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THE REACTIONS OF SELECTED ELEMENTARY TEACHERS TO THE TRAINING FOR AND IMPLEMENTATION OF THE SCIENCE CURRICULUM IMPROVEMENT STUDY IN SELECTED SCHOOLS IN MICHIGAN

By

Steven M. Barnes

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ABSTRACT

THE REACTIONS OF SELECTED ELEMENTARY TEACHERS TO THE TRAINING FOR AND IMPLEMENTATION OF THE SCIENCE CURRICULUM IMPROVEMENT STUDY IN SELECTED SCHOOLS IN MICHIGAN

By

Steven M. Barnes

Problem investigated. The purpose of this study was to ascertain teacher reaction to the Science Curriculum Improvement Study (SCIS) training and implementation program as carried out at Michigan State University during 1968-1969. Also of interest were the relationships which may have existed between the teachers' reactions and selected teacher characteristics, as well as, the effects of the SCIS training and materials in the cooperating schools.

Descriptive features and treatment of data. The study involved thirty-three first and second grade teachers from four mid-Michigan school districts. Through an NSF Cooperative College-School Science Program, the teachers attended a Summer Workshop in 1968 designed to acquaint them with the science content, recommended modes of teaching, and psychological bases for the SCIS program. The Summer Workshop was followed by consultant services throughout the 1968-1969 school year as the teachers implemented the SCIS materials.

Data concerning the teachers' reactions to the SCIS training and materials were gathered via questionnaires administered during the 1968 Summer Workshop and the following April and also through feedback forms completed by the teachers after each SCIS lesson taught. The teacher characteristic data involved in the study concerned: age, years of teaching experience, knowledge of the SCIS program, personality, academic background in science, attitude toward the teacher-pupil relationship, and knowledge of science process skills. In addition to the instruments designed by the writer, the Minnesota Teacher Attitude Inventory and the Sixteen Personality Factor Questionnaire were used to collect data.

Analysis of the data involved tabulation, repeated measures analysis of variance, and the Pearson product-moment correlation coefficient. The criterion of the minimum level of significance was set at .05 for all statistical tests.

Findings. An analysis of the questionnaire and test data, along with the statistical tests, seems to support the following data: (1) the elementary teachers did agree on the relative merit of the workshop experiences of the SCIS in-service training program; (2) the teachers' reactions to the workshop experiences were significantly different in August than were their reactions the following April; (3) the elementary teachers consistently rated the lectures on the "Nature of Science" as low in value as an aid in implementing the SCIS program; (4) the teachers' reactions to the workshop experiences appeared to be related to the teacher characteristics considered; (5) the workshop activities which the teachers considered as most valuable required their active participation.

The average number of feedback forms returned per teacher was 22.5. These feedback forms were on the average, sixty-one (61) per cent complete. The specific feedback responses, when examined quantitatively, appeared to be related to the teachers' attitudes and personality factors.

The findings of this study provide sufficient evidence to support the need for further research in the area investigated. This research could also be expanded to include the effects of such in-service experiences on student achievement.

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CHAPTER I

INTRODUCTION

The need for improvement in science and mathematics instruction was evidenced during World War II when the testing of young men for the armed services revealed extensive inadequacies in the science and mathematics backgrounds of high school graduates.[1] However, little attention was given to the problem of improving students' backgrounds in these areas prior to 1957 when the Russians launched Sputnik I. This event emphasized the need for providing adequate training in science and mathematics, at all levels of instruction, in order for the United States to have necessary personnel which could compete successfully in the search for scientific and technological advancements.

The past decade, 1958-1967, has seen the development of several curricular programs in science at both the secondary and elementary levels. In general, these science programs have been developed through the cooperative efforts of educators, scientists, and psychologists working as teams.

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[1]John I. Goodlad, The Changing School Curriculum, (New York: The Georgian Press, Inc., 1966), p. 9.

The programs have been funded extensively by private foundations and/or by the National Science Foundation (NSF) and the United States Office of Education (USOE).

As an extension of the revolution in curriculum, which began in the late 1950's, the new elementary school science programs, in the main, represent a significant departure from previous elementary science programs which stressed the learning of factual knowledge from a textbook. Each of the new programs has developed its own goals and curriculum materials. The development of new materials and the greater emphasis which has been placed on fundamental science concepts, the inquiry approach, and the processes of science have pointed to the need for providing experiences for elementary science teachers which would adequately prepare them to implement the newer programs effectively.

Hurd, in 1968, pointed to this need when he stated, "Assuming that every teacher will be able to use the new approach without assistance in understanding the rationale, content, and essential teaching procedure is, ..., unfair and unrealistic."[2] There are several reasons as to why teachers, in general, need to have adequate science preparation for handling the new programs. One reason, as revealed

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[2]Paul DeHart Hurd and James Joseph Gallagher, New Directions in Elementary Science Teaching (Belmont, California: Wadsworth Publishing Company, Inc., 1968), p. 127.

by the literature, is the teacher's feeling of insecurity in teaching science due to inadequate science background. Another reason is that few teachers have been trained in discovery teaching, whereby the processes of science are stressed as means of securing warranted knowledge. Many teachers, for varying reasons, indicate little interest in science and, consequently, are not very enthusiastic about teaching science. Thus, experiences need to be provided so that teachers may be stimulated to acquire the knowledge, skills, and interest necessary for teaching a modern science program.

One method of preparing teachers for implementing specific programs has been through in-service training. Goodlad, in 1966, stated that:

> The dominant position in current curriculum reform is that the teacher is of prime importance. In the early years of the movement, project staffs considered in-service teacher education to be almost as important as curriculum revision itself. Accordingly, they provided summer and all-year institutes, answering services to deal with teachers' questions, short-conferences, and other kinds of teacher help. Some groups required in-service teacher education as a condition for gaining access to the materials....[3]

Hurd also points out that:

> Some of the new programs include preliminary plans for developing self-instructional, in-service materials for use by teachers. These materials consist of science experiences for teachers in terms of reading, laboratory experiments, and instructional films designed to acquaint the teacher with both the substance

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[3]Goodlad, op. cit., pp. 102-103.

> and the pedagogical aspects of the new curriculum. There are also films showing experienced teachers working with children in a style compatible with the new program.[4]

The need for specific training for a given program is shown by the observation that too often many of the classrooms using the newer curriculum materials fail to have teachers who understand the underlying philosophy and objectives of the project writers. Long conditioned to the authoritative approaches which dominate the traditional classroom, the teachers turn materials designed for student investigation and inquiry into objects of rote response. Such has been the fate of curriculum innovation for many decades.

> Clearly, curriculum planners must not stop with the production of materials. If the proposed changes are worth introducing at all, then they must be introduced thoroughly with careful attention to every component of the change process. The intent of the new curricula is not adequately comprehended by large numbers of teachers now using them. And neither the general nor the professional curriculum of prospective teachers reflects the point of view of the curricula for which they soon will be responsible.[5]

The question is not, "Is there a need for in-service training?" but rather, "How best can the needed in-service training be provided?" Willard Jacobson wrote of the preparation of teachers for the new elementary science programs of the future when he said, "A great variety of educational

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[4]Hurd, op. cit., p. 128.

[5]Goodlad, loc. cit.

procedures and materials will be available for teacher education, and a rigorous analysis will be made to choose those that will be most effective to achieve the ends that are desired."[6]

Teacher-training institutions often hesitate to provide courses in how to teach a specific new curriculum.[7] The institutions assume their role is educating teachers for teaching a variety of curricula rather than training teachers to teach one particular curriculum. School systems employing teachers educated under this philosophy find, when attempting to implement one of the new science curricula such as AAAS Science--A Process Approach or Science Curriculum Improvement Study (SCIS), that the teachers need in-service training specific to these curricula if they are to fulfill the role intended by the project writers.

One means of providing such in-service training is through the cooperative efforts of schools and colleges. By this means, schools can utilize the personnel and resources of a university or college for in-service training and also assist in the development of the leadership potential in the local system. This study investigated certain phases of

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[6]Willard Jacobson, "Teacher Education and Elementary School Science--1980," Journal of Research in Science Teaching, Vol. V, Issue 1, 1968, p. 77.

[7]Hurd, loc. cit.

such an in-service effort between four (4) Michigan public schools and the Science and Mathematics Teaching Center at Michigan State University.[8] The in-service program was specifically concerned with the Science Curriculum Improvement Study.

Background and design of the study. The Science Curriculum Improvement Study was established in 1962 under the direction of Robert Karplus, professor of theoretical physics at the University of California in Berkeley. The program is based upon fundamental concepts and the process of science which emphasizes pupil observation and experimentation. The purpose of this K-6 project is to develop "scientific literacy"[9] in the school population.

In order to prepare teachers to use SCIS materials and also test the materials, trial centers were established under the SCIS project. Five (5) such centers have been established. The Science and Mathematics Teaching Center at Michigan State University became, in 1967, one of these official trial centers.[10] Each of the centers is supervised

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[8]NSF Cooperative College-School Science Program Between Michigan State University and East Lansing, Grand Ledge, DeWitt, and Perry, Michigan, 1968.

[9]Robert Karplus and Herbert D. Thier, A New Look at Elementary School Science (Chicago: Rand McNally, 1967), p. 31.

[10]The other trial centers were located at the University of California at Los Angeles, the University of Hawaii, the University of Oklahoma, and Teachers College, Columbia University.

by a locally appointed coordinator who is responsible for conducting in-service education programs, coordinating evaluation activities, disseminating materials, and securing feedback.[11]

With the establishment of the trial center at Michigan State University, a three-week workshop was held during the summer of 1967 under the direction of Dr. Glenn D. Berkheimer, Trial Center coordinator. The workshop was designed to provide ten (10) first grade teachers from DeWitt, Grand Ledge, and Perry, Michigan, with the science content, the recommended modes of teaching, and the psychological bases of the newer elementary science programs, especially SCIS. This workshop was followed by consultant service and periodic meetings with the workshop participants during the 1967-1968 school year. All of these services were designed to aid in the testing and implementation of the SCIS program.

The experience gained during this first year of operation was found useful in the redesign and expansion of the following year's activities. The school districts cooperating in the program the first year were DeWitt, Grand Ledge, and Perry, Michigan. These three (3) school districts were selected for their relatively stable student population, and because none of the new elementary science programs had been used in the systems. The following year the East Lansing,

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[11]Karplus, loc. cit.

Michigan, Public School system became the fourth cooperating system with the center.

