the higher mental processes it also involves them in close conjunction with one another. As the situation demands, we analyze, organize, criticize, reject, reason, and judge with one process merging imperceptively into another.[1]

Pratt emphasized that, since thought is limited by the reader's ability to combine, transpose, augment, and diminish ideas, he is using the thought process when he puts ideas together and establishes an organization that is meaningful to him. These ideas are embellished from the reader's background of knowledge and he must reorganize them "to combine the compounded and augmented ideas so that they come to represent what he understands regarding the subject which stimulated thought."[2] Pratt also stated:

> In making application of thought in reading we might observe that the thoughtful reader conceives ideas inherent in the author's presentation, gains insight by bringing his own experience into interaction with what he believes the author is suggesting, and achieves understanding by extracting what

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[1]Althea Beery, "Clustering Comprehension Skills to Solve Problems," Forging Ahead in Reading, International Reading Association Proceedings, XII (1967), 110.

[2]Edward Pratt, "Reading as a Thinking Process," Vistas in Reading, International Reading Association Proceedings, XI (1966), 53.

> to him is the essence of the combination of the author's expression and his own experience. The thought process might be considered a progression from conception to insight to understanding.[1]

Thus, it becomes apparent that "if thought is to occur in association with reading, the reader must do more than name words and apply appropriate expressional groupings."[2]

Since there can never be much critical thinking if students are not actively involved in a sharing and discussion of what has been read the role of the guided discussion following the reading of a story is of vital importance. Gordon pointed out that:

> From guided discussions emerge hitherto unrecognized problems that establish purposes for further reading, thinking, and discussion. This process leads to a general clarification of issues. Students learn to modify their ideas, to accept or reject the ideas of others, to recognize prejudice in themselves as well as in others, and to sense a need for more knowledge of the subject under discussion.[3]

Through a discussion of what is read students can be led to identify, and to think about the motives of the story characters, the drives influencing their behavior, and the emotions that affect their actions and decisions. In this way children can be helped to achieve the objectivity essential for true critical thinking.[4]

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[1] Ibid.

[2] Ibid.

[3] Lillian G. Gordon, "Promoting Critical Thinking," Reading and Inquiry, International Reading Association Proceedings, X (1965), 120.

[4] Ibid., p. 121.

Artley stated that:

> Any reading situation, regardless of level, that gives the children an opportunity to face a situation having several alternatives, to weigh evidence, to face beliefs, to examine facts, to come up with a reason, a judgment, a conclusion, or a solution based on defensible criteria is one that provides an opportunity for critical reading. The differences from grade to grade are differences in level of maturity and quality of thought rather than the type of process in which the reader engages.[1]

Stauffer asserted that:

> If a well-conceived plot has been read in such a way as to enable the reader to think, then pupils can grasp the deeper, underlying principles of thinking and learning in a generic way. This, in turn, gives pupils the power to use a generic understanding about thinking when reading other kinds of materials.[2]

The review of literature to this point has been concerned with the teaching of reading-thinking skills through the medium of reading instruction. Most of the comments by reading authorities directed toward teaching or improving the teaching of reading-thinking skills are theoretical in nature and are based on little evidence of research. A majority of the information available appears in periodicals, books of readings, or proceedings from reading conventions and, all too often, are recipes for improving classroom procedures which are hypothetical or are assumed to exist by reading authorities not actually engaged in classroom teaching.

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[1]A. Sterl Artley, "Implementing a Critical Reading Program on the Primary Level," Reading and Inquiry, International Reading Association Proceedings, X (1965), 111.

[2]Stauffer, op. cit., p. 525.

Few are based on actual classroom observation and fewer still are based on research design formulated to discover, describe, and improve actual classroom situations. Reading authorities who have published comments in this area of reading instruction are in agreement that full advantages are not being made of teaching children to think while teaching them to read.

Questions and Questioning

Any discussion of questioning would be incomplete without some reference to Socrates. Questions were the very essence of his teaching technique. He wanted each of his students to realize that truth was within his own power to find and that the student had only to reach long enough and hard enough to arrive at the truth by reason alone. Through questioning, Socrates challenged his students to explain the nature of truth, beauty and goodness and further challenged their imperfect answers by asking the kinds of additional questions that caused them to view the inadequacy of their answers. Through his prodding he led his students to construct and reconstruct their thinking, to formulate better explanations of reality, and to move even closer to the perfect understanding their souls enjoyed "prior to its being shackled to this world of imperfect, shimmering copies of shadows of reality."[1]

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[1]Philip G. Smith, "The Art of Asking Questions," The Reading Teacher, XV (September, 1961), 3.

Clearly, the purposes of questions in today's classroom are different from the Socratic purpose, yet the Socratic method of teaching is still widely used and considered an acceptable and useful procedure. Smith asserted that this is true because, even today, "an important aim of education is the development of the ability and inclination to engage in the thoughtful reconstruction of ideas."[1] This reconstruction of ideas can still be well facilitated by the use of good questioning behavior.

Though the usefulness of questions has long been recognized as significant in the teacher-learning interaction it has been an area for research that has been relatively neglected during the past several decades. With the current emphasis in education concerned with methods of discovery and inquiry, processes of thinking and ways of finding out, it seems likely that teachers' questions and questioning behavior will become even more important. Contemporary educators recognize that the oral question is still an important instrument in classroom practice and that questioning plays an important part in learning. Horn asserted:

> There has probably never been a time during the last seventy-five years when some form of question-and-answer recitation has not been the most prevalent method of teaching. Throughout this period, the enemies of formal teaching have attacked the mechanical procedures into which questioning often degenerates, have suggested improvements or substitute forms of teaching, and have sometimes

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[1] Ibid., p. 3.

> deluded themselves by the belief that the objectionable practices were disappearing. Many advocates of new methods, however, have been hypercritical of questioning. Faults have been attributed to questioning that should have been charged to its misuse; and by thus centering attention exclusively upon objectionable features, the potentialities of good questioning have been obscured. Meanwhile, both good and poor questioning persists.[1]

The comments of Horn, made over thirty years ago, seem an appropriate commentary for today as questioning in today's classrooms is as prevalent now as it was several decades ago. Aschner stated that "the classroom teacher probably devotes more time and thought to asking questions than anybody since Socrates. One might even say the teacher is a professional question maker."[2] Aschner stated that one of the basic ways by which a student's thinking and learning are stimulated is through questioning. By studying the answers to these questions the teacher measures and evaluates the thinking and learning of his students.[3]

Stevens, in 1912, estimated that four-fifths of the school time was taken up with question-and-answer recitations.[4] The following year, Yamada wrote, "today more than

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[1] Ernest Horn, Methods of Instruction in the Social Studies (New York: Charles Schribner's Sons, 1937), p. 336-337.

[2] M. J. McCue Aschner, "Asking Questions to Trigger Thinking," NEA Journal, L (September, 1961), 44.

[3] Ibid.

[4] Romiett Stevens, "The Question as a Measure of Efficiency in Instruction," Teachers College Contribution to Education, No. 48 (New York: Teachers College, Columbia University, 1912), 6.

two-thirds of the school time is occupied with questions and answers."[1] Horn pointed out:

> Even before the Herbartian influence had gained much headway in America, there had been protests against formal catechetical methods, with their attendant emphasis on verbal memory; and these protests eventuated in many excellent constructive suggestions. The Herbartians, in turn, placed a high value on questioning as a means of developing, organizing, and using new ideas.[2]

From Stevens' investigation, considered an early classic on teacher questioning behavior, two important conclusions were drawn: (a) most of the questioning in classes was done by the teachers; pupil's expression was smothered under the sheer number of teacher's questions, and individual differences of pupils received slight attention; (b) the classroom was considered primarily a place for displaying knowledge instead of a laboratory for gaining understanding in depth, and slight effort appeared to be exerted to guide pupils in becoming self-reliant and independent workers.[3] In her investigation, Stevens drew a rather unfavorable picture of questioning practices characteristic of the early 1900's. She rightly pointed out that the weaknesses were not attributable to any intrinsic weakness in questioning as a method but rather to a lack of skill on the part of

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[1] Soshichi Yamada, "A Study of Questioning," The Pedagogical Seminary, XX (June, 1913), 129.

[2] Horn, op. cit., p. 340-341.

[3] Stevens, op. cit., p. 2-3.

teachers. She stated that "the question-and-answer recitation may become a conversation hour between teacher and pupil, a period of richest opportunity for true education, i.e., the 'leading out' of what is in the mind of the pupils."[1]

Horne also supported the use of questioning by stating, "questioning is one of the supreme methods by which a mature mind can assist a learner's growing mentality. It best enables teacher and pupil to work together."[2]

More recently, Klebner voiced an opinion in favor of questioning by stating:

> Carefully thought-out questions, used in logical sequence at appropriate times, are vital to achieving the purposes of education. The centrality of questioning in stimulating learning has been recognized since the age of Socrates and continues to occupy an important place in both teaching and learning.[3]

Carner supported these views by stating "one of the major avenues through which we help guide and shape pupils' thinking is by recognizing the importance of proper questioning."[4] Sanders equated questioning ability with scholarship by stating, "The teachers most talented in questioning are usually deep and continuing scholars."[5]

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[1] Ibid., p. 2.

[2] Herman H. Horne, Story-telling, Questioning, and Studying: Three School Arts (New York: The Macmillan Company, 1916), p. 64.

[3] Ruth Perlman Klebaner. "Questions That Teach," Grade Teacher, LXXX (March, 1964), 10.

[4] R. L. Carner, "Levels of Questioning," Education, LXXXIII (May, 1963), 546.

[5] Sanders, op. cit., p. ix.

The early work of Stevens[1] provided the empirical evidence that teachers' questions are not directly aimed at the development of higher cognitive functions of students. As a result, she requested a more purposeful use of questions as instructional devices and stated that questions can and should stimulate reflective thought in addition to memorization of facts.[2]

In a discussion of the amount of energy spent on recall-type activities in the elementary school classroom, Miller commented:

> The learning of facts, definitions, concepts and general ideas is absolutely necessary for pupil growth cannot be denied, but that this should be the near single concern of the school is surely open to doubt. . . . Studies of actual classroom teaching indicate that pupils receive a disproportionate amount of such memory testing questions and assignments.[3]

While it is impossible to determine an accurate percentage figure for the amount of time spent in developing various rational powers, Renner estimated that as much as eighty to ninety per cent of instructional time is commonly used on activities which tend to develop only recall.[4]

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[1]Stevens, op. cit., pp. 1-86.

[2]Stevens, op. cit., p. 75.

[3]George L. Miller, "The Teacher and Inquiry," Educational Leadership, XXIII (April, 1966), 552-553.

[4]John W. Renner, "Lockstep Teaching," The Pedagogic Reporter, XVII (March, 1966), 3.

Davis and Tinsley supported the statement by Renner. These researchers stated that "Questions posed in classrooms for over a century have been recognized as emphasizing memory as the most important cognitive operation."[1]

Aschner observed that teachers, by their use of questions, commonly initiate four types of thinking activity; remembering, reasoning, evaluating or judging, and creative thinking. Aschner suggested that teachers, in designing a good question, should begin by analyzing the type of thinking to be fostered and the type of task which must be set to initiate such thinking. For the question to possess the capacity to focus the thinking activity of pupils, it must be clearly and precisely worded.[2]

Bradley characterized four levels of questions and made the plea for elementary teachers to understand and utilize these:

> (1) Questions which require the child to develop grouping skills. Questions of this type call for the child to check categories of knowledge he now has, and further require that he regroup some skills and extend his ideas as he bridges gaps in his thinking processes.
> (2) Questions that call for the child to use skills in interpreting information and making of inferences. This type question has actually no right response. The less evaluative or exact an answer sought the better the type of response from the student. A very high level of response should be

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[1]O. L. Davis and Drew C. Tinsley, "Cognitive Objectives Revealed by Classroom Questions Asked by Social Studies Student Teachers," Peabody Journal of Education, XLV (July, 1967), 21.

[2]Aschner, *op. cit.*, p. 46.

expected from questions of this type because one must transform what he knows to the question as cited.

(3) Questions which utilize the skills in predicting consequences. In this type question there is an independent variable that is known which must be used to discover the rest of the answer to the question.

(4) Questions that call for the use of feelings and emotions. This type question gives opportunities to the class for them to respond with feeling and emotion.[1]

Klebaner pointed out that:

> Questioning, like other aspects of teaching, is a complex process. It can serve a variety of purposes; to elicit simple information or to stimulate thinking, to arouse interest or to guide research, to evaluate learning or for review, to assess students' background of information or to stimulate an enquiring attitude.[2]

Wellington and Wellington also advocated more effective use of questions in the teaching situation. Teaching, they stressed, was not the teacher asking questions, but rather the teacher guiding pupils so that they asked effective questions.[3] Carner took a similar position in stressing that teachers must be cognizant of the types of thinking required before they can frame effective questions. He concluded that teachers need to be aware of the level (concrete or abstract) of questions which is most appropriate to a

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[1]R. C. Bradley, "Structuring Questions. A Teacher's Major Teaching Tool: The Art of Questioning," _Arizona Teacher_, LIV (March, 1966), 15.

[2]Kelbaner, _op. cit._, p. 76.

[3]Jean Wellington and Burleigh Wellington, "What is a Question," _Education Digest_, XXVIII (September, 1962), 39.

particular learning situation. He discussed the several cognitive skills which should be nurtured by questions; those of sensing continuity and sequence, perceiving relationships, making inferences, drawing sound conclusions, and evaluating the validity of information. He also stressed that pupils needed to be given opportunity to develop the ability to formulate questions independently about materials with which they have dealt.[1]

Burton identified general principles of method basic to good questioning and formulated suggestions to draw teacher-questioning away from the emphasis on recall. He asserted that questions could be grouped into two general classes: thought questions, designed to stimulate the reflective processes of students; and drill questions, emphasizing isolated facts or arbitrary associations. He asserted that the thought question demands of the teacher more patience to let the students think. Thought questions need situations which force pupils not to accept information, but to withhold opinions, to question, to analyze, and to think about information.[2] Later, Burton stated that if teachers were to improve their questioning behavior, their knowledge of the purposes and aims of questions had to undergo improvement. Teachers had to consider the mental processes of learning

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[1]Carner, op. cit.

[2]William H. Burton, The Guidance of Learning Activities (New York: D. Appleton and Co., 1929), p. 501.

and adapt the questioning technique to these processes.[1] More recently, Burton, in collaboration with Kimball and Wing, elaborated the previously stated values of the question and questioning procedures with particular attention to the development of critical thinking.[2]

Loughlin stated that effective questioning is effective teaching. His list of principles for questioning included suggestions to (1) distribute questions so that the entire class is involved, (2) have a balance between factual and thought-provoking questions, (3) utilize both simple and exacting questions, (4) encourage responses of some length, and (5) stimulate critical thinking by asking "To what extent? How? Why? Compare?"[3] Klebaner supported these general principles by asserting that the purpose of the question must be identified by the teacher and realized by the pupil. Pupils should be made aware, he insisted, of the types of answers which different kinds of questions demand.[4] This recommendation is consistent with Yamada's point that the

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[1] William H. Burton, The Nature and Direction of Learning (New York: Appleton-Century-Crofts, Inc., 1944), p. 447.

[2] William H. Burton, Ronald B. Kimball and Richard L. Wing, Education for Effective Thinking (New York: Appleton-Century-Crofts, Inc., 1960), p. 477.

[3] Richard L. Loughlin, "On Questioning," The Educational Forum, XXV (May, 1961), 481.

[4] Klebaner, op. cit.

nature of the answer is somewhat dependent upon the form of the question.[1]

Horn reported that the various functions of questions are many. Their major functions include: (1) bringing about proper understanding and cooperation between students and teachers; (2) teaching students to think; (3) improving the accuracy, clearness, and organization of meanings and concepts; (4) developing within students an active and aggressive attitude toward learning; and (5) affording a basis by which students and teachers may appraise results.[2]

Though there is meager data on the influence of oral questioning upon efficiency of learning, a number of conclusions from reported research can be drawn. Horn summarized these conclusions:

> First, the number of significant items that can be accurately recalled as a result of a given experience is relatively small. Some items may have been erroneously perceived, some forgotten, and some not perceived at all. Various studies on reading have demonstrated that very little is obtained, on the average, by a single reading; that serious misconceptions are common and difficult to prevent; that such misconceptions occur when the source of meaning is the spoken word, as well as when it is the printed page; and that questioning may operate either to clarify or to muddle concepts that have been gained through study.
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> Second, both the amount and accuracy of what is recalled are affected by the way the recall is stimulated. The pupil may be asked to tell, with little or no interruption, all that he knows about a given matter, or he may be questioned specifically

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[1] Yamada, op. cit.

[2] Horn, op. cit., p. 343-344.

> about it. In the former case, the data are more accurate in detail but much less complete than those obtained by questioning, and the effect upon subsequent learning or retention is much less beneficial.
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> Third, the quality, content, and accuracy of pupils' answers are influenced by the nature of the questions asked. . . . Improper questions not only distort ideas by focusing upon certain facts or principles to the neglect of others but also may bring about imaginative constructs that are partly or wholly fictional . . . The effect of improper questioning must therefore be regarded as a matter for serious concern. Good questions, on the other hand, are as beneficial and essential as poor questions are harmful and unnecessary.
>
> Fourth, the attitude of the questioner, as well as that of the questioned, must be reckoned with as factors that determine not only a continuing interest in a problem but also the character of the ideas acquired. Both interest and thinking may easily be inhibited by improper attitudes on the part of the teacher, and even where this does not occur, the worst type of indoctrination often results. The teacher's attitude as well as his questions should stimulate inquiry, not discourage it.[1]

Cole attempted to provide the teacher with insight into the "how" of good questions and questioning. According to him the greatest skill in questioning was manifested not so much by the teacher asking effective questions, but, rather, by the teacher stimulating the pupils to formulate pertinent questions concerning the subject.[2] Cole's rationale exhibited a similarity to that underlying the recent emphasis on inquiry training, having the pupils question, search, evaluate, question again.

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[1]Horn, op. cit., p. 344-347.

[2]Percival R. Cole, The Method and Technique of Teaching (New York: Oxford University Press, 1933), p. 11.

Yamada, in his research on questioning, made a contribution to the development of a strategy of question usage. He compared the effectiveness of questioning or telling about pictures with that of questioning or telling about objects or events from real life. He concluded that the questioning sessions provided far greater range in supplying information. The narrative or telling activities, however, seemed to supply greater quality of thoughts. Yamada also exhibited concern with the position of questions in classroom discussion. He suggested that it is better to have a narrative session with free spontaneous reporting first, and then to engage in questioning activity.[1]

Taba, also, proposed specific teaching strategies employing questions to develop thinking. In one of her studies she attempted to facilitate the augmentation of thought under three optimum training conditions: (1) a curriculum designed for thought development; (2) teaching strategies focused explicitly on the mastery of cognitive skills; and (3) sufficient time span to permit a developmental sequence in this process development. She reported that questions can serve as a focus which includes the mental operations which pupils can perform, limits the points possible to explore, and influence the types of thinking students can develop. She stated that:

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[1]Yamada, op. cit., p. 180.