In setting up the program, the original plans called for expanding the training of teachers by one grade level per year. Thus, a Summer Workshop was held in 1968 which was attended by first and second grade teachers from the four (4) cooperating school districts. Forty (40) individuals attended this workshop. The present study began with this workshop and extended throughout the 1968-1969 school year.

The study was designed to gather both qualitative and quantitative data concerning the 1968 SCIS teachers' reactions to the Summer Workshop, the in-service training, which was conducted during the school year, and SCIS implementation procedures occurring throughout the school year. Test results and information relative to teacher characteristics were also secured as a part of the study.

<u>Need for the study</u>. A review of the literature revealed that relatively little effort has been exerted to quantitatively determine teachers' reactions to the in-service training and subsequent implementation of modern science curricula. The literature regarding preservice training in this area is also nearly void of research findings. Stollberg, in discussing the preservice education of elementary school teachers, states that "... a major finding in the literature of the field is that there is an overwhelming need for a great deal of research concerning the education

of elementary school teachers in science."[12]

Hone stated, "Implementation of any new curriculum material depends upon the extent and quality of in-service education of teachers in the new material."[13] This thesis presents the "extent" of in-service education of the teachers by reporting the training received by the SCIS teachers. The "quality" of the in-service activities was inferred from the teachers' reactions to the training.

Related to and held concurrently with the SCIS Workshop in the summer of 1968 was a Leadership Workshop on Elementary School Science, at Michigan State University. This workshop was designed to prepare the participants, college teachers and science consultants, to help schools implement two (2) of the new elementary science curricula, AAAS Science--A Process Approach and the SCIS.[14]

If these and other workshops are to achieve maximum effectiveness, quantitative evidence must be gathered regarding how elementary teachers respond to various aspects of

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[12]Robert Stollberg, "The Task Before Us--1962 The Education of Elementary School Teachers in Science," Readings on Teaching Children Science (Wadsworth Publishing Company, Inc., 1969), p. 305.

[13]Elizabeth Hone, "Elements of Successful In-Service Education for Elementary Science" (A paper presented at session C-1, NARST 42nd Annual Meeting), 1969.

[14]Dale Gordon Merkle, "A Leadership Workshop on Elementary School Science: An In-Depth Evaluation" (Unpublished Ph. D. Dissertation, College of Education, Michigan State University, 1969), p. 32.

in-service training and subsequent implementation of the new curricula. Information of this nature should be extremely valuable in further redesigning SCIS Workshops and Leadership Workshops of the type described above. These data should also aid in determining the extent to which the Michigan State University Trial Center fulfills its role as a source of feedback for the revision of curriculum materials. Like the elementary science program, the in-service teacher education program is also experimental in nature and should also be revised and improved in light of experience.[15]

Purpose of the study. The major purposes of this study were: (1) to ascertain teacher reaction to the SCIS training program as implemented at Michigan State University during 1968-1969, (2) to ascertain the effects of the SCIS training program and materials in the cooperating schools during the 1968-1969 school year, and (3) to investigate relationships which may exist between the teachers' reactions and selected teacher characteristics.

Hypotheses of the study. In order to investigate the qualitative and quantitative aspects of teacher reactions and their relationship to teacher characteristics, the following hypotheses were tested:

1. There is significant agreement among the SCIS teachers' rankings of workshop activities

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[15]Karplus, op. cit., p. 129.

made at the conclusion of the 1968 Summer Workshop.

2. There is significant agreement among the SCIS teachers' rankings of the 1968 Summer Workshop activities made the following April.

3. There are significant differences between the SCIS teachers' rankings of the 1968 Summer Workshop activities made at the conclusion of the workshop and the corresponding rankings made the following April.

4. There are significant correlations between the SCIS teachers' rankings of the workshop activities and specified teacher characteristics.

5. There are significant correlations between the teachers' total feedback and specified teacher characteristics.

6. There are significant correlations between the teachers' feedback indices and specified teacher characteristics.

7. There are significant correlations between specified teacher characteristics and the teachers' mean rankings of:
   a) student-materials interaction
   b) student-student interaction
   c) student-teacher interaction

d) teacher's guide directions

e) materials.

8. There are significant correlations between specified teacher characteristics and the total number of SCIS Teacher Reaction Sheet comments concerning:

   a) teacher's guide directions

   b) materials

   c) the lesson in general--items 5 and 6, additional ideas and activities used, problems, or suggestions.

Definition of terms. The SCIS teachers were those teachers who participated in the 1968 SCIS Summer Workshop and taught the SCIS program throughout the 1968-1969 school year.

The personality factors were operationally defined as the SCIS teacher's score on each of the factors of the Sixteen Personality Factor Questionnaire.[16]

The attitude toward the teacher-pupil relationship was defined by the teacher's score on the Minnesota Teacher Attitude Inventory.[17]

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[16]Raymond B. Cattell and Herbert W. Eber, "Sixteen Personality Factor Questionnaire" (Champaign, Illinois: Institute for Personality and Ability Testing, 1967).

[17]Walter W. Cook, Carroll H. Leeds, and Robert Callis, "Minnesota Teacher Attitude Inventory" (New York: The Psychological Corporation, 1950).

The knowledge of science process skills was defined by the SCIS teacher's score on the Science Process Test for Elementary Teachers--3rd Edition.

Knowledge of the SCIS program was defined by the score on the Science Curriculum Improvement Study Workshop Content Achievement Evaluation.

Teacher reaction was defined as the written responses to the questionnaires and SCIS Teacher Reaction Sheets completed by the SCIS teachers during the Summer Workshop and while teaching the SCIS program.

Lesson feedback was defined as the written responses on the SCIS Teacher Reaction Sheets returned by the teachers.

Feedback index was defined as the total lesson feedback divided by seventeen times the number of Teacher Reaction Sheets returned by the teacher.

$$\text{OR} \quad \frac{\text{TOTAL LESSON FEEDBACK}}{\text{17 x TEACHER REACTION SHEETS RETURNED}}$$

The teacher characteristics referred to in this study were defined as age, in years; teaching experience, in years; knowledge of the SCIS program; personality factors; science background, in quarter hours; attitude toward the teacher-pupil relationship; and knowledge of science process skills.

As used in this study, in-service training was defined as any instruction, including summer workshops, received by a teacher while under contract with a school district.

Delimitations and assumptions of the study. All phases of the study were carried out in connection with the teachers from the four (4) Trial Center school districts previously discussed. The study did not attempt to:

1. assess the effectiveness of the SCIS program or the SCIS teachers;
2. assess the knowledge acquired by the students of the SCIS teachers;
3. analyze SCIS Teacher Reaction Sheet data from units other than Material Objects and Interaction;
4. assess the SCIS reachers' science content knowledge; or
5. make a judgment as to the quality of lesson feedback returned to the Trial Center.

It was assumed that the instruments used in conjunction with the study were valid for the purposes intended, and the teachers of the population were intellectually honest in their responses to the instruments.

Organization of the dissertation. The general organizational plan of the thesis is as follows: in this chapter is presented a statement of the problem area, which includes the purpose of the study, along with a rationale for the investigation of such a study. In addition, the objectives, hypotheses to be tested, delimitations, assumptions, and definition of terms are presented.

A review of the pertinent literature related to the study is reported in Chapter II. Chapter III contains a description of the study, sources of data, selection and description of the population, specific instruments used, in-service training, statistical tools used, and method of analysis. The results of data collected, tests of hypotheses, and analysis of data are reported in Chapter IV. Chapter V presents a general summary of the study and the conclusions drawn from the findings of the study. Also included in Chapter V are the educational implications of the study and some suggestions with respect to needed areas of related research.

CHAPTER II

REVIEW OF RELATED LITERATURE

Reviews of the literature by the writer and others reveal the relative scarcity of research on the preparation of elementary school teachers for science teaching as compared to that directed toward secondary level. "This situation persists despite the continuing criticisms that many elementary teachers do an inadequate job of teaching science...."[1] The studies presented in this chapter have been divided into four (4) categories. In the first category, studies dealing with the status of science teaching in the elementary school and the preservice preparation of elementary teachers in science are reviewed. The second category deals with the in-service preparation of elementary teachers. Those studies concerned with the evaluation of in-service education for elementary school teachers are presented in the third category. Teacher characteristics and teacher reaction to in-service education are the subjects of the final group of studies.

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[1]Patricia E. Blosser and Robert W. Howe, "An Analysis of Research on Elementary Teacher Education Related to the Teaching of Science," Science and Children, Vol. 6, no. 5, (January/February, 1969), pp. 50-60.

<u>Elementary school science and teacher training</u>. The upper elementary science teachers in one hundred fourteen (114) elementary schools in Cleveland were the subjects of a 1949 study by Maddux.[2] As a result of visits with these teachers, Maddux felt the outstanding problem seemed to be insecurity in the teachers' knowledge of subject matter. Another problem was a lack of interest in science.

The feeling of insecurity may be due to the types of preservice science courses taken by elementary teachers. In 1956, Mallinson[3] reported that one of the reasons for elementary teachers' inadequate science backgrounds was "the courses in science offered them are not of the general, survey-type they need." Also reported as a factor was the minimal amount of science often required for graduation and certification.

Three hundred (300) elementary teachers in Illinois were studied by Brown.[4] The problems encountered in teaching science expressed by these teachers were: (1) lack of space,

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[2]Grace Curry Maddux, "Helping the Elementary Science Teachers," <u>School Science and Mathematics</u>, Vol. 49, no. 432 (October, 1949), pp. 534-537.

[3]Jacqueline Mallinson, "What Have Been the Major Emphases in Research in Elementary Science During the Past Five Years?" <u>Science Education</u>, Vol. 40 (April, 1956), pp. 206-208.

[4]Clyde M. Brown, "A Workshop in Teaching Elementary Science: An In-Service Training Program for Teachers," <u>Science Education</u>, Vol. 42 (December, 1958), pp. 401-405.

(2) lack of time, (3) lack of materials, and (4) lack of an adequate background. The findings of Hines[5] are somewhat contradictory to Brown. In Hines's study, three hundred thirty-five (335) elementary teachers responded to a questionnaire designed to provide insight into their reported reluctance to teach science. Among Hines's conclusions, which differed from Brown's was:

> (1) The availability and the use of science materials and equipment are not indicated as factors influencing the teaching of science at the elementary school level.