> A questioning strategy should provide for appropriate constraint within a structured freedom. Questions can be utilized as transition devices from one level of thought to another. They also can stimulate the formation of new conceptual schemes. . . . Questions should do more than stimulate the regurgitation of information. The discrimination of data is a skill which is prerequisite to performing the more sophisticated operations of inference making. A strategy of questions should stimulate and guide the direction of a knowledge, instead of providing a particular model or the end product of the search.[1]

She concluded that strategies utilizing questions emphasizing specific facts first and then proceeding to higher-level questions seem to produce an effective and persistent raising of thought to higher levels.[2]

One of the earliest investigations concerning the number of questions asked by teachers was the study conducted by Stevens. Stevens pointed out that:

> So far as our data furnishes evidence, the paramount conclusions regarding our ability to measure the efficiency of instruction by the number of questions are these: (1) a large number of questions is an indisputable index of bad teaching--except in some modern language and developmental lessons; (2) a small number of questions does not necessarily indicate good teaching.[3]

According to Steven's summary tables the indication is that, on the average, teachers asked a question every two

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[1]Hilda Taba, Samuel Levine and Freeman F. Elzey, Thinking in Elementary School Children. U.S. Department of Health, Education and Welfare, Office of Education, Cooperative Research Project No. 1574 (San Francisco: San Francisco State College, 1964), p. 200.

[2]*Ibid*., p. 207.

[3]Stevens, *op. cit*., p. 71.

minutes. History teachers asked an average of 81.2 questions per forty minute period, the number ranging from 41 to 142.[1] Horn reported that "subsequent counts made in recitation at all levels from the elementary school to college confirm these findings in a general way."[2]

Horn emphasized that the rapidity of questioning should be appraised in light of the various functions that questions serve. He stated:

> One cannot agree with Stevens that rapid and incisive questioning is always and necessarily objectionable. It has its place in checking or clarifying essential matters of fact, and stimulating simple deductions, and in putting vigor and direction in a lazy or wandering discussion, but these functions, while important, must be kept subordinate to the stimulation of interest, the encouragement of thinking and the organization of ideas. It is doubtless because none of these functions has been served, that rapid questioning has fallen into disrepute. . . . When, however, questions are asked at a rate of one or two a minute, the student has very little time to comprehend the question or formulate an answer. To be sure, in mere repetitive drill, or in reports on problems that have been previously raised and thought out, little time is required to formulate answers, but exercises of this type must be limited if formalism and verbal memorizing are to be avoided.[3]

Yamada called attention to the probability that individual differences of pupils are ignored and exceedingly superficial and inefficient habits of thought are developed

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[1] _Ibid._, p. 11.

[2] Horn, _op. cit._, p. 349.

[3] _Ibid._, p. 350.

as a result of too many questions or questions requiring quick answers. He emphasized that:

> Time should be considered in answering questions. Speedy answers emphasize quantity rather than quality. Sufficient time is needed for comprehension of the question correctly and to make correct comparisons, discrimination, and true inference, as well as called for right associations, or to make orderly associations with the old. . . . Any demand for speedy reactions deprives a child of time for suspension of judgment and for weighing the evidence pro and con; it prevents him from appealing to concrete experience latent in his mind, but encourages him to accept any suggestions from within as well as without, and to react at random. As a result such a method may bring about mental automatism, a habit of instinctive premature reaction.[1]

Houston, like Horn and Yamada, expressed the belief that questioning must be evaluated to a large extent, in terms of its contribution toward the realization of the purpose of instruction. The acceptance of the criterion of purpose, Houston pointed out, "prevents one from being arbitrary concerning the number of questions used, because the number becomes important only to the extent that quantity influences and becomes an aspect of quality."[2]

Houston elaborated:

> Teaching pupils how to think is one of the worthy and frequently mentioned aims in any subject fields. Facility in the art of expression is one means by which pupils indicate their ability to think and organize their thoughts. This ability can be acquired only by practice.

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[1] Yamada, op. cit., p. 174.

[2] V. M. Houston, "Improving the Quality of Classroom Questions and Questioning," Educational Administration and Supervision, XXIV (January, 1938), 18.

> Teachers who do not take time to formulate questions that demand the use of facts but who ask as many as 79 short, factual questions in a single class period are, consequently, denying to pupils the opportunity to think, to organize their thoughts, and to develop the art of expression.[1]

Though not abundant recent available research on the topic of questioning suggests that it still holds an important place in today's classroom. Questioning is commonly used as a technique of instruction. Floyd found in his analysis of the oral questioning activity in forty selected Colorado primary classrooms an overall questioning rate of nearly three-and-a-half questions per minute. Of the forty teachers in his study, nineteen asked more than three questions a minute on the average. In one classroom six-and-a-half questions per minute were asked. Nine teachers asked more than two hundred forty questions during the hour-long visitations. During the ten all-day visitations of these same teachers, Floyd found that the average teacher asked three hundred forty-eight questions daily.[2] An analysis of the taped discourses of these classrooms revealed that about seventy per cent of the oral expressions were delivered by the teacher and that ninety-three per cent of all questions were asked by teachers. Concerning quality of questions,

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[1] _Ibid._, p. 18-19.

[2] William D. Floyd, "An Analysis of the Oral Questioning Activity in Selected Colorado Primary Classrooms" (unpublished Ed.D. dissertation, Colorado State College, 1960), p. 139.

Floyd observed that questions capable of stimulating thinking were employed only slightly more than six per cent of the time. Forty-two per cent of the questions asked were memory questions. Teachers' oral questions seemed to be used primarily to check the recall of facts, not to stimulate thinking. Additionally depressing was his finding that pupils in the investigation generally did not receive opportunities to question and that little time was provided either before or after teacher-talk for pupils to raise questions or obtain additional information.[1]

In all the research concerned with teachers' questions and questioning behavior, researchers usually have devised unique criterion measures. Somewhat surprising is that the Taxonomy of Educational Objectives; Handbook I: Cognitive Domain, in existence for over a dozen years, has so seldom been employed as a guide for teachers' questions and as a means for their study. Recently, some research studies have used the Taxonomy as a guide in analysis of teaching behavior. For example, in the Ohio State University Research Study of Children's Critical Reading, a modified form of Bloom's Taxonomy was used to analyze the questioning behavior of twenty-four classroom teachers. King reported that the experimental teachers, those trained in the art of asking questions, asked proportionally more

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[1]Ibid., p. 170-174.

interpreting, analyzing, and evaluating questions. These teachers elicited from their pupils higher levels of thinking which were classified by the observers as inferring, illustrating, hypothesizing, theorizing, and evaluating. Improvement in pupil's ability to engage in higher levels of thinking was noted during the time of the study. King reported that:

> Pupils may become increasingly aware of the goals of reading instruction through the questions the teacher asks: and that when they clearly understand the expectations to think more deeply or in a variety of ways, they are motivated to meet the expectations.[1]

This part of the review of literature has pointed out the overemphasis of teachers on questioning for recognition and recall and for literal comprehension. The majority of researchers have pointed out the need to reduce the proportion of questions aimed at recalling facts and increase the proportion of questions calling for higher levels of thought.

Inquiry-Discovery Learning

The purpose of this section of the review of literature was to characterize the inquiry-discovery approach to science instruction in the elementary schools.

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[1]Martha L. King, "Evaluating Critical Reading," Developing Comprehension: Including Critical Reading; Compiled by Mildred A. Dawson (Newark: International Reading Association, 1968), 206-213.

The terms inquiry and discovery are commonplace in the writings and discussions of educators today. The proponents of inquiry and discovery bespeak their merits with missionary zeal ascribing to them all the advantages sought after by current authoritative curriculum designers. And yet the terms and even the ideas implied by these terms are not new. They are as ancient as Socrates, as historical as Dewey, and yet they are as comtemporary as their modern-day protagonists Bruner, Taba, Karplus, and others.

What explains the rekindled interest in these age old methods of learning? The comments of Miller help clarify this query.

> Thoughtful educationists have always been concerned with learning that goes beyond the mere taking in and storing away of someone else's knowing. They have always searched for ways to help learners experience and build upon native curiosity, the drive to find out, to understand, and to know at firsthand.[1]

Miller expressed the belief that inquiry and discovery teaching was not misplaced to be discovered again recently by examiners of past methods of successful teaching. He stated:

> Professionally and consciously or instinctively, sensitive teachers have always tried to arrange instructional conditions so that pupils would become seekers after meaning, users of information, discoverers of general principles, validators of first conclusions, and builders of values as well as memorizers of facts, concepts, and more general ideas.

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[1] Miller, op. cit., p. 550.

> In short, good teachers have always tried to help their pupils to become students.[1]

Taba suggested that "learning by discovery is not the completely new invention that some of its proponents as well as its critics seem to assume."[2] She traced her own exploration with discovery learning back to a 1904 publication, Preparation of the Child for Science, by Boole.[3] Taba asserted that Boole "developed ideas about learning and thinking that were amazingly similar to the characterization of discovery learning today."[4]

Taba also reminded her readers that some elements of the current conception of discovery learning can be attributed to Maria Montessori, though in a much more rigid form. Taba reported that Montessori "was interested in the sequence of mental development. She maintained that abstractions were always a result of individual experience and required 'pre-building' through a proper organization of these experiences."[5]

Taba outlined the emphasis in Dewey's teaching and writing by stating:

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[1] Ibid.

[2] Hilda Taba, "Learning by Discovery: Psychological and Educational Rationale," The Elementary School Journal, LXIV (March, 1963), 308.

[3] M. E. Boole, Preparation of the Child for Science (Oxford: Clarendon Press, 1904).

[4] Taba, op. cit.

[5] Ibid., p. 309.