However, Hines also concluded that:

> (1) The teachers are providing more time to science teaching and to science demonstration and experimentation than one would expect from the review of the research.
>
> (2) An inadequate science background is a definite factor influencing science teaching at the elementary school level....[6]

A comparative analysis, conducted by Hines, indicated that the number of years of teaching experience, grade level taught, and whether they had taken a science methods course were not related to the questionnaire response patterns. However, her study indicated that the number of hours of science course work may have been related to the response patterns.

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[5]Sallylee H. Hines, "A Study of Certain Factors Which Affect the Opinions of Elementary School Teachers in the Teaching of Science," Dissertation Abstracts, 27:12 (June, 1967), 4153-A.

[6]Ibid.

Bryant[7] studied the science courses required of elementary education majors in two hundred twenty-five (225) institutions belonging to the American Association of Colleges for Teacher Education. Analysis of the data collected showed a mean of 17.7 quarter-hours of science was required, biological and physical science survey courses and elementary school sciences methods courses were most frequently specified, and over three-fourths of the instructors of the above mentioned courses had no experience in teaching children.

An observation checklist, an interview checklist, and a questionnaire were used by Tyndall to evaluate the science teaching of forty (40) graduates of Atlantic Christian College. Tyndall concluded that:

> There was a high degree of relationship between grades made in science courses and performance as elementary teachers of science. There was no significant relationship between courses taken and the quality of science teaching, nor any between teachers with or without in-service experiences and the quality of their science teaching.[8]

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[7]Paul Payne Bryant, (Abstract), "Science Understandings Considered Important for Children and the Science Required of Elementary Teachers," Research in the Teaching of Science, Washington, D. C.: U. S. Department of Health, Education, and Welfare (July, 1957-July, 1959), 1962, p. 29.

[8]Jesse Parker Tyndall, "The Teaching of Science in Elementary Schools by Recent Graduates of Atlantic Christian College as Related to Their Science Preparation," Science Education, Vol. 44, no. 2 (1960), p. 119.

Historical data gathered from theses, methods books, courses of study, and yearbooks were used by Verrill[9] to study the preparation of elementary school teachers in relation to science subject matter, methods and materials courses, and in-service education opportunities from 1870 to 1959. A questionnaire was also sent to teacher training institutions in six (6) states to determine the then present practices in the same areas. The data showed that elementary teachers had been poorly prepared to teach science over the entire period under study. Verrill also found that the types of programs needed to prepare the teachers to teach science lacked clarity, direction, and a definite goal.[10]

One of the most extensive surveys on science teaching in the elementary school was made by Blackwood[11] during 1961-1962. Blackwood's study was conducted under the auspices of the U. S. Office of Education, and questionnaire responses were received from 1,476 of the 1,680 schools in the sample. The schools were asked to rank thirteen (13) items considered as effective barriers to science teaching. The most frequent

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[9]J. E. Verrill, "The Preparation of General Elementary Teachers to Teach Science: 1870 to the Present," Research in the Teaching of Science. Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1965, pp. 126-127.

[10]Ibid.

[11]Paul E. Blackwood, "Science Teaching in the Elementary School: A Survey of Practices," Journal of Research in Science Teaching, Vol. 3 (September, 1965), pp. 177-197.

responses, listed in rank order were:

1. lack of adequate consultant service;
2. lack of supplies and equipment;
3. inadequate room facilities;
4. insufficient funds for purchasing needed supplies, equipment, and appropriate science reading materials;
5. teachers do not have sufficient science knowledge.[12]

As a result of his findings, Blackwood recommended that schools develop or participate in effective in-service programs that enable teachers to update their knowledge of science subject matter and methods of teaching.

Victor[13] also used a questionnaire technique to investigate elementary school teachers' reported reluctance to teach science. One hundred six (106) of one hundred seventeen (117) elementary teachers in an Illinois city of 25,000 responded to the questionnaire. Among the reported responses for their reluctance were: (1) lack of familiarity with the subject matter and science materials, and (2) embarrassment and dislike for repeatedly being asked questions for which they had no answers.

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[12]Blosser, op. cit., p. 51.

[13]Edward Victor, "Why Are Our Elementary School Teachers Reluctant to Teach Science?" U. S. Office of Eduation, 1965, pp. 16-17.

Teacher education programs were under investigation in a questionnaire study by Moorehead[14] in 1965 in which returns were received from one hundred twenty-five (125) colleges and universities. Moorehead also surveyed thirty (30) selected elementary schools in Oklahoma. The responses to these surveys showed that the discovery method was used sparingly in science courses, but heavily emphasized in science methods courses. Moorehead drew the following conclusions:

> 1. The teacher education program should ... emphasize the discovery method.
>
> 2. The twenty-eight (28) schools using the conventional materials in elementary school science showed a definite need for in-service programs, consultants....
>
> 3. The two schools using the newer developments in elementary school science demonstrated that teachers can learn to use these materials through in-service programs, qualified consultants, and seminars.[15]

In a study reported by Berryessa[16] in 1959, student teaching supervisors from Brigham Young University and the University of Utah were asked to identify outstanding female cooperating teachers with whom they worked. Out of the one

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[14]William Douglas Moorehead, "The Status of Elementary School Science and How it is Taught," Dissertation Abstracts, Vol. 26, no. 4 (1965), p. 2070.

[15]*Ibid*.

[16]Max Joseph Berryessa, "Factors Contributing to the Competency of Elementary Teachers in Teaching Science," Dissertation Abstracts, Vol. 20, no. 2 (1959), p. 558.

hundred (100) so identified, the twenty-five (25) highest and lowest were chosen. Among the findings of this study were: (1) the total number of credit hours in science accumulated by the teachers seemed to be a factor in the kind of program developed by the teachers in each group; (2) the teachers whose science programs were considered most effective seemed not to differ in teacher attitudes, as measured by the Minnesota Teacher Attitude Inventory, from those whose science programs were less effective; (3) adequate room space, facilities, and storage space seemed to be a factor in the development of effective science programs in the elementary school.

Although there is some difference of opinion, most of the studies reviewed in this section indicate that the elementary teacher is inadequately prepared to teach science and is, therefore, reluctant to do so. Other studies also supporting these views have been written by Buck and Mallinson,[17] Kleinman,[18] Sims,[19] and Lammers.[20]

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[17]Buck and Mallinson, "Some Implications of Recent Research in the Teaching of Science at the Elementary School Level," Science Education, Vol. 38, no. 1 (February, 1954), pp. 81-101.

[18]G. S. Kleinman, "Needed: Elementary School Science Consultants," School Science and Mathematics, Vol. 65 (November, 1965), pp. 738-746.

[19]Ward L. Sims, "The Development and Evaluation of an In-Service Education Program in Elementary School Science," Science Education, Vol. 42 (December, 1958), pp. 391-398.

[20]Theresa J. Lammers, "One Hundred Interviews With Elementary School Teachers Concerning Science Education," Science Education, Vol. 33, no. 4 (October, 1949), pp. 292-295.

Most writers concern themselves with either the recipients of in-service training or the students of the recipients without regard to the qualifications of those responsible for dispensing the training. Blough spoke to this point when he said:

> The teacher of courses that will be really useful for elementary-school teachers must: (a) be acquainted with the elementary school, its philosophy and objectives; (2) be sympathetic to the needs and capacities of the teachers; (3) be general in his outlook of the science field and not so specialized in one field as to ride his own interest to the exclusion of other equally important ones.[21]

<u>In-service education for elementary teachers</u>. The types of in-service education available to elementary teachers vary considerably. To what extent the services are utilized is unique to local systems.

An analysis of the research on in-service education conducted between 1919 and 1951 was attempted by McFeaters.[22] Two hundred fifty-three (253) representative studies were selected for inclusion in the study. The results of the study indicated that in-service teacher education has become a planned investment which must be based upon the objectives of the particular school system for which it is used, ...

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[21]Glenn O. Blough, "Preparing Teachers for Science Teaching in the Elementary School," <u>School Science and Mathematics</u>, Vol. 58 (October, 1958), p. 525.

[22]Mary M. Marshall McFeaters, "A Critical Analysis of Selected Research Literature on In-Service Teacher Education," <u>Dissertation Abstracts</u>, Vol. 14, no. 8 (1954), p. 1340.

and a constantly evaluated program.[23] Although the college or university credit course has been the most popular form of in-service training according to this study, the increasing interest in workshops was also indicated. The trend toward workshops as a means of in-service education was also noted by Lammers in 1955.[24]

An NEA Research Division survey conducted in the spring of 1968 attempted to determine the in-service education needs of public school classroom teachers. The responses of the elementary teachers closely paralleled those of the secondary teachers. "Teaching methods" was ranked third, out of thirteen areas, in importance when the "much need" and "moderate need" categories were combined.[25]

Eiss[26] reported on a series of conferences sponsored by the Commission on the Education of Teachers of Science of the National Science Teachers Association. One area of agreement was that in-service education in science should be a planned part of each teacher's assigned teaching responsibility and not an additional burden beyond the regular

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[23] Ibid.

[24] Theresa J. Lammers, "The Thirty-First Yearbook and Twenty Years of Elementary Science," Science Education, Vol. 39 (February, 1955), pp. 39-41.

[25] "Teachers' Needs for In-Service Training," NEA Research Bulletin, Vol. 46, no. 3 (October, 1968), pp. 80-81.

[26] Albert F. Eiss, "Science Preparation for Elementary Science Teachers," Science and Children, Vol. 2, no. 8 (May, 1965), pp. 17-18.

teaching duties.

Costa[27] listed the means by which teachers keep up to date in science as magazines and journals, institutes, professional science teacher organizations, local in-service programs, services of colleges and universities, and the learning occurring during the classroom situation. Lerner[28] grouped these basic sources of in-service education into three (3) categories: (1) Programs that operate within the local system; (2) Opportunities afforded by colleges and universities; and (3) Self-initiated and self-sustained education by the teacher herself. Lerner also emphasized the importance of the administrator in planning for in-service opportunities. Verrill[29] found the two (2) most prevalent in-service opportunities offered to experienced teachers for improving science instruction were summer classes and curriculum libraries. Chamberlain[30] agreed that summer school was the most common type of in-service training.

A two-semester institute in physical and biological science designed to improve elementary teachers' subject

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[27]Arthur L. Costa, "How Elementary Science Teachers Keep Up-to-Date in Science," Science Education, Vol. 50, no. 2 (1966), pp. 126-127.