Inquiry as a method of learning was, of course, central to all Dewey's teaching and writing. In his How We Think he developed the theoretical concept of the nature of inquiry and of reflective thought. He identified learning with thinking, and thinking with active discovery of relationships and organizing principles. He considered that quality of searching to be the prime motive power of thinking and, therefore, maintained that the problem-solving processes are essential to active learning.[1]

Relating the ideas of Dewey to more contemporary theories, Taba stated:

> These ideas could be matched almost point by point with current conceptions of the process of learning by discovery: helping learners get at the structure, or at the laws and principles of a subject, by allowing them to discover these laws and principles through intensive exploration of concrete instances; withholding verbalization of the basic principles until they are understood operationally and used intuitively; defining the process of learning as an active organization and reorganization of mental schemata with which to process information and to perceive relationships; strengthening the process of inference, that is, the process of going beyond that which is given.[2]

Concerning the contemporary emphasis on discovery learning, Taba emphasized that the learning by discovery rationale stresses the need to develop within the learner a strategy for cultivating active mental processes which enable the learner to understand the structure and logic of the science content. Taba wrote:

> The learner must construct his own conceptual schemata with which to process and to organize whatever information he receives. Teaching is directed to enabling the learner to establish a relationship between his existing schemata and the new phenomena and to remake or extend the schemata to accommodate new

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[1] Ibid.

[2] Ibid.

> facts and events. In doing this the learner has to decenter his current view of the situation or of the problem before him and reorganize his perception of it. He must also build a strategy of inquiry.[1]

In this strategy of inquiry, particularly in the field of science, a different view of content is involved. As Taba suggested:

> Content is seen not as an array of facts to be absorbed, but as something that has structure, namely, a way of organizing detailed facts in the light of some concepts and principles.[2]

Schwab suggested that one of the distinguishing characteristics of contemporary scientific inquiry is not simply to:

> . . . prove that such-and-such is true or to show that so-and-so occurred. . . . but it also involves a process of discovery--discovery in the very special sense of the construction of scientific knowledge by the interpretation of data through use of conceptual principles of the enquiry.[3]

Thus, the inquirer, in his study of science is not primarily seeking complete and unquestionable verification of "fact." He does not seek a "climactic terminus to a process of proof."[4] Instead, he seeks theory, theory in the sense of "an imposition of intellectual order, coherence, organization, upon data."[5]

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[1] *Ibid.*, p. 311.

[2] *Ibid.*

[3] J. J. Schwab, "The Teaching of Science Enquiry," *The Teaching of Science* (Cambridge: Harvard University Press, 1962), p. 31.

[4] *Ibid.*, p. 30.

[5] *Ibid.*

Schwab emphasized the importance of this inquiry-approach to science by stating:

> It is precisely such theory--such ordering, organizations, of data--which constitutes the outcomes of scientific enquiry as a process of discovery. This sense of "theory" is not entirely at odds with the sense it has in the progression "hypothesis-theory-fact," for it remains something intermediate, something which will be changed. The change, however, will not be merely in the direction of more and more "proof." Nor will the change end somewhere, once and for all, by transforming theory into "fact." For we must remember that the data embodied in the theory are not all possible data about the subject but only a highly restricted part or aspect of what is possible. Further, enquiry will disclose more, and more varied, data and these new bodies of data will require expanded, revised and new conceptions to confer order, organization, upon them.[1]

Schwab contrasted this inquiry approach of learning science to the textbook centered approach by stating:

> It is the almost total absence of this portrayal of science which marks the greatest disparity between science as it is and science as seen through most textbooks of science. We are shown conclusions of enquiry as if they were certain or nearly certain facts. Further, we rarely see these conclusions as other than isolated, independent "facts." Their coherence and organization--the defining marks of <u>scientific</u> knowledge--are underemphasized or omitted. And we catch hardly a glimpse of the other constituents of scientific enquiry: organizing principles, data, and the interpretation of data.[2]

The inherent danger in presenting laboratory exercises which lead to an inevitably correct solution is that this mode of teaching science leads the student to build an image of the scientist as being inevitably correct and

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[1] *Ibid*., p. 30-31.

[2] *Ibid*.

inflexible in his so-called "scientific-method."[1] Brandwein stated:

> Our purpose becomes clearer perhaps if we regard science not merely as a body of information about the world but as a way of learning more about the world. If we regard the scientist as a perpetual learner, as indeed he is, then we see a teacher of science to be similarly engaged; and in turn expect of the child no more than is to be found in a child free to seek, free to be curious, free to enquire; that is, we expect persistent learning--with the zest of creativity.[2]

Concerning the place of the facts of science in the scientific education of a child, Renner stated:

> They are the "raw material" needed to develop the facility of children with the process of inquiry. We cannot think in a vacuum; we must use facts. The facts which we use, however, are subject to change; these will not be a permanent part of our mental processes. We _use_ the facts of science to learn how to learn. But if we teach children the facts of science only, the development of ability to think and learn will not occur as a concomitant outcome. If, however, we concentrate our efforts upon developing the child's ability to learn science, many of the facts of science _will_ become known as such an outcome.[3]

Hurd does not discount nor disparage the acquisition of scientific knowledge or facts. He stressed:

> It is wasteful to teach facts divorced from a meaningful concept. When facts, which have meaning for the learner, are tied into a logically related conceptual pattern, retention is improved and insight is more likely to occur. After learning one pattern, a

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[1] Paul F. Brandwein, "Elements in a Strategy for Teaching Science in the Elementary School," _The Teaching of Science_ (Cambridge: Harvard University Press, 1962), p. 108.

[2] _Ibid._, p. 109.

[3] John W. Renner, _Science, Elementary School Children and Learning_. (Randolph, Wisconsin: Educators Progress Service, 1965), p. 8.

> student tends to respond more systematically to the alternatives in a new situation. An understanding of conceptual structure and training in inquiry help him select what is pertinent in a new situation. The test of learning is the extent to which a student is able to use a conceptual pattern and associated inquiry skills in new contexts.[1]

Carin and Sund pointed out the importance of facts in the study of science by stating that "Facts are the air of science. Without them the men of science can never rise. Without them . . . theories are vain surmises."[2] These authors reported that scientific facts have grown out of intensive studies of nature; studies which have resulted in related, verified bodies of knowledge which comprise the various subject matter fields of science. In explaining the relationship between scientific knowledge and the manner in which it is acquired, Carin and Sund stated:

> This organized and systematized subject matter is the product of scientific investigation. Schools have, however, traditionally overemphasized this product of science, the subject matter, and underemphasized or forgotten the process of science. A look at the process by which the subject matter is obtained reveals the dynamic nature of the scientific process, for facts become valid and cumulative only after they survive unrelenting scrutiny. Thus, scientific facts--although extremely necessary for any scientific

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[1] Paul DeH. Hurd, "Toward a Theory of Science Education Consistent With Modern Science," Readings in Science Education for the Elementary School, [Edward Victor and Marjorie S. Lerner; eds.] (New York: The Macmillan Company, 1967), p. 28.

[2] Arthur Carin and Robert B. Sund, Teaching Science Through Discovery (Columbus, Ohio: Charles E. Merrill Books, Inc., 1964), p. 4.

investigation--are only a product of the greater contribution of modern science, the process of inquiry.[1]

Carin and Sund contrasted the discovery emphasis in science instruction with science instruction aimed at and based on student memory by stating:

> Science education should stress the spirit of discovery characteristic of science. Both teachers and students find that science teaching and learning becomes a chore when approached as a series of facts to be memorized and regurgitated back on exams; nothing is more contrary to the spirit of science than this lecture-memorize-test method. This does not mean that concepts, theories, principles, and content areas are abandoned in our science curriculum; to the contrary, they can be learned better when approached from a discovery method. The student, while learning concepts, develops his skills in observing, checking, measuring, criticizing, and interpreting discoveries as well as other skills inherent in the prepared or scientific mind. Students cannot learn the skills nor grasp the true spirit of science unless they engage in discovery.[2]

Education and the Spirit of Science, the "Magna Carta of science education,"[3] included the following comment on the spirit of science:

> In the modern world the approach of rational inquiry--the mode of thought which underlies science and technology--is spreading rapidly and, in the process, is changing the world in profound ways. . . . The spirit of rational inquiry, driven by a belief in its efficacy and by restless curiosity, is . . . commonly called the spirit of science.[4]

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[1] Ibid.

[2] Ibid., p. 11.

[3] Fred W. Fox, "Education and the Spirit of Science: The New Challenge," The Science Teacher, XXXIII (November, 1966), 58.

[4] Educational Policies Commission, Education and the Spirit of Science (Washington, D.C.: National Education Association, 1966), p. 1.

One of the ways in which education and the spirit of science is "changing the world in profound ways" is by challenging the traditional values through which men have found direction for their lives. Fox, in a critique of this publication, emphasized that:

> The traditional value words . . . will not be found among its pages; love, honesty, beauty, patriotism. But other profound values are characterized by the enterprise called science, and are highly desirable as the content of education:
> 1. The longing to know and to understand
> 2. Questioning of all things
> 3. Search for data and their meaning
> 4. Demand for verification
> 5. Respect for logic
> 6. Consideration of premises
> 7. Consideration of consequences
>
> (The spirit of science) can enable entire peoples to use their minds with breadth and dignity and with striking benefit to their health and standard of living. It promotes individuality. It can strengthen man's efforts in behalf of world community, peace, and brotherhood. It develops a sense of one's power tempered by an awareness of the minute and tenuous nature of one's contributions. Insofar as an individual learns to live by the spirit of science, he shares in the liberation of mankind's intelligence and achieves an invigorating sense of participation in the spirit of the modern world. To communicate the spirit of science and to develop people's capacity to use its values should therefore be among the principal goals of education in our own and every country.[1]

Teachers cannot assist their students in the development of this spirit of science simply by dispensing to them the facts or products which this spirit has produced. Only when the child is permitted to be an active participant in a stimulating classroom environment can he ever hope to achieve the spirit of rational inquiry.

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[1]Fox, op. cit., p. 58-59.