[28]Marjorie S. Lerner, "In-Service Science Activities," Science and Children, Vol. 4, no. 3 (November, 1966), pp. 21-23.

[29]Verrill, op. cit., p. 127.

[30]W. D. Chamberlain, "Development and Status of Teachers Education in the Field of Science for Elementary School," Science Education, Vol. 42, no. 5 (December, 1958), pp. 406-409.

matter competence and also their knowledge of science processes was reported on by Kleinman[31] in 1966. Concerning the teachers' willingness to take in-service courses of this nature, Kleinman found that they are eager to take these courses provided the courses are relevant to their needs. Also, she learned that the teachers can benefit from courses requiring limited skill, and they are willing to put in long hours in class and do homework, thereby improving their competence in science.

Evaluation of in-service education. Investigators have tried to determine how the science needs of elementary teachers can best be remedied. This section deals with attempts at analyzing those types of in-service programs which seem to be most successful.

Mailed questionnaires were returned by 1,191 of 1,551 Connecticut teachers in a study by Hempel.[32] These teachers reported the following types of in-service training as valuable. In order of preference, they were as follows:

1. graduate study leading to a degree;
2. workshops under the direction of university staff;

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[31]Gladys S. Kleinman, "Progress Report of an Experimental In-Service Institute in Science for Elementary School Teachers of Grades K-6," Science Education, Vol. 50, no. 2 (1966), pp. 136-140.

[32]Carl Hempel, "Attitudes of a Selected Group of Elementary School Teachers Toward In-Service Education," Dissertation Abstracts, Vol. 21, no. 13 (1961), p. 3684.

3. individual study not connected with college or university;
4. extension courses not leading to a degree;
5. local in-service activities other than workshops;
6. workshops under local leadership.[33]

A consensus of practicing supervisors concerning in-service education was reported in 1960 by Tannenbaum.[34] He stated that the effectiveness of an in-service program is directly proportional to its duration, one-day programs having little effect. The size of the group has been listed as important, with programs limited to twenty-five (25) students more effective than with larger groups. Programs which actively involve teachers in manipulating science materials have been more effective than those having an "expert" demonstrate. Tannenbaum stated that:

> Programs which combine theoretical science and actual experiences with materials and opportunities to discuss effective techniques for teaching science concepts to elementary school children have been the most effective by far.[35]

Thirty-nine (39) elementary teachers attending a workshop during a summer session at the University of Southern

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[33]Ibid.

[34]Harold E. Tannenbaum, "Supervision of Elementary School Science: In-Service Courses," Science Teacher, Vol. 27 (April, 1960), pp. 50-51.

[35]Ibid.

California were the subjects of a study by Bingham.[36] He found that the activities most valued in a workshop were: participating in experiments, demonstrations by the faculty, workshop demonstration-discussions, work with various kinds of teaching materials, and sharing of workable ideas by workshop members.[37] According to the responses of the thirty-nine (39) teachers surveyed by Bingham, there should be about thirty (30) members in an ideal workshop with a staff of two (2). Also, the workshop should take the full time of the students for a period of six weeks.

In 1958, Eccles[38] evaluated a methods course at the University of Illinois. She called attention to the lack of precise information as to the effect of the teachers' knowledge, skills, and attitudes on the quality of their work in the field of science and the lack of suitable objective instruments to measure some of the traits considered important. She concluded that very little student change results from a one-semester course in teaching science in the elementary school.

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[36]N. Eldred Bingham, "What Elementary Teachers Want in Workshops in Elementary Science," Science Education, Vol. 39, no. 1 (February, 1955), pp. 59-64.

[37]Ibid.

[38]Priscilla Jacobs Eccles, "An Evaluation of a Course in Teaching Science in the Elementary School," Dissertation Abstracts, Vol. 19, no. 11 (1959), p. 2862.

Teacher characteristics and teacher reactions to in-service education. "One measure of the success of in-service education is the reaction of teachers to various aspects of the program."[39] This section deals mainly with teacher characteristics and how they may be related to the teachers' reactions to various types of in-service programs. In some instances, success has been measured in terms of student achievement. This aspect is also reported.

Teacher reaction to consultant services as a form of in-service education was reported in a study by DeVault, Houston, and Boyd.[40] Forty-three (43) teachers of the Dallas Independent School District were the subjects of this study. The teachers' reactions were obtained through questionnaire items, and these reactions were correlated with consultant variables. The results revealed that the total time that the consultants spent with the teachers was significantly related, with a correlation of .59, to their general reaction to the in-service education program and also related, with a correlation of .48, to the perceived usefulness of the program. The number of small group discussions was related, with a correlation of .33, to their general reaction to the program, and with a correlation of .30, to their reaction to

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[39] M. Vere DeVault, Robert W. Houston, and Claud C. Boyd, "Do Consultant Services Make a Difference?" School Science and Mathematics, Vol. 63 (April, 1963), pp. 285-290.

[40] Ibid.

the usefulness of the program. Consultant services do seem to make a difference, but "the specific nature of desired changes must be identified; and appropriate selected consultant services provided, if maximal effectiveness is to be achieved."[41]

Studies by Ashley and Kleinman support the conclusions of DeVault _et al_. On the basis of a literature review, Kleinman[42] stated a need for science consultants in the elementary school, and Ashley [43] found that elementary science consultants and elementary classroom teachers can successfully develop a science program that is an integral part of the total classroom program.

Consultant services were used in a study by Boyd[44] which involved ninety-six (96) elementary teachers of grades four (4), five (5), and six (6). This study, designed to compare methods of in-service education, revealed no difference in the change in mathematics achievement and achievement

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[41]DeVault _et al_., _op_. _cit_., p. 290.

[42]Kleinman, G. S., "Needed: Elementary School Science Consultants," _op_. _cit_., pp. 738-746.

[43]Tracy Hollis Ashley, "The Development of a Science Program in the Elementary School," _Research in the Teaching of Science_, Washington, D. C.: U. S. Department of Health, Education, and Welfare, July, 1957-July, 1959 (1962), p. 28.

[44]Claud Collins Boyd, "A Study of the Relative Effectiveness of Selected Methods of In-Service Education for Elementary School Teachers," _Dissertation Abstracts_, Vol. 22, no. 10 (1961), pp. 3531-2.

in selected aspects of mathematics teaching methods between two (2) groups of teachers. Both groups participated in similar in-service programs, but only one group was given consultant help.

Curriculum change and innovation often introduce new methods or styles of teaching as well as new materials. Certain teachers may find it more difficult than others to adapt to the changes evoked by the innovation. Myers and Torrence[45] studied the personality characteristics of teachers who were resistant to change. Among the characteristics which they identified were authoritarianism, defensiveness, insensitivity to pupil needs, pre-occupation with information-giving functions, intellectual inertness, disinterest in promoting initiative in pupils, and pre-occupation with discipline.

A similar attempt at identifying personality characteristics representative of teachers resistant to change was reported by Urick and Frymier.[46] The study was conducted by a graduate class at Ohio State University. Mailed questionnaires were returned by one hundred thirty-seven (137) of two hundred sixteen (216) teachers who had been identified

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[45]R. E. Myers and E. Paul Torrence, "Can Teachers Encourage Creative Thinking?" Educational Leadership, Vol. 19 (December, 1961), pp. 156-159.

[46]Ronald Urick and Jack R. Frymier, "Personalities, Teachers and Curriculum Change," Educational Leadership, Vol. 21, no. 2 (November, 1963), pp. 107-111.

by their principals as either most or least willing on the faculty to consider curriculum change. The study was unsuccessful in its attempt to identify differences in these two groups of teachers.

An explanation for the lack of extensive research on in-service education may have been indicated by Flanders when he said, "Proper evaluation would more than double the costs of in-service activities."[47] In discussing an in-service project in human relations training, Flanders stated,

> ... the results showed that not all teachers can benefit from this kind of training, while other can. In general, teachers whose personality measures initially were correlated with more effective classroom practices, in turn, gained most from the training.[48]

His study showed that consistency between teachers' own styles of teaching and methods used during in-service training will influence the progress of the teacher. During this study the teachers were classified according to personality and attitude data collected by administering the Minnesota Multiphasic Personality Inventory, the Minnesota Teacher Attitude Inventory, and the Bowers Teachers Opinion Inventory. "What little research has been done so far suggests the tests that can be used for selecting teachers, who can benefit more

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[47]Ned A. Flanders, "Teacher Behavior and In-Service Programs," Educational Leadership, Vol. 21 (October, 1963), p. 25.

[48]Ibid., p. 27.

from in-service training."[49]

Between 1953 and 1958 Washton[50] studied one hundred (100) elementary science teachers enrolled in a graduate course at Queens College. He found that rigid teachers have greater difficulty teaching others to develop scientific attitudes, but that age is not a factor affecting the teachers' abilities to learn science.

Several studies have attempted to evaluate teacher training in terms of student achievement. Using a sample of twenty-seven (27) elementary teachers in Calgary, Alberta, Eccles[51] obtained a correlation of (-.04) between teacher knowledge of science subject matter and student achievement. Eccles cites a study by Heil et al.[52] in which it was concluded that personality traits of the teacher have a significant relationship to student achievement, while traits such as knowledge of subject matter do not.

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[49]Ibid., p. 29.

[50]Nathon S. Washton, "Improving Elementary Teacher Education in Science," Science Education, Vol. 45 (February, 1961), p. 34.

[51]P. J. Eccles, "The Relationship Between Subject Matter Competence of Teachers and the Quality of Science Instruction in the Elementary School," Alberta Journal of Educational Research, Vol. 8, no. 4 (December, 1962), pp. 238-245.

[52]Louis M. Heil, Marion Powell, and Irwin Feifer, "Characteristics of Teacher Behavior Related to the Achievement of Children in Several Elementary Grades" (Brooklyn College Office of Testing and Research, 1960).

McCall and Krause[53] obtained similar results when working with seventy-three (73) sixth grade teachers in North Carolina. Using student growth as a criterion for teacher efficiency, they found that teachers' knowledge of subject matter showed no correlation (-.06) with efficiency. Of all the measures used, the one which gave the highest correlation was the McCall-Herring Personality Measure. The five (5) parts of this measure correlated from .22 to .39 with teacher merit.

Teacher attitude and personality data were used by Bixler[54] to investigate the relationship between teacher traits and student achievement in science. Minnesota Teacher Attitude Inventory scores from sixty-two (62) intermediate grade teachers showed no significant relationship to student achievement. Similar results were obtained regarding the teachers' authoritarianism.

Hempel[55] concluded that knowledge of learning theory may be one factor affecting teachers' attitudes towards in-service education. A tendency for those who know more about

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[53]W. A. McCall, and Gertrude R. Krause, "Measurement of Teacher Merit for Salary Purposes," Journal of Educational Research, Vol. 53, no. 2 (October, 1959), pp. 73-75.

[54]J. E. Bixler, Abstract, "The Effect of Teacher Attitude on Elementary Children's Science Information and Science Attitude," Research in the Teaching of Science, Washington, D. C.: U. S. Department of Health, Education, and Welfare (1962), pp. 28-29.

[55]Hempel, loc. cit.

learning theory to hold more desirable attitudes toward in-service education was discovered.

Summary. The review of literature relevant to pre-service and in-service training of elementary school teachers in the area of science revealed some divergence of opinion although a more generalized note of agreement. Conclusions may be drawn in each of the areas reviewed.

1. Studies relevant to the status of science in the elementary school and the preservice preparation of elementary teachers revealed a definite inadequacy in background. This feeling of insecurity and inadequacy was noted in studies by Maddux (2)*, Mallinson (3), Victor (13), Verrill (9), Brown (4), and Hines (5). Tyndall (8) reported a high degree of relationship between grades made in science courses and performance as elementary science teachers. Berryessa (16) also found the total credit hours in science to be a factor in the kind of science program developed by teachers. Blackwood (11) found lack of consultant services as a major barrier to science teaching. Moorehead's (14) study reveals the discovery method to be used sparingly in science courses but heavily emphasized in science methods courses.

The findings listed above are, in part, supported by Buck and Mallinson (17), Kleinman (18), Sims (19), and Lammers (20).

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*The number in parentheses refers to previously cited references.

The study by Blough (21) was the only research reviewed dealing with those responsible for the training of teachers.

2. In-service education has become a planned investment according to an analysis of research conducted by McFeaters (22). Summer school and college credit courses were reported to be an important source of in-service training by Verrill (29), Lammers (24), and Chamberlain (30). Teachers also keep up to date through journals, institutes, and professional organizations according to Costa (27) and Lerner (28).

3. Research designed to evaluate in-service training programs was conducted by Hempel (32). He found graduate study leading to a degree to be preferred by teachers. Tannenbaum (34) reported the duration of an in-service program to be proportional to its effectiveness. Activities which actively involved the teachers were favored by the teachers attending a workshop in a study by Bingham (36). Eccles (38) pointed out a lack of knowledge concerning the relationship between teacher characteristics and the quality of their work. Eccles also noted the lack of suitable objective instruments to measure traits considered important and concluded that little student change takes place in a one-semester methods course.

4. Flanders (47) offered as an explanation for the lack of extensive evaluation of in-service education, the costs which are involved. Teacher reaction to consultant services was reported by DeVault _et al_. (40). A significant positive correlation between the total time consultants spent with

teachers and their general reaction to the in-service program was found in Boyd's study. Studies by Kleinman (42) and Ashley (43) supported the opinion that consultant services can make an important contribution to the successful development of a science program.

Myers and Torrence (45) and Urick and Frymier (46) attempted to study personality characteristics of teachers resistant to change. Although Urick and Frymier were unsuccessful, Myers and Torrence identified authoritarianism and defensiveness as characteristic traits. Urick and Frymier were unsuccessful in their attempts. Washton (50) found rigid teachers have greater difficulty developing scientific attitudes.

The relationship between teacher attitude and personality, and student achievement has been investigated by several authors. Bixler (54) found no significant relationship between MTAI scores and student achievement. Eccles obtained a correlation of (-.04) between teacher knowledge of science subject matter and student achievement, while Heil, Powell, and Feifer (52) concluded that personality traits have a significant relationship with student achievement. Heil *et al.*, also concluded that subject matter is not significantly related to student achievement. McCall and Krause (53) obtained similar results.

CHAPTER III

DESCRIPTIVE FEATURES OF THE STUDY

Presented in this chapter are: (1) the general objectives and design of the cooperative in-service program under which the study was carried out, (2) a description of the participants and the methods used to select them, (3) a description of the Summer Workshop, (4) the SCIS implementation program, (5) the scheduling of classroom visitations and bi-weekly meetings with the SCIS teachers, (6) the Gull Lake week-end conferences, (7) the sources of teacher data collected, (8) the manner in which the data were treated, and (9) a summary.

General objectives and design of the cooperative in-service program. The study was designed to investigate teacher reactions to training for, and implementation of, the SCIS program as carried out under the terms of the NSF Cooperative College-School Science Program between Michigan State University and the public school systems of East Lansing, Grand Ledge, DeWitt, and Perry, Michigan. This program began in the summer of 1968 and extended through the 1968-1969 school year. The specific objectives for the cooperative program, as presented in the original proposal, included:

1. To provide a three (3) week summer workshop specifically designed to help teachers learn the science content, the recommended modes of teaching, and the psychological basis of the newer elementary school science programs, especially the Science Curriculum Improvement Study (SCIS).

2. To provide frequent classroom visitations by university science consultants during the 1968-1969 school year to help individual teachers and small groups of teachers to attack problems as they arise and to increase their effectiveness in teaching the SCIS program.

3. To provide teachers with specific ecological experiences at the Kellogg Gull Lake Biological Station at Hickory Corners, Michigan, which will contribute to their capacity to deal with the life science portion of the SCIS curriculum.[1]

Instruments were constructed and administered to collect information concerning the teachers' reactions to both the training and implementation phases of the cooperative program.

Selection and description of the participants. The teachers involved in this study were those who attended the Summer Workshop in 1968. During the spring of 1968, the principals and teachers of the schools included under the cooperative proposal were contacted in person by the program director, Dr. Glenn D. Berkheimer. The terms of the proposal and the general features of the SCIS program were explained at that time. The first and second grade teachers, as well

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[1]Glenn D. Berkheimer, Proposal for--"NSF Cooperative College-School Science Program Between Michigan State University and East Lansing, Grand Ledge, DeWitt, and Perry, Michigan" (Science and Mathematics Teaching Center), 1968.

as the principals of the respective schools, were invited to attend the Summer Workshop and to participate in the implementation during the following school year. Prior approval of the proposal had been obtained in writing from each of the school boards. Also, a commitment to purchase the needed SCIS kits, to provide any necessary administrative service, and to encourage the teachers to participate was secured. At the time the workshop began on August 5, 1968, forty (40) individuals had been accepted as participants.

Of the forty (40) participants attending the 1968 Summer Workshop, thirty-four (34) taught the SCIS program for the entire 1968-1969 school year. Of those not teaching the SCIS program for the entire year; one (1) was a school district science supervisor, two (2) were elementary principals, two (2) did not remain in teaching, and one (1) was transferred to a grade level not using the SCIS program.

Of the thirty-four (34) teachers using the SCIS materials throughout the school year, one teacher did not complete all the instruments needed for the study. Thus, a total of thirty-three (33) teachers constituted the participants in the investigation.

Fifteen (15) of the teachers in the investigation were employed in East Lansing, Michigan, seven (7) each from DeWitt and Perry, Michigan, and four (4) from Grand Ledge, Michigan. Table 1 indicates the number of participating teachers, by grade level, from each school district.

Table 1. School district and grade level of the SCIS teachers included in the study.

Grade Level	School District			
	East Lansing	DeWitt	Grand Ledge	Perry
1	7	4	2	2
2	8	3	2	5

The thirty-three (33) teachers were females and ranged in age from twenty-one (21) years to sixty (60) years with a mean age of 33.2 years. The subjects' records of academic background revealed that they had acquired from three (3) to fifty-four (54) term credits in science with a mean 14.8 credits. The range in teaching experience for the teachers was from zero (0) years to forty-three (43) years with a mean of 5.3 years. The information pertaining to teacher age, preparation in science, and teaching experience is listed by teacher and grade level in Table 2. All of the teachers had earned a B.A., B.S., or A. B. degree. In addition, four (4) teachers had also acquired an M. A. degree.

<u>Summer workshop</u>. The 1968 SCIS Summer Workshop was held August 5 through August 23, 1968, at Holmes Hall on the Michigan State University Campus. The facilities of the Science and Mathematics Teaching Center in McDonel Hall were also used. The activities of the workshop centered around the following seven (7) areas: (1) lectures on the "Nature of Science," (2) films and lectures on "Modes of

Table 2. Age, science background, and teaching experience data for the participants.

Teacher	Age	Science Credits	Teaching Experience	Teacher	Age	Science Credits	Teaching Experience
1*	25	21	4	20**	26	12	5
2	24	15	2	21	23	15	1
3	26	15	5	22	53	8	10
4	48	10	16	23	23	21	2
5	49	6	8	24	41	11	4
6	28	12	7	25	26	18	4
7	32	16	5	26	22	8	1
8	21	21	0	27	35	13	10
9	24	14	0	28	23	11	2
10	24	7	1	29	53	7	17
11	29	6	6	30	55	9	8
12	23	13	0	31	57	13	1
13	32	24	0	32	60	3	43
14	46	32	2	33	22	20	0
15	24	7	3	34	41	6	6
				35	26	54	1
				36	22	20	0
				37	34	13	1
Means	30.3	14.6	3.9	Means	35.6	14.6	6.4

*Numbers 1 through 15 represent first grade teachers.
**Numbers 20 through 37 represent second grade teachers.

Teaching SCIS," (3) "Psychology of Jean Piaget," (4) inquiry laboratories, (5) micro-teaching, (6) demonstration teaching of specific SCIS lessons, and (7) planning for the 1968-1969 school year.

Lectures on the nature of science were presented by Dr. Glenn D. Berkheimer and Dr. Sherwood Haynes, Professor and Head, Department of Physics at Michigan State University. These lectures were scheduled during the first week of the workshop and were used to emphasize the SCIS approach to teaching science.

Films developed by the SCIS project for teacher training were used during the workshop. The films used to illustrate "Modes of Teaching SCIS" were: "Grandma's Button Box," "Experimenting with Air," "Karplus with Children," "Inventing the Comparison of Objects Using Signs," "Observing Liquids," "Invention of the Concept of Material," "Relativity (Documentary)," and "Interaction (Documentary)."