When science is taught dogmatically and unscientifically certain damaging effects result. Boulos suggested that:

> When we teach this way, students get a distorted view of science and are seldom, if ever, exposed to science as a process; they miss the opportunity of perceiving science as man's attempt to interpret the universe. They do not see the skills and the attitudes which make up the scientific process. They fail to develop any skills, and consequently many of them miss the chance of becoming interested in science. What makes a scientist is not how much information he has stored in his memory, but the actual training he receives in the rigors of the scientific process: how he wonders about phenomena, how he observes, how he sets up controlled experiments, his willingness to withhold judgment, to admit that he is wrong when there is ample proof, and how much he realizes the limitations of science. These are some of the important traits that make up a scientist. Children are not given a chance to develop these traits when they only experience science as a group of final absolute "facts." This type of teaching defies the very goals of teaching science.[1]

The Oklahoma Curriculum Improvement Commission has pointed out that science is a natural vehicle by which a child's ability to think objectively is developed. This commission specified that:

> In order to accomplish this goal . . . the emphasis in science teaching must shift from the teaching of "facts" to the development of a child's ability to observe carefully, collect information, and draw logical inferences. In other words the child acquires <u>his</u> scientific information only through <u>his own</u> powers of observation and inductive inference. <u>The process</u>, therefore, <u>of arriving at an item of scientific</u>

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[1]Sami I. Boulos, "Are You Teaching Science Unscientifically," <u>Science and Children</u> (April, 1965), 25.

information becomes more important than the information obtained.[1]

When an "inquiry" approach to science instruction is utilized the child is benefitted in other ways. The child's interest in things around him is sustained; ability to think logically in other areas is increased; and opportunities to learn clear and concise expression in other areas are more likely to develop. All these abilities have value in the study of other disciplines.[2]

Renner and Ragan summarized the objectives of elementary-school science as follows: "(a) to begin to develop in the learner the ability to think and inquire, and (b) to familiarize the child with all phases of his environment."[3] These objectives can best be pursued by an inquiry-discovery approach to science instruction which progresses by a special method of investigation "in which a problem is analyzed; an experiment is imagined; experimental results are classified, compared and analyzed; an hypothesis is synthesized and tested and the results of these tests evaluated; generalizations are formed; and future results are inferred."[4]

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[1]The Oklahoma Curriculum Improvement Commission [William D. Carr, Chairman], The Improvement of Science Instruction in Oklahoma; Grades K-6, (Oklahoma State Department of Education, 1968), p. 1.

[2]Ibid.

[3]John W. Renner and William B. Ragan, Teaching Science in the Elementary School (New York: Harper and Row, Inc., 1968), p. 57.

[4]Ibid., p. 53.

In this special method of investigation each child makes his own inquiries and discoveries. He is permitted to observe scientific phenomena and interpret his observations as he views them. In short, the learner is allowed to discover in his own way.[1] Bruner believes that "the very attitudes and activities that characterize 'figuring-out' and 'discovering' things for oneself also seems to have the effect of making material more readily accessible in memory."[2]

Fish and Goldmark, in a recent presentation to the National Science Teachers Association, summarized the importance of questioning in inquiry science teaching. They stated:

> The kinds of questions we use determine the kinds of operations the children will perform. The questions we use outline the kinds of thinking, observing, and other behaving responses of the learners for which we, their teachers, search. Therefore, through looking at the various kinds of questions we ask, we can begin to build a picture of our own teaching behavior. Do we ask <u>only</u> questions which demand recall and then convince ourselves we are giving children opportunities to engage in higher level thinking? Do we ask <u>only</u> those questions which call for <u>our</u> answers and then convince ourselves we are stimulating divergent, creative behaviors in the children of our class? Do we often wait <u>after</u> our questions to give our students <u>time to think</u>, without jumping in to give them clues--just to keep the "noise" going? Over a period of several lessons, do we ask a <u>variety</u> of kinds of questions which stimulate the <u>range</u> of behaviors we

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[1] <u>Ibid</u>.

[2] J. S. Bruner, "The Act of Discovery," <u>Harvard Educational Review</u>, XXXI (1961), 32.

> may readily identify as aspects of sciencing in science education?[1]

Carin and Sund emphasized the need for proper questioning by teachers to get students actively involved in the intellectual activities of science. They reminded teachers that:

> By asking questions you require students to be active participants in the learning process. In answering your questions the students have to analyze what you ask and call upon their past and present experiences to make hypotheses before, during, and after the actual experiment. As they gather information from their observations of the experiment or demonstration they are guided to check their hypotheses; questions guide them in synthesizing their tentative conclusions.[2]

Renner and Ragan summarized the importance of questions in inquiry science instruction by stating: "Questions properly asked and the replies to them properly used are exceedingly important in teaching science by inquiry."[3]

These summary statements are much in agreement with the comments of reading authorities presented earlier concerning the role of questions and questioning in the teaching of reading. Researchers and theorists in both reading and science agree that to insure the maximum development of thinking skills and abilities in children, teachers must so structure their questions as to enable the students to go

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[1]Alphoretta S. Fish and Bernice Goldmark, "Inquiry Method: Three Interpretations," The Science Teacher, XXXIII (February, 1966), 13-14.

[2]Carin and Sund, *op. cit.*, p. 92.

[3]Renner and Ragan, *op. cit.*, p. 225.

beyond simple recall of facts and literal interpretation of materials read.

This part of the review of literature has pointed out the characteristics and intended contributions of the inquiry-discovery approach to science instruction in the elementary school. It is likely that if students are taught science via an inquiry-discovery approach they will learn not only the facts or products of science but also something about how to learn. This knowledge will assist them in all phases of their school careers.

CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

This study was conducted to determine whether differences exist between the types of questions asked while teaching reading by teachers educated in the Science Curriculum Improvement Study (SCIS), inquiry-discovery method of science instruction and teachers of reading not so educated.

Eight second and eight fourth grade reading teachers who had been instructed to teach by the SCIS, inquiry-discovery approach to science instruction were selected. A second group of eight second and eight fourth grade reading teachers who had not been instructed to teach by the SCIS, inquiry-discovery approach were also selected. Data were collected from two complete reading lessons for each reading group within each of the thirty-two classrooms. Transcriptions of these lessons were made. A classification of each question was made using an adaptation of the <u>Teacher Question Inventory</u>. The composite of the tabulations recorded under each of the nine categories of the <u>Teacher Question Inventory</u> were converted into proportions which were used in the statistical analyses of data. The normal standardized z score was the technique used for the statistical analyses since the data represented observed frequencies and such a score was derived for each category. Confidence level for z was set _a priori_ at the 0.05 level, which required a value for significance that was equal to or greater than 1.96.

Data for the Composite Second and Fourth Grade Teacher Groups

The data have been organized in various manners to make available to the reader the general information central to its interpretation. Composite frequencies and proportions for each of the nine categories of the _Teacher Question Inventory_ for all SCIS-educated second and fourth grade reading teachers are presented in Table I. Table II presents the composite frequencies and proportions for each of the nine categories of the _Teacher Question Inventory_ for all non-SCIS educated second and fourth grade reading teachers. Proportions and z scores for the _Teacher Question Inventory_ categories of the composite SCIS and non-SCIS educated second and fourth grade teacher groups are presented in Table III.

To accomplish the purpose of this study, twenty-seven hypotheses were established to be tested. Hypotheses 1-9 are related to the combined second and fourth grade SCIS-educated reading teachers and the combined non-SCIS educated reading teachers. Hypothesis 1 is that there is no significant difference between the proportion of _recognition_ questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 12.19 which is a statistically significant difference in favor of the non-SCIS educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated reading teachers were of the type requiring only recognition of the correct option when two or more choices are presented to the student.

TABLE I

COMPOSITE FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE SCIS-EDUCATED SECOND AND FOURTH GRADE TEACHERS

Types of questions	Number	Proportion
Recognition	622	.1555
Recall	1363	.3407
Demonstration of Skills	111	.0277
Translation	414	.1035
Interpretation	270	.0675
Analysis	448	.1119
Synthesis	75	.0187
Opinion	616	.1540
Attitude	82	.0205
TOTALS	4001	

TABLE II

COMPOSITE FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE NON-SCIS EDUCATED SECOND AND FOURTH GRADE TEACHERS

Types of questions	Number	Proportion
Recognition	1086	.2662
Recall	1784	.4374
Demonstration of Skills	135	.0331
Translation	307	.0753
Interpretation	144	.0353
Analysis	145	.0355
Synthesis	3	.0007
Opinion	451	.1106
Attitude	24	.0059
TOTALS	4079	

Hypothesis 2 is that there is no significant difference between the proportion of recall questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 8.91 which is a statistically significant difference in favor of the non-SCIS educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated reading teachers were of the recall type requiring only the retrieval of small pieces of factual material previously read.

TABLE III

PROPORTIONS AND z SCORES FOR THE TEACHER QUESTION INVENTORY CATEGORIES OF THE COMPOSITE SCIS AND NON-SCIS EDUCATED SECOND AND FOURTH GRADE TEACHERS

	SCIS	NON-SCIS		
Questions	Proportions	Proportions	Difference in Proportions	z
Recognition	.1555	.2662	.1108	12.19*
Recall	.3407	.4374	.0967	8.91*
Demonstration of Skill	.0277	.0331	.0054	1.40
Translation	.1035	.0753	.0282	4.45*
Interpretation	.0675	.0353	.0322	6.56*
Analysis	.1119	.0355	.0764	13.16*
Synthesis	.0187	.0007	.0180	8.28*
Opinion	.1540	.1106	.0434	5.76*
Attitude	.0205	.0059	.0146	5.80*

*Significant at the 0.05 level.

Hypothesis 3 is that there is no significant difference between the proportion of demonstration of skills questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 1.40. This fell below the established level of significance and was interpreted to indicate no significant difference between the two groups of teachers in the proportion of demonstration of skills questions requiring the student to demonstrate an understanding of a generalization or principle by applying it to an actual lifelike problem or practical social situation. The hypothesis of no significant difference was accepted.