Activities related to the developmental psychology of Piaget were introduced with a "Demonstration of Piaget's Developmental Stages" by Dr. Donald Neuman, whose recently completed doctoral study dealt with Piaget's developmental stages. Dr. Neuman illustrated the different mental capacities of children by asking children to perform various tasks. The children ranged in age from five (5) to eight (8) years. The tasks centered mainly around conservation. This demonstration was followed with a lecture by Dr. Berkheimer entitled, "The Psychology of Jean Piaget."

The teachers were later shown the films, "Piaget's Developmental Theory: Classification" and "Piaget's Developmental Theory: Conservation."

The inquiry laboratories used during the workshop were adapted from a Laboratory Guide by Thier.[2] The inquiry laboratories were held on six (6) occasions at both the first and second grade levels with the activities, "Marble and Acid," "Classification," "Whirly Birds," "Mealworms," "Systems and Sub-systems," "Pendulums," and "Relativity." During one of the inquiry laboratories, "Marble and Acid," the combined grade levels of SCIS teachers were observed by the members of the Leadership Workshop on Elementary School Science which was held concurrently with the SCIS Workshop on the Michigan State University Campus. The participants of the SCIS Workshop and the Leadership Workshop worked cooperatively on several occasions including the one inquiry laboratory session and one micro-teaching situation.

The teachers were involved in a micro-teaching situation on three (3) occasions during the workshop. The children who were used for the micro-teaching sessions, were obtained from the married housing units on the Michigan State University campus. For the micro-teaching, the teachers prepared a SCIS lesson which was to be presented to two (2) children

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[2]Herbert D. Thier, "Teaching Elementary Science A Laboratory Approach" (Laboratory Guide--Revised. Boston: D. C. Heath and Company, May, 1968).

during a period of not more than fifteen minutes. The teachers at each grade level, first and second, worked in pairs. While one teacher presented the lesson to the children the other teacher was an observer. At the conclusion of the lesson and after a short break, the teachers changed roles. The second teacher then presented a different lesson to the same two (2) children, while the first teacher observed. All of the lessons were recorded by the teachers or staff members with either video or audio equipment or both. These recordings were used as feedback to be analyzed by the teachers. The SCIS teachers and Leadership Workshop participants worked as pairs during one microteaching session. The participants of the Leadership Workshop presented either a SCIS lesson or a lesson from the AAAS Science--A Process Approach. The SCIS teachers presented only SCIS lessons.

The demonstration teaching consisted of SCIS lesson presentation by grade level groups of four (4) or five (5) teachers. The unit chapters or activities were divided among the members of the groups. Each member was then responsible for gathering the necessary kit materials and presenting the lesson before other members of her group who played the role of pupils. In this manner, each teacher either presented or was involved with all the lessons in the units she would be teaching at her grade level during the 1968-1969 school year. No record was kept of which lessons or how many lessons each teacher presented.

Due to the many and varied responsibilities of elementary school teachers near the beginning of the school year, the latter portion of the workshop was scheduled to provide time for detailed planning of the SCIS lessons to be taught the first few weeks of school. This planning time was designed to relieve the teachers of some of the added planning necessitated when implementing a new curriculum project. The number of lessons planned by the individual teachers varied considerably.

The last day of the Summer Workshop, the teachers were given feedback forms, SCIS Teacher Reaction Sheets, which were to be completed after each SCIS lesson taught during the 1968-1969 school year, and then returned to the Trial Center. At the same time the teachers were given group instruction concerning how to complete the feedback forms.

Upon the completion of the Summer Workshop, each of the participants was paid a sum of $180.00 and received three (3) graduate term credits. A complete listing of the SCIS Summer Workshop Schedule is presented in Appendix A, page 128.

Implementation program. The teaching of the SCIS program in the four (4) cooperating school systems began during the first few weeks of the 1968-1969 school year. Each teacher decided when to begin the program in her classroom. The only stipulation was that a lesson should be taught, if possible, on the day the Michigan State University SCIS consultant visited her school. The teachers were usually visited on a Tuesday or Thursday, every two weeks. While the frequency varied across schools and classrooms, the usual practice was for the SCIS lessons to be taught two (2) or three (3) times per week. Fifteen to forty-five minutes was the usual amount of time devoted to a lesson. Feedback relative to the lessons was secured by means of forms, SCIS Teacher Reaction Sheets, which the individual teachers completed and returned to the Trial Center Office at Michigan State University.

The investigator of this study and two (2) other doctoral candidates in science education at Michigan State University were employed as consultants. The duties of the consultants included visiting the SCIS teachers' classrooms during science lessons and conducting meetings approximately once every two (2) weeks with the participating teachers in a given school or schools. The consultants also aided the SCIS teachers in lesson planning and preparation of materials when requested. At various times during the school year, teaching materials were delivered to the schools by the consultants. Occasionally, assistance was given to a teacher in the presentation of a SCIS lesson to the pupils. These experiences were used by the consultants to describe and evaluate the methods and materials of the SCIS program as they were being implemented in the classroom situation. Each consultant was assigned, during the Summer Workshop, to a group of teachers with whom he worked throughout the school year. Each of these groups included approximately one-third of the teachers. Geographic location of the school buildings was a major consideration in making the assignments.

Weekly meetings were held at the Science and Mathematics Teaching Center by the SCIS Trial Center Staff, composed of Dr. Glenn D. Berkheimer, coordinator, and the three (3) consultants. The purpose of the meetings was to coordinate the staff efforts and to provide feedback on the SCIS implementation as it was taking place in the cooperating schools. Since each of the consultants was conducting independent research[3,4] relative to the SCIS teachers, close communication and cooperation were maintained by the consultants. Each consultant was familiar with his colleagues' investigations and aided in the collection of data.

Classroom visitations and bi-weekly meetings. Each teacher was visited approximately once every two (2) weeks while a SCIS lesson was being taught. During these classroom visitations the consultants were able to observe the teachers'

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[3]Thomas Charles Moon, "A Study of Verbal Behavior Patterns in Primary Grade Classrooms During Science Activities" (unpublished Ph. D. dissertation, College of Education, Michigan State University, 1969).

[4]Larry R. Bruce, "A Determination of the Relationships Among SCIS Teachers' Personality Traits, Attitude Toward Teacher-Pupil Relationship, Understanding of Science Process Skills and Question Types" (unpublished Ph. D. dissertation, College of Education, Michigan State University, 1969).

progress in teaching the SCIS program and also observe student reaction to the lessons.

During most of the classroom visitations from September through April the consultants carried portable audio-tape recorders with which the SCIS lessons were recorded. These recordings were analyzed by the other two (2) consultants as part of their research.[5,6] Since the purpose of the recording was to capture the "normal" classroom situation, on those occasions when the lessons were recorded, the role of the consultant was limited to that of an observer.

Coinciding with the classroom visitations were grade level meetings between the consultants and SCIS teachers. The meetings were usually held after school dismissal the same day the consultant had visited classes. The purposes of the meetings were to provide opportunities for:
(1) assessing programs on the SCIS program implementation,
(2) exchange of teaching ideas or methods among the teachers and between the teachers and consultants, and (3) planning lessons for the next few weeks.

The meetings could be considered formal in that they were conducted by a consultant and followed a structured format designed to accomplish the three purposes described above. In January, however, the teachers had become accustomed to the format of the SCIS lessons and familiar with

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[5]Moon, op. cit.

[6]Bruce, op. cit.

the SCIS program in general. At this time, the teachers and SCIS Staff agreed that the formal group meetings were no longer necessary. The SCIS Staff decided it would be better to meet with the teachers on an individual basis to discuss any problems which might have developed. Group meetings were held only when the consultant or the teachers deemed it necessary.

Gull Lake week-end conferences. Two (2) in-service conferences were held at the Kellogg Gull Lake Biological Station at Hickory Corners, Michigan, September 28-29, 1968, and May 17-18, 1969. The two day week-end conferences were designed to aid the teachers in understanding ecological systems and also help them interrelate their immediate surroundings with the SCIS program. Dr. T. Wayne Porter, Professor of Zoology at Michigan State University, conducted the conferences. Aiding Dr. Porter were Dr. Berkheimer, Trial Center Coordinator and the three (3) SCIS consultants.

A day at the Kellogg Gull Lake Biological Station included:

8:00--9:00 a.m.	Lecture related to field work.
9:00--12:00 p.m.	Field Work--study ecosystems, take measurements, and collect specimens.
1:00--2:00 p.m.	Discussion of morning field experiences.
2:00--4:30 p.m.	Laboratory examination of specimens which had been collected.
4:30--5:30 p.m.	Summation of field and laboratory experiences.
7:00--8:00 p.m.	Slides, lecture, and discussion on ecosystems.

Seventeen (17) of the SCIS teachers attended the fall conference; six (6) from the first grade level and eleven (11) from the second grade level. The spring conference was attended by five (5) first grade level teachers and eight (8) second grade level teachers. Two (2) other first grade level teachers attending the spring conference had attended the 1967 SCIS Summer Workshop and had taught the SCIS program since the beginning of the 1967-1968 school year.

<u>Sources of teacher data</u>. Data were secured by means of tests, questionnaires, application forms, lesson feedback forms, audio-tape recordings, and personal observation. Each of these means is discussed in the following paragraphs.

The <u>NSF Applicant Information Sheet</u> was completed by each of the SCIS teachers attending the Summer Workshop. This sheet was used as the source of information concerning the teachers' ages, academic degrees held, years of teaching experience, and academic background in science.

The <u>Minnesota Teacher Attitude Inventory</u> (MTAI) was administered near the beginning of the Summer Workshop in August and again at the April 19, 1969, testing session when the teachers returned to the Michigan State University Campus. The MTAI purports to measure those attitudes which predict how well a teacher will get along with pupils in interpersonal relationships and indirectly, how well satisfied the teacher will be in teaching as a vocation. Norms have been established for various types of high school and college students, for teacher trainees, and for experienced elementary and secondary school teachers.[7] The possible range of scores for the MTAI is -150 to +150. A random sample of 247 elementary teachers with four (4) years of training and from systems of twenty-one (21) or more teachers had a mean score of 55.9 and a standard deviation of 37.2.[8]

The Sixteen Personality Factor Questionnaire (16 PF) was administered on Thursday of the second week of the Summer Workshop. The instrument was not administered again as it was assumed that no significant changes in personality would occur during the duration of the study. One of the specific advantages of this instrument is that by providing scores on factors that are not purely evaluative (i.e., psychologically "good" or "bad"), the test encourages the use of hypotheses that are more sophisticated than those linking "adjustment maladjustment" or some such dicotomous variable to the complex phenomena of teaching and of teaching effectiveness.[9] The personality factors covered in this instrument are cited in Appendix J, page 181.