Hypothesis 4 is that there is no significant difference between the proportion of translation questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 4.45 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type which require the student to change words, ideas, and pictures into different symbolic form.

Hypothesis 5 is that there is no significant difference between the proportion of interpretation questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 6.56 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type requiring the student to identify and comprehend the major ideas which are included in a communication as well as understand their relationship.

Hypothesis 6 is that there is no significant difference between the proportion of analysis questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 13.16 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type emphasizing the breakdown of material into its constituent parts and detection of the relationship of the parts and of the way they are organized.

Hypothesis 7 is that there is no significant difference between the proportion of synthesis questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 8.28 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type requiring the student to put together the elements and parts of a communication so as to form a whole and to convey to others ideas, feelings, and experiences related to the communication.

Hypothesis 8 is that there is no significant difference between the proportion of opinion questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 5.76 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type directed at the student's beliefs or opinions where he is fully aware of the bases on which he is forming his appraisals.

Hypothesis 9 is that there is no significant difference between the proportion of attitude or value questions asked by reading teachers educated in the SCIS, inquiry-discovery method of science instruction and reading teachers not so educated. The obtained z score was 5.80 which is a statistically significant difference in favor of the SCIS-educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated reading teachers were of the type which permit the student to display a particular behavior or to communicate to others about it.

Data for the Second Grade Teacher Groups

Frequencies and proportions for each of the nine categories of the Teacher Question Inventory for all SCIS-educated second grade reading teachers are presented in Table IV. Table V presents the frequencies and proportions for each of the nine categories of the Teacher Question Inventory for all non-SCIS educated second grade teachers. Proportions and z scores for the Teacher Question Inventory categories of the SCIS and non-SCIS educated second grade teacher groups are presented in Table VI.

TABLE IV

FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE SCIS-EDUCATED SECOND GRADE TEACHERS

Types of questions	Number	Proportions
Recognition	354	.1680
Recall	737	.3498
Demonstration of Skills	66	.0313
Translation	229	.1087
Interpretation	97	.0460
Analysis	194	.0921
Synthesis	30	.0412
Opinion	351	.1666
Attitudes	49	.0233
TOTALS	2107	

TABLE V

FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE NON-SCIS EDUCATED SECOND GRADE TEACHERS

Types of questions	Number	Proportions
Recognition	770	.3020
Recall	1074	.4212
Demonstration of Skills	105	.0412
Translation	195	.0765
Interpretation	63	.0247
Analysis	53	.0208
Synthesis	2	.0008
Opinion	270	.1059
Attitudes	18	.0071
TOTALS	2550	

Hypotheses 10-18 are related to the second grade SCIS and non-SCIS educated reading teachers. Hypothesis 10 is that there is no significant difference between the proportion of recognition questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 10.63 which is a statistically significant difference in favor of the non-SCIS educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated second grade reading teachers were of the type requiring only recognition of the correct option when two or more choices are presented to the student.

TABLE VI

PROPORTIONS AND z SCORES FOR THE TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIS AND NON-SCIS EDUCATED SECOND GRADE TEACHERS

	SCIS	NON-SCIS		
Questions	Proportions	Proportions	Difference in Proportions	z
Recognition	.1680	.3020	.1340	10.62*
Recall	.3498	.4212	.0714	4.97*
Demonstration of Skill	.0313	.0412	.0099	1.78
Translation	.1087	.0756	.0322	3.80*
Interpretation	.0460	.0247	.0213	3.98*
Analysis	.0921	.0208	.0713	10.81*
Synthesis	.0412	.0008	.0315	5.53*
Opinion	.1666	.1059	.0607	6.07*
Attitude	.0233	.0071	.0162	4.62*

*Significant at the 0.05 level.

Hypothesis 11 is that there is no significant difference between the proportion of recall questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 4.97 which is a statistically significant difference in favor of the non-SCIS educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated second grade reading teachers were of the recall type requiring only the retrieval of small pieces of factual material previously read.

Hypothesis 12 is that there is no significant difference between the proportion of demonstration of skills questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 1.78. This fell below the established level of significance and was interpreted to indicate no significant difference between the two groups of teachers in the proportion of demonstration of skills questions requiring the student to demonstrate an understanding of a generalization or principle by applying it to an actual life-like problem or practical social situation. The hypothesis of no significant difference was accepted.

Hypothesis 13 is that there is no significant difference between the proportion of translation questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was

3.80 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type which require the student to change words, ideas, and pictures into different symbolic form.

Hypothesis 14 is that there is no significant difference between the proportion of interpretation questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 3.98 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type requiring the student to identify and comprehend the major ideas which are included in a communication as well as understand their relationship.

Hypothesis 15 is that there is no significant difference between the proportion of analysis questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 10.81 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type emphasizing the breakdown of material into its constituent parts and detection of the relationship of the parts and of the way they are organized.

Hypothesis 16 is that there is no significant difference between the proportion of synthesis questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z score was 5.53 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type requiring the student to put together the elements and parts of a communication so as to form a whole and to convey to others ideas, feelings, and experiences related to the communication.

Hypothesis 17 is that there is no significant difference between the proportion of opinion questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained z

score was 6.07 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type directed at the student's beliefs or opinions where he is fully aware of the bases on which he is forming his appraisals.

Hypothesis 18 is that there is no significant difference between the proportion of attitude or value questions asked by second grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and second grade reading teachers not so educated. The obtained Z score was 4.62 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated second grade reading teachers were of the type which permit the student to display a particular behavior or to communicate to others about it.

Data for the Fourth Grade Teacher Groups

Frequencies and proportions for each of the nine categories of the Teacher Question Inventory for all SCIS-educated fourth grade reading teachers are presented in Table VII. Table VIII presents the frequencies and proportions for each of the nine categories of the Teacher Question

Inventory for all non-SCIS educated fourth grade teachers. Proportions and z scores for the Teacher Question Inventory categories of the SCIS and non-SCIS educated fourth grade teacher groups are presented in Table IX.

TABLE VII

FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE SCIS-EDUCATED FOURTH GRADE TEACHERS

Types of questions	Number	Proportions
Recognition	268	.1415
Recall	626	.3305
Demonstration of Skills	45	.0238
Translation	185	.0977
Interpretation	173	.0929
Analysis	254	.1341
Synthesis	45	.0238
Opinion	265	.1400
Attitudes	33	.0174
TOTALS	1894	

Hypotheses 19-27 are related to the fourth grade SCIS and non-SCIS educated reading teachers. Hypothesis 19 is that there is no significant difference between the proportion of recognition questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 5.04 which is a statistically significant difference in favor of the non-SCIS educated reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated fourth grade reading teachers were of the type requiring only recognition of the correct option when two or more choices are presented to the student.

TABLE VIII

FREQUENCIES AND PROPORTIONS FOR THE TEACHER QUESTION INVENTORY FOR THE NON-SCIS EDUCATED FOURTH GRADE TEACHERS

Types of questions	Number	Proportions
Recognition	316	.2067
Recall	710	.4644
Demonstration of Skills	30	.0196
Translation	112	.0733
Interpretation	81	.0530
Analysis	92	.0602
Synthesis	1	.0007
Opinion	181	.1184
Attitudes	6	.0040
TOTALS	1526	

TABLE IX

PROPORTIONS AND z SCORES FOR THE TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIS AND NON-SCIS EDUCATED FOURTH GRADE TEACHERS

	SCIS	NON-SCIS		
Questions	Proportions	Proportions	Difference in Proportions	z
Recognition	.1415	.2067	.0652	5.04*
Recall	.3305	.4644	.1338	7.97*
Demonstration of Skill	.0238	.0196	.0041	.82
Translation	.0977	.0733	.0244	2.52*
Interpretation	.0929	.0530	.0400	4.43*
Analysis	.1341	.0602	.0741	7.13*
Snythesis	.0238	.0007	.0231	5.83*
Opinion	.1400	.1184	.0215	1.86
Attitude	.0174	.0040	.0135	3.70*

*Significant at the 0.05 level.

Hypothesis 20 is that there is no significant difference between the proportion of recall questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 7.97 which is a statistically significant difference in favor of the non-SCIS educated fourth grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the non-SCIS educated fourth grade reading teachers were of the recall type requiring only the retrieval of small pieces of factual material previously read.

Hypothesis 21 is that there is no significant difference between the proportion of demonstration of skills questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was .82. This fell below the established level of significance and was interpreted to indicate no significant difference between the two groups of teachers in the proportion of demonstration of skills questions requiring the student to demonstrate an understanding of a generalization or principle by applying it to an actual lifelike problem or practical social situation. The hypothesis of no significant difference was accepted.

Hypothesis 22 is that there is no significant difference between the proportion of translation questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 2.52 which is a statistically significant difference in favor of the SCIS-educated fourth grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated fourth grade reading teachers were of the type which require the student to change words, ideas, and pictures into different symbolic form.

Hypothesis 23 is that there is no significant difference between the proportion of <u>interpretation</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 4.43 which is a statistically significant difference in favor of the SCIS-educated second grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated fourth grade reading teachers were of the type requiring the student to identify and comprehend the major ideas which are included in a communication as well as understand their relationship.

Hypothesis 24 is that there is no significant difference between the proportion of <u>analysis</u> questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 7.13 which is a statistically significant difference in favor of the SCIS-educated fourth grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated fourth grade reading teachers were of the type emphasizing the breakdown of material into its constituent parts and detection of the relationship of the parts and of the way they are organized.

Hypothesis 25 is that there is no significant difference between the proportion of synthesis questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 5.83 which is a statistically significant difference in favor of the SCIS-educated fourth grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated fourth grade reading teachers were of the type requiring the student to put together the elements and parts of a communication so as to form a whole and to convey to others ideas, feelings, and experiences related to the communication.