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[7]J. S. Getzels and P. W. Jackson, "The Teacher's Personality and Characteristics," Handbook of Research on Teaching, ed. N. L. Gage (Chicago: Rand McNally, 1963), p. 508.

[8]Walter W. Cook, Carroll H. Leeds, and Robert Callis, The Minnesota Teacher Attitude Inventory Manual (New York: The Psychological Corporation, 1950), p. 9.

[9]Getzels and Jackson, op. cit., pp. 553-554.

The Science Curriculum Improvement Study, Workshop Content Achievement Evaluation (SCIS Test) was constructed by the investigator to measure the participants' knowledge of the academic and process information covered in the Summer Workshop. The test was administered on August 22, 1968, one day before the end of the Summer Workshop. The items on the SCIS Test were submitted to the Summer Workshop Staff to determine if the items adequately represented the experiences provided the teacher through their workshop activities. The items were also checked for clarity. Questionable items were either re-written or omitted. The test contained fifty (50) multiple-choice items. Items 1-41 were common to workshop activities at both the first and second grade level. The last nine (9) items were specific to each grade level and, therefore, scored separately. Each item was composed of from three (3) to five (5) options. The test is included in Appendix B, page 136.

The Science Process Test for Elementary School Teachers (Process Test) was administered near the beginning of the Summer Workshop on August 6, 1968, and again on April 19, 1969. This unpublished test was a forty (40) item multiple-choice test designed to measure process skills such as those emphasized in SCIS and Science--A Process Approach. Item analysis summary data provided by the author[10] of the test

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[10]Evan A. Sweetser, Science Process Test for Elementary School Teachers, 3rd Edition (East Lansing, Michigan: Michigan State University, 1968).

are presented in Table 3.

The SCIS Workshop Evaluation, Forms 1 and 2 were designed by the investigator to sample the teachers' reactions to specific Summer Workshop activities. The teachers rated the activities on a five (5) point scale, 1 to 5, and made comments. These instruments were administered at the conclusion of the first and second weeks of the Workshop, respectively.

Form 1 contained the activities of the first week of the Summer Workshop and Form 2, the activities of the second week. The activities included films, lectures, microteaching, and inquiry laboratories. The two (2) questionnaires are found in Appendices C and D, pages 156 and 158, respectively.

SCIS Workshop Evaluation, Form 3 was constructed by the writer during the third week of the workshop. In preparing Form 3, the knowledge gained from the teachers' responses to Forms 1 and 2 was helpful. An examination of the teachers' responses on Form 1 and Form 2 revealed high ratings, 4 or 5, on most items. Many teachers rated all activities as 5 in value. The investigator decided to categorize by activity area all of the workshop activities when constructing Form 3. The seven (7) activity areas, as listed previously in this chapter under the section entitled, "Summer Workshop," were: (1) lectures on the "Nature of Science," (2) films and lectures on "Modes of Teaching SCIS,"

Table 3. Process test item analysis summary data (summer 1968)

	Michigan-Maryland Teachers N=103	AAAS Workshop Teachers N=49
Mean	21.34	20.57
S. D.	5.60	4.58
Variance	31.38	20.96
Mean Item Difficulty	48.00	49.00
Mean Item Discrimination	34.00	28.00
Mean Point Biserial Correlation	32.00	26.00
Kuder Richardson Reliability #20	0.7601	0.6481
Standard Error of Measurement	2.7429	2.7169

(3) "Psychology of Jean Piaget," (4) inquiry laboratories, (5) micro-teaching, (6) demonstration teaching of specific SCIS lessons, and (7) planning for the 1968-1969 school year. In Form 3 the teachers were asked to rank the above activity areas according to the degree they perceived each would contribute to their teaching of the SCIS program during the 1968-1969 school year. The categorization of activities greatly reduced the number of items, and the ranking forced the teachers to discriminate the relative values of the activities. On Form 3, questions were also asked concerning workshop scheduling, number and selection of topics, strong and weak points, and general feelings about changes in thinking concerning science or science teaching which may have been elicited by the workshop experiences. A copy of Form 3 is found in Appendix E, page 160.

In writing items for the evaluation questionnaires, the investigator tried to provide a balance between structured items, which provided specific, desired information and open-ended items, which provided more freedom of response on the part of the teachers. The items were distributed to the workshop staff for examination and when items were found that appeared to be vague or misleading, these items were rewritten.

The Questionnaire on Teacher Reaction to Training, Materials, and Implementation of the SCIS Program was administered on April 19, 1969. The questionnaire, prepared by the investigator, consisted of sixty-nine (69) items, some requiring more than one response. Most of the items were of the multiple-choice type with the remainder open-ended. As the title indicates, the three sections of the questionnaire dealt with the teachers' training during the Summer Workshop and throughout the 1968-1969 school year, the SCIS materials, and teacher and student reaction to the general implementation of the SCIS program. All items were submitted to the SCIS staff members as a check for clarity and accuracy.

All but two of the SCIS teachers in the study returned to the Science and Mathematics Teaching Center on April 19, 1969, to retake as a post-test the MTAI, Science Process Test for Elementary School Teachers, and a final questionnaire, Questionnaire on Teacher Reaction to Training, Materials, and Implementation of the SCIS Program. The two (2) teachers who could not return on April 19, 1969, were given packets containing the tests and questionnaire. They completed the instruments and returned them to the Trial Center within ten days. During the April 19th testing session, every effort was made to replicate the group testing conditions of the Summer Workshop. The schedule followed on April 19th is found in Appendix K, page 182. A listing of the tests and questionnaires, along with when they were administered, is found in Table 4.

Table 4. Tests and questionnaires completed by the SCIS teachers and analyzed for the study.

Instruments	Time Administered	
	August 1968*	April 1969
Tests:		
1. Minnesota Teacher Attitude Inventory (MTAI)	X	X
2. 16 Personality Factor Questionnaire (16 PF)	X	
3. Science Process Test for Elementary School Teachers (3rd revised edition) (Process Test)	X	X
4. Science Curriculum Improvement Study, Workshop Content Achievement Evaluation (SCIS Test)	X	
Questionnaires:		
1. SCIS Workshop Evaluation, Form 1	X	
2. SCIS Workshop Evaluation, Form 2	X	
3. SCIS Workshop Evaluation, Form 3	X	
4. Questionnaire on Teacher Reaction to Training, Materials, and Implementation of the SCIS Program (Final Questionnaire)		X

*During the workshop.

The <u>SCIS Teacher Reaction Sheets</u> were a major source of data for the study. The Reaction Sheets were a revision of those used during the previous year. During the school year the teachers were supplied with Reaction Sheets by the consultants. The sheets could be returned to the Trial Center either by the stamped, addressed envelopes provided, or by giving the forms to a consultant. The feedback served two main purposes: (1) to keep the consultants informed of the teachers' progress, and (2) as a source of information to be used in revision and improvement of the SCIS program.

Seventeen (17) of the items on the Reaction Sheet were considered important as feedback information and, therefore, used in the computation of the total feedback and feedback index for each teacher. These seventeen (17) items plus a brief description were: (1) Unit, either Material Objects or Interaction; (2) Chapter or Activity, depending upon the unit; (3) Lesson Number within Activity, some activities required several lessons to complete; (4) Preparation Time, for each lesson in minutes; (5) Class Time Used, for each lesson in minutes; (6) Student-Materials Interaction; (7) Student-Student Interaction; (8) Teacher-Student Interaction; (9) Teacher's Guide Directions, rated according to clarity; (10) Comments, on item #9; (11) Lesson Type, how they taught the lesson; (12) Materials, rated on appropriateness, construction, etc.; (13) Comments, on item #12;

(14 and 15) Additional Ideas or Activities Used, a maximum of two (2); (16 and 17) Comments, Problems or Suggestions, anything not covered in items #1-15.

The seventeen (17) items were considered quantitatively. The only consideration was whether the teacher did or did not respond to a particular item. The only attempt made to place a value on a response was whether that response had been listed under the appropriate category on the Reaction Sheet. For example, a comment about materials would belong under item #13 rather than item #17. A copy of the SCIS Teacher Reaction Sheet is found in Appendix G, page 176.

On the last day of the Summer Workshop each consultant talked with the group of teachers with whom he was to work during the school year. The subject of the discussions was the Workshop, its good and bad points, and how it could be improved. These conversations were recorded via portable audio-tape recorders. The tapes were analyzed by the writer to determine if they contained any relevant information not contained in the questionnaire responses.

Analysis of data. All data were coded and placed on data coding forms by the writer. The coding transformed all responses to numerical form. Responses to open-ended questions were first categorized. Trained personnel at the Michigan State University Computer Laboratory were employed to transfer the coded data to key punch cards and verify the results. Personnel of Applications Programming of the

Michigan State University Computer Center were utilized to adapt existing programs to the needs of the researcher and submitted the data to the Control Data Corporation 3600 and 6500 Computers for tabulation and analysis.

The SCIS Test administered at the conclusion of the Summer Workshop was scored and item analyzed for difficulty and discrimination at the Michigan State University Scoring Service. The results of the item analysis can be found in Table 7 in Chapter IV. The MTAI, Process Test, and the 16 PF were scored and double checked by hand.

Hypotheses one (1) through four (4) were concerned with the teachers' rankings of the seven (7) categories of workshop activities which were listed earlier in this chapter. These rankings were in response to item #1 on the SCIS Workshop Evaluation, Form 3, and item #69 on the Questionnaire on Teacher Reaction to Training, Materials, and Implementation of the SCIS Program. These hypotheses were analyzed using a repeated measures four-way analysis of variance model. The significance of the results was tested by the F-test.

Hypotheses five (5) through eight (8) were concerned with the relationships between teacher characteristics and variables associated with lesson feedback. The values for these variables, defined in Chapter I, were computed by the CDC 3600 Computer and analyzed with the Pearson product-moment correlation statistic. The .05 level of significance was chosen in this and all other cases as the minimum level at which to reject the null hypotheses. Other data from the questionnaires were of a descriptive nature and are treated as such in Chapter IV.

Summary. Data relevant to teacher reaction to the training for the implementation of the SCIS elementary science program in four (4) mid- Michigan communities were collected via application forms, tests, questionnaires, feedback forms, and audio recordings. The study of the thirty-three (33) teachers began with the SCIS Summer Workshop in August 1968 and continued throughout the 1968-1969 school year.