Hypothesis 26 is that there is no significant difference between the proportion of opinion questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 1.86. This fell below the established level of significance and was interpreted to indicate no significant difference between the two groups of teachers in the proportion of opinion questions directed at the student's beliefs or opinions where he is fully aware of the bases on which he is forming his appraisals. The hypothesis of no significant difference was accepted.

Hypothesis 27 is that there is no significant difference between the proportion of attitude or value questions asked by fourth grade reading teachers educated in the SCIS, inquiry-discovery method of science instruction and fourth grade reading teachers not so educated. The obtained z score was 3.70 which is a statistically significant difference in favor of the SCIS-educated fourth grade reading teachers. The hypothesis was rejected. The results indicated that a significantly larger proportion of the questions asked by the SCIS-educated fourth grade reading teachers were of the type which permit the student to display a particular behavior or to communicate to others about it.

Summary

On the basis of the analyses of these data, twenty-three of the twenty-seven statistical hypotheses were rejected. For all second grade teachers used in this study the results of the statistical analyses of data taken from their reading lessons indicated that non-SCIS educated reading teachers asked a significantly larger proportion of questions requiring recognition and recall of information. SCIS-educated second grade reading teachers asked a significantly larger proportion of questions requiring of students higher cognitive processes of translation, interpretation, analysis, and synthesis. In the affective domain emphasizing a feeling tone, an emotion, or a degree of acceptance or rejection, SCIS-educated second grade reading teachers asked a significantly larger proportion of questions which permitted the expression of an opinion or an attitude or value. For second grade teachers of reading there was no significant difference in the proportion of questions requiring a demonstration of skill.

For all fourth grade teachers used in this study the results of the statistical analyses of data taken from their reading lessons indicated that non-SCIS educated reading teachers asked a significantly larger proportion of questions requiring of students recognition and recall of information. SCIS-educated fourth grade reading teachers asked a significantly larger proportion of questions requiring of students higher cognitive processes of translation, interpretation, analysis, and synthesis. In the affective domain, SCIS-educated fourth grade teachers asked a significantly larger proportion of questions which permitted an expression of an attitude or value. For fourth grade teachers of reading there was no significant difference in the proportion of questions requiring a demonstration of skill or permitting the expression of an opinion.

The results of the statistical analyses of data from the combined second and fourth, SCIS and non-SCIS educated teachers of reading, indicated that non-SCIS educated teachers asked a significantly larger proportion of questions requiring recognition and recall of information. SCIS-educated reading teachers asked a significantly larger proportion of questions requiring of students higher cognitive processes of translation, interpretation, analysis, and synthesis. In the affective domain, SCIS-educated reading teachers asked a significantly larger proportion of questions which permitted an expression of an opinion or an attitude or value. For the combined second and fourth grade, SCIS and non-SCIS educated reading teachers there was no significant difference in the proportion of questions requiring a demonstration of skill.

CHAPTER IV

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine whether elementary school reading teachers who have been instructed in one of the "new," inquiry-discovery methods of teaching science in the elementary school ask a significantly different proportion of divergent questions while teaching reading than elementary school reading teachers not so instructed. Sixteen teachers from the Norman Public Schools who have been instructed in the Science Curriculum Improvement Study (SCIS) and who have had the opportunity to teach SCIS science to their classes were selected. These eight second and eight fourth grade teachers had received instruction from the director of the trial center for the Science Curriculum Improvement Study at the University of Oklahoma. The eight second and eight fourth grade non-SCIS instructed teachers had received no instruction in any of the "new," inquiry-discovery approaches to teaching elementary school science. The two groups of teachers were similar in terms of years of teaching experience, level of educational attainment, and age. Recordings of two complete reading lessons for each reading group within each of the thirty-two classes were made. Transcriptions of these recordings were used to place each question into one of nine categories of the Teacher Question Inventory. For each of the four groups of teachers, composite tabulations for each question category were determined and converted into proportions. Statistical analyses using the normal standardized z score were made to determine whether differences in observed proportions existed. The level of significance was established at 0.05.

Two problem hypotheses in this study suggested that SCIS-educated teachers would ask a greater number of questions while teaching reading than non-SCIS educated reading teachers, and the proportion of questions aimed at cognitive levels above recognition and recall of knowledge would be proportionally greater for the SCIS-educated teachers.

Statistical hypotheses of no significant difference between the proportions of questions in the nine categories of the Teacher Question Inventory for: (1) composite SCIS-educated second and fourth grade reading teachers and the composite non-SCIS educated second and fourth grade reading teachers; (2) second grade SCIS and second grade non-SCIS educated reading teachers; and (3) fourth grade SCIS and fourth grade non-SCIS educated reading teachers were established. In all, twenty-seven statistical hypotheses were tested. Of the nine question categories in the Teacher Question Inventory, seven were in the cognitive domain and included solicitations which dealt with the "recall or recognition of knowledge and the development of intellectual abilities and skills."[1] The two remaining question categories were in the affective domain which included solicitations which dealt with opinions, attitudes, and values.

Findings

The total number of questions asked by all teachers was 8,080. Of this number the non-SCIS educated teachers asked 4,079, or 1.02 times as many as the total of 4,001 asked by the SCIS-educated teachers.

The total number of questions asked by all second grade teachers was 4,657. Of this number the non-SCIS educated second grade teachers asked 2,550 questions, or 1.21 times as many as the total of 2,107 asked by the SCIS-educated second grade teachers.

The total number of questions asked by all fourth grade teachers was 3,423. Of this number the SCIS-educated fourth grade teachers asked 1,894 questions, or 1.24 times as many as the total of 1,529 asked by the non-SCIS educated fourth grade teachers.

Eighty-three per cent of the questions asked by the SCIS-educated teachers were classified as cognitive questions and seventeen per cent of their questions were classified as being of an affectivity nature.

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[1] Bloom, op. cit., p. 7.

Eighty-eight per cent of the questions asked by the non-SCIS educated teachers were classified as cognitive questions and twelve per cent of their questions were classified as affective.

Eighty-one per cent of the questions asked by the SCIS-educated second grade teachers were classified as cognitive questions and nineteen per cent of their questions were classified as affective.

Eighty-nine per cent of the questions asked by the non-SCIS educated second grade teachers were classified as cognitive questions and eleven per cent of their questions were classified as affective.

Eighty-four per cent of the questions asked by the SCIS-educated fourth grade teachers were classified as cognitive questions and sixteen per cent of their questions were classified as affective.

Eighty-eight per cent of the questions asked by the non-SCIS educated fourth grade teachers were classified as cognitive questions and twelve per cent of their questions were classified as affective.

Fifty-seven per cent of the cognitive questions asked by the SCIS-educated teachers were convergent questions requiring only recognition or recall of knowledge.

Eighty per cent of the cognitive questions asked by the non-SCIS educated teachers were convergent questions.

Sixty-four per cent of the cognitive questions asked by the SCIS-educated second grade teachers were convergent questions.

Eighty-two per cent of the cognitive questions asked by the non-SCIS educated second grade teachers were convergent questions.

Fifty-six per cent of the cognitive questions asked by the SCIS-educated fourth grade teachers were convergent questions.

Seventy-six per cent of the cognitive questions asked by the non-SCIS educated fourth grade teachers were convergent questions requiring only recognition or recall of knowledge.

SCIS-educated second grade teachers asked, on the average, 3.0 questions per minute. Non-SCIS educated second grade teachers asked, on the average, 3.1 questions per minute.

SCIS-educated fourth grade teachers asked, on the average, 3.0 questions per minute. Non-SCIS educated fourth grade teachers asked, on the average, 2.8 questions per minute.

The following findings from the statistical analyses of data are considered the most significant:

Recognition and recall questions were used significantly more by both second and fourth grade non-SCIS educated reading teachers.

Translation, interpretation, analysis, and synthesis questions were used significantly more by both second and fourth grade SCIS-educated reading teachers.

Questions permitting the expression of opinion were used significantly more by second grade SCIS-educated than non-SCIS educated second grade reading teachers.

Attitude or value solicitations which permitted the students to display a particular behavior or to communicate to others about it were used significantly more by both second and fourth grade SCIS-educated reading teachers.

Recall questions were used more than any other type of question in all teacher groups. Recall questions accounted for thirty-four per cent of the questions asked by SCIS-educated teachers and forty-four per cent of the questions asked by the non-SCIS educated teachers.

For questions categorized demonstration of skills, the results indicated no significant difference between the SCIS and non-SCIS educated teachers.

Conclusions

From the results of this investigation the following conclusions were derived:

The null hypothesis of no significant difference between the questioning behavior of SCIS-educated and non-SCIS educated reading teachers was rejected as untenable, since twenty-three of the twenty-seven comparisons reported in Tables III, VI, and IX revealed differences significant at the 0.05 level of confidence.

Non-SCIS educated second and fourth grade teachers of reading, as evidenced by the data in this study, dwell in the literal comprehension areas of recognition and recall.

The questions asked by the non-SCIS educated teachers were, generally, of a very low quality. These questions tended to limit the patterns of understanding to strictly recognition and recall items rather than engaging the students in higher levels of thought.

The fact that so many questions asked by non-SCIS educated teachers required the use of memory may be indicative that acquisition and retention of knowledge was the goal of their instruction.

The questioning skill of the non-SCIS instructed teachers was not highly developed. There was substantial evidence to support the idea that the oral question was not generally wisely and thoughtfully used. It seemed apparent that these teachers did not understand the methodology of effective oral questioning and tended to misuse the oral question.

Because these teachers were not skillful oral questioners certain educational advantages inherent in the [illegible]er use of oral questioning were not being realized.

Though the results of statistical analyses indicated significant differences in the proportions of recognition and recall questions in favor of the non-SCIS educated reading teachers, it should be noted that all observed teachers asked a disproportionately high percentage of questions which are least conducive to building thinking skills in students.

As a result of overusing the memory categories, many teachers tended to offer students too few questions requiring demonstration of skills, translation, interpretation, analysis and synthesis.

Demonstration of skills questions were used very little by any of the teachers. Apparently, demonstration of skills questions are asked in reading lessons at times other than during the discussions of the stories. Teachers may provide opportunities for demonstration of skills during the introduction of the story, presentation of background information, development of new vocabulary, or completion of student work-book exercises.

Second and fourth grade teachers used in this study who had been instructed in the SCIS, inquiry-discovery method of science instruction asked greater proportions of questions which called for higher levels of thought than teachers in the study not so instructed. This may, in part at least, be attributable to the methodology used in the inquiry-discovery science instruction. Throughout the instructional period pre-service and in-service teachers were exposed to a variety of questioning techniques; discussions were conducted on the kinds and purposes of questions classroom teachers may ask and the concomitant thinking skills that are stimulated by these questions; and many high-level questions were utilized to exemplify the methodology of proper questioning. One may assume that teachers transferred this theoretical and practical use of questions and questioning into the area of reading instruction.

Recommendations

Replication of this study would be informative and would provide a broader base for conclusions. The study could be modified to include a larger number of teachers at all elementary school grade levels. The number and types of reading lessons could be expanded to include all the various instructional lessons engaged in by reading teachers.

A study designed to determine the extent to which proper questioning influences achievement in reading or any other content subject would be desirable. If higher cognitive levels of questions prove capable of stimulating higher achievement, then teachers should be using these questions in greater proportions than they currently do.

An experimental study could be conducted to determine the extent to which higher level teachers' questions influence the types of questions employed by students as they engage in discussions or ask questions of each other or their teachers.

An instructional program in question construction should be made a part of teacher-preparatory courses at colleges and universities. With emphasis placed on the types and purposes of questions characterizing the taxonomy of questions, on furnishing guidelines for use in question formation, and on experiences in designing questions, both pre-service and in-service teachers could have the opportunity to improve their questioning practices. Teachers must be made aware of the importance of the oral question and be sensitive to the value of skillful, purposeful questioning. Bloom's Taxonomy would be an appropriate tool for classifying the various types of questions teachers ask and for making judgments concerning the degree to which individual teachers are asking questions which are capable of stimulating high-level thinking. Student teaching seminars would be an appropriate place to consider questioning. Tape recordings of elementary school classroom discussions could be played, after which students could discuss the question-asking practices employed in the recorded lesson.

An experimental study could be conducted to determine the effectiveness of a carefully planned instructional program designed to assist prospective and in-service teachers in developing skill in the art of oral questioning.

An analytical study of the types of questions recommended by authors of basal reading series would reveal the extent to which the proposed guide questions printed in the teachers' manuals facilitate the teaching of thinking skills. Recommendations for supplementing proposed guide questions with specific types of high-level questions could be made. This would enable teachers, desiring to achieve a particular cognitive objective, to incorporate an effective strategy of questioning into their teaching.

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APPENDIX A

TEACHER QUESTION INVENTORY

TEACHER QUESTION INVENTORY*

Teacher________________ School____________ Grade____
Time________________ to________________ Date_________

TABULATION WORKSHEET

Question Types / Examples	Tallies	Total
A. COGNITION		
1. Recognition (Which of these? Was it this way or that? Where does it say......? etc.)		
2. Recall (Who? What? When? etc.)		
3. Demonstration of Skill (Divide into syllables.....? Locate in the dictionary..... What does that sentence mean?)		
4. Translation (Dramatize.......Draw a picture of..... Tell the story in your own words.)		
5. Interpretation (Put the following ideas in correct sequence. Engineer is to train as_____is to ship. Why was Henry sad because he could not go fishing?)		
6. Analysis (How are they similar? What is the main idea? Give a modern-day illustration of the fable.)		
7. Synthesis (What general principle do you see in this? What would it be like to.......?)		
B. AFFECTIVITY		
8. Opinion (What is your opinion on this issue? What do you suppose? How do you feel about this situation? What was the most beautiful sight we saw on our trip?)		
9. Attitudes or Values (Should the boy be punished? Why do you believe that to be right? What would you have done? Why?)		
TOTAL--ALL TYPES		

*Adapted from the "Teacher Question Inventory" by Kenneth E. McIntyre and Ben M. Harris. (Austin: University of Texas Press, 1964).

APPENDIX B

LETTER OF PERMISSION TO USE THE <u>TEACHER QUESTION INVENTORY</u>

THE UNIVERSITY OF TEXAS
College of Education
Austin 78712

October 10, 1968

Mr. Denny Porterfield
Special Instructor
College of Education
University of Oklahoma
Norman, Oklahoma 73069

Dear Mr. Porterfield:

You have my permission to use the Teacher Question Inventory for your research efforts. Please make reference to the source of the instrument, and send me a summary of your study.

Sincerely,

Ben M. Harris
Professor

BMH/sh

APPENDIX C

RAW DATA

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY SECOND GRADE TEACHER GROUP

Teacher	Recognition	Recall	Demonstration of Skill
1	8	23	7
	22	73	1
2	27	60	18
	11	53	0
3	22	23	3
	60	34	9
4	4	51	4
	20	53	6
5	19	48	3
	18	36	5
6	25	56	0
	27	51	1
7	9	34	0
	48	41	2
8	18	26	4
	16	75	3

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY SECOND GRADE TEACHER GROUP

Teacher	Translation	Interpretation	Analysis
1	2 25	1 4	9 18
2	30 6	6 5	16 12
3	11 14	6 10	2 10
4	14 17	17 6	35 8
5	8 15	3 4	3 18
6	11 28	3 9	5 24
7	10 25	6 6	18 14
8	9 4	5 6	0 2

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY SECOND GRADE TEACHER GROUP

Teacher	Synthesis	Opinion	Attitude
1	3	29	4
	1	32	0
2	6	45	2
	1	23	1
3	2	9	1
	5	36	12
4	5	21	10
	0	13	3
5	1	15	3
	2	15	1
6	2	33	1
	1	49	9
7	0	18	1
	0	6	1
8	1	1	0
	0	6	0

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED SECOND GRADE TEACHER GROUP

Teacher	Recognition	Recall	Demonstration of Skill
1	69	76	3
	66	89	2
2	13	47	17
	29	37	7
3	16	45	14
	19	125	0
4	91	94	23
	54	140	3
5	30	36	0
	25	47	0
6	84	47	6
	34	45	5
7	72	68	13
	97	60	12
8	25	68	1
	46	50	0

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED SECOND GRADE TEACHER GROUP

Teacher	Translation	Interpretation	Analysis
1	6	0	0
	18	4	3
2	4	11	0
	6	7	0
3	9	0	0
	10	8	7
4	26	16	3
	9	3	0
5	8	1	2
	6	3	9
6	20	0	0
	8	0	3
7	25	4	13
	30	4	13
8	9	1	0
	1	1	0

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED SECOND GRADE TEACHER GROUP

Teacher	Synthesis	Opinion	Attitude
1	0	24	1
	0	29	1
2	0	7	2
	0	0	0
3	0	4	0
	0	8	0
4	0	53	0
	0	37	0
5	0	8	0
	1	19	6
6	1	22	0
	0	15	2
7	0	22	0
	0	6	0
8	0	14	6
	0	2	0

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY FOURTH GRADE TEACHER GROUP

Teacher	Recognition	Recall	Demonstration of Skill
1	26	56	2
	20	37	0
2	17	57	0
	14	41	5
3	6	33	7
	8	24	4
4	15	50	5
	17	57	10
5	35	42	1
	20	27	1
6	45	48	6
	17	39	1
7	3	28	0
	1	8	0
8	16	33	2
	8	46	1

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY FOURTH GRADE TEACHER GROUP

Teacher	Translation	Interpretation	Analysis
1	5	8	10
	4	4	6
2	31	28	30
	17	52	23
3	4	4	6
	7	0	10
4	5	4	11
	31	9	15
5	18	17	17
	16	5	29
6	18	27	29
	10	0	27
7	0	4	17
	3	1	9
8	11	7	6
	5	3	9

TEACHER QUESTION INVENTORY CATEGORIES FOR THE SCIENCE CURRICULUM IMPROVEMENT STUDY FOURTH GRADE TEACHER GROUP

Teacher	Synthesis	Opinion	Attitude
1	2	3	0
	3	9	0
2	0	26	1
	0	15	1
3	0	5	0
	5	7	0
4	1	25	2
	5	20	7
5	8	19	0
	8	42	7
6	5	30	1
	7	12	0
7	0	14	1
	0	23	4
9	0	8	2
	1	7	7

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED FOURTH GRADE TEACHER GROUP

Teacher	Recognition	Recall	Demonstration of Skill
1	5	69	0
	7	36	1
2	46	30	1
	7	20	6
3	12	62	5
	32	70	10
4	26	51	1
	23	47	0
5	0	6	0
	1	13	0
6	57	57	3
	20	42	0
7	12	30	0
	10	78	0
8	49	54	0
	9	45	3

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED FOURTH GRADE TEACHER GROUP

Teacher	Translation	Interpretation	Analysis
1	0 0	5 4	2 0
2	4 12	17 12	18 11
3	3 6	3 3	0 1
4	29 10	9 5	9 6
5	11 1	3 1	1 2
6	9 3	4 8	6 8
7	1 7	2 1	8 8
8	13 3	3 1	7 5

TEACHER QUESTION INVENTORY CATEGORIES FOR THE NON-SCIS EDUCATED FOURTH GRADE TEACHER GROUP

Teacher	Synthesis	Opinion	Attitude
1	0 0	20 14	0 2
2	0 0	6 13	3 0
3	0 0	1 8	0 0
4	0 0	18 4	0 0
5	0 0	1 7	0 0
6	0 0	18 24	0 0
7	0 0	9 13	0 0
8	1 0	19 6	0 1