All data were coded by the writer, transferred to key punch cards by trained key punch operators, and tabulated and analyzed by the Control Data Corporation 3600 and 6500 Computers. Hypotheses concerning teacher ranking of workshop activities were analyzed with a four-way analysis of variance model and tested for significance by use of the F-test. Relationships existing between teacher characteristics and teacher feedback variables and between teacher characteristics and teacher ranking of workshop activities were determined by the Pearson product-moment correlation statistic. A minimum of the .05 level of significance was employed in all cases.

CHAPTER IV

ANALYSIS OF DATA AND RESULTS

The purpose of this chapter is to present the results obtained from the instruments used to collect teacher data as described in Chapter III, as well as, the results of the testing of the eight (8) hypotheses. The results of the four (4) tests, MTAI, 16 PF Questionnaire, SCIS Test, and Process Test, are presented first. These findings are followed by the results of the questionnaires administered during the Summer Workshop, as well as, the final questionnaire administered in April. Next are presented the feedback data obtained from the Teacher Reaction Sheets and the recordings from the Summer Workshop. The hypotheses tested are grouped according to whether they dealt with the ranking of workshop activities, hypotheses 1-4, or the feedback from the Teacher Reaction Sheets, hypotheses 5-8.

<u>NSF applicant information sheet data</u>. The data obtained from the NSF Applicant Information Sheets concerned the teachers' ages, years of teaching experience, and total credit hours of science. These data, although previously listed in Chapter III, are presented along with other teacher characteristic data in Table 5.

Results of the Minnesota teacher attitude inventory. The scores of the MTAI administered during the Summer Workshop and again the following April revealed little change in group attitude. A mean of 61.0 resulted from the summer testing, while a mean of 60.0 occurred in April. The standard deviation was slightly higher for the April testing; 31.3 as compared to 26.9. These results are similar to the mean of 55.9 and standard deviation of 37.2 for the random sample of 247 elementary teachers as reported in Chapter III. The scores of the individual teachers and the mean averages for the first and second grade teachers are presented in Table 5.

Results of the sixteen personality factor questionnaire. This test was administered only during the Summer Workshop. The resulting scores, along with the data in Table 5, were used in the testing of the hypotheses 4-8, related to teacher characteristics. The scores of the 16 PF Questionnaire for each teacher are presented in Table 6.

Results of the SCIS test. Although the scores from the grade levels can not be compared due to differences in the last nine (9) questions, the first grade teachers had a mean score of 35.4 and standard deviation of 4.6. The mean score and standard deviation for the second grade teachers on the SCIS test were 32.4 and 4.6 respectively. The needed attention which was given a few of these answer sheets to make certain they were properly scored by the machine indicated

Table 5. Teacher characteristics data.

Teacher Number	Age	Process Test August	Process Test April	SCIS Test	MTAI August	MTAI April	Total Science Hours	Teaching Experience
1*	25	25	26	36	81	94	21	04
2	24	16	19	37	76	86	15	02
3	26	23	24	38	46	72	15	05
4	48	26	24	41	89	87	10	16
5	49	24	18	32	77	70	06	08
6	28	21	24	40	84	76	12	07
7	32	20	16	34	78	56	16	05
8	21	22	28	40	78	83	21	00
9	24	14	12	29	93	47	14	00
10	24	26	24	37	69	58	07	01
11	29	26	17	38	38	15	06	06
12	23	17	18	41	48	56	13	00
13	32	24	19	30	76	80	24	00
14	46	17	20	28	57	36	32	02
15	24	16	21	30	44	39	07	03
Means	30.3	21.1	20.7	35.4	68.9	63.7	14.6	3.9

20**	26	25	21	35	83	81	12	05
21	23	23	25	33	04	-06	15	01
22	53	19	16	27	73	76	08	10
23	23	23	30	41	66	49	21	02
24	41	24	21	32	69	90	11	04
25	26	21	21	32	90	67	18	04
26	22	22	21	30	58	32	08	01
27	35	29	25	33	80	87	13	10
28	23	25	25	34	60	99	11	02
29	53	18	14	25	29	33	07	17
30	55	05	06	23	-32	-49	09	08
31	57	16	21	34	67	79	13	-1
32	60	22	18	29	64	79	03	43
33	22	27	25	33	85	56	20	00
34	41	21	14	39	43	52	06	06
35	26	20	17	31	32	66	54	01
36	22	23	20	39	79	93	20	00
37	34	12	20	33	30	41	13	01
Means	35.6	20.8	20.0	32.4	54.4	56.9	14.6	6.4

* Numbers 1 through 15 represent first grade teachers.

** Numbers 20 through 37 represent second grade teachers.

Table 6. Sixteen personality factor questionnaire scores.

Teacher Number	Factor***															
	A	B	C	E	F	G	H	I	L	M	N	O	Q_1	Q_2	Q_3	Q_4
1*	10	08	22	20	16	07	20	08	04	12	12	04	12	09	13	16
2	04	07	07	15	10	04	05	14	06	14	06	10	10	10	10	17
3	04	08	14	16	12	08	12	12	10	16	18	18	12	15	12	06
4	11	11	18	05	12	17	04	16	06	10	10	13	09	08	07	23
5	12	10	19	06	11	16	08	13	03	16	06	10	08	11	13	08
6	16	09	14	20	12	12	19	12	10	12	11	12	12	11	09	11
7	12	09	13	18	14	08	15	13	08	19	06	08	10	08	07	16
8	18	10	16	11	13	20	19	12	06	10	10	05	10	07	16	10
9	13	08	16	10	16	15	19	08	06	13	11	11	11	11	14	15
10	13	08	13	10	08	10	07	13	07	11	08	13	10	08	05	19
11	16	09	14	10	15	12	10	10	10	12	06	07	10	12	10	13
12	14	09	14	08	17	15	12	11	02	10	09	07	11	10	10	07
13	18	11	19	10	09	15	19	12	06	10	13	04	07	08	12	06
14	11	09	12	06	04	15	06	11	05	20	09	17	10	10	09	20
15	08	05	14	06	07	14	08	09	06	12	08	15	06	13	12	17
20**	10	11	21	14	17	11	12	13	06	16	15	06	08	14	15	09
21	12	10	12	16	20	11	08	10	11	10	07	20	10	11	09	23
22	12	09	15	03	13	13	13	16	12	16	08	13	10	08	10	20
23	18	10	16	06	17	18	12	14	08	10	12	11	12	11	09	12
24	08	07	15	13	14	14	07	14	02	14	14	10	12	11	09	16
25	11	10	12	07	09	13	09	08	05	11	08	11	07	14	11	15
26	11	09	12	10	13	17	04	14	05	07	10	10	04	05	09	21
27	12	10	15	08	19	07	14	17	08	17	07	13	13	10	10	11
28	11	08	16	12	20	07	16	08	09	09	12	07	10	11	06	09
29	16	07	10	09	17	15	09	10	09	09	10	17	09	08	07	21
30	10	06	18	13	13	16	11	12	12	08	14	13	10	09	17	15
31	16	07	12	07	13	05	07	16	06	11	06	11	08	11	12	19
32	12	06	19	07	11	14	11	15	06	11	10	07	15	14	11	10
33	12	09	13	11	13	07	11	12	04	16	08	10	12	11	10	12
34	08	10	10	05	09	06	11	14	09	13	11	06	07	09	13	13
35	10	10	13	06	09	15	13	10	09	10	11	15	05	15	14	18
36	10	07	24	13	19	14	18	08	05	10	13	05	12	11	14	08
37	15	12	13	16	08	10	13	09	12	14	14	06	12	16	13	18

* Numbers 1 through 15 represent first grade teachers.
** Numbers 20 through 37 represent second grade teachers
*** Brief descriptions of the factors are listed in Appendix J, page 181.

that some of the teachers were unfamiliar with the answer sheets, but the author feels this did not invalidate the results. The tests, along with the scoring keys, are presented in Appendix B, page 136.

The item analysis summary data for the forty (40) workshop participants who took the SCIS Test are presented in Table 7. These data indicate the item difficulty for items 42-50 on the second grade test exceeded the item difficulty for items 42-50 on the first grade test. This may account for the difference in mean scores for the two grade levels on the total test.

Table 7. SCIS test item analysis summary data for the forty workshop participants.

	Items		
	1-41 Grades 1&2	42-50 Grade 1	42-50 Grade 2
Mean Item Difficulty	30.0	34.0	48.0
Mean Item Discrimination	24.0	36.0	53.0
Mean Point Biserial Correlation	24.0	40.0	47.0
Kuder Richardson Reliability	0.5654	0.1173*	0.6127
Standard Error of Measurement	2.5449	1.2495	1.2135

* It is recognized that this is a very low reliability coefficient.

Results of the process test. The means for the August and April testings for the Process Test were 21.0 and 20.3 respectively out of a possible 40. The standard deviations were both 4.9 when rounded to one decimal place. These results indicate the knowledge of process skills for the thirty-three (33) SCIS teachers was nearly the same at the two testings. Also, the mean score of the SCIS teachers was similar to the mean scores of the one hundred three (103) Michigan-Maryland teachers and the forty-nine (49) AAAS Workshop teachers taking the Process Test in the summer of 1968. The means were 21.34 and 20.57 respectively. These data were previously presented in Table 3. The individual scores of the SCIS teachers are listed in Table 5.

Results of workshop evaluation, form 1. Form 1 was administered at the conclusion of the first week of the 1968 Summer Workshop. The form was designed to sample teacher reactions to specific activities during the first week. Each activity was rated on a five-point scale according to how much the teacher felt it would contribute to her teaching of the SCIS program. Five was the highest rating. The mean rating for each activity is presented in Table 8. Although all activities were rated rather high, those activities which were of the lecture type received the lower ratings.

Results of workshop evaluation, form 2. The results of Form 2, administered at the end of the second week, were similar to Form 1. Lectures were again rated lower than

Table 8. 1968 workshop participants' mean ratings of the first week of workshop activities.

Workshop Activity	Mean Rating*
Demonstration SCIS lesson	4.77
"The Role of the Teacher in Teaching SCIS" and "Reactions and Experiences of the SCIS Teacher"	4.91
"What Are the Purposes of the Elementary School?"	3.55
Inquiry Laboratory (marble in acid)	4.09
SCIS Scope and Sequence (35 mm slides)	3.70
"The Nature of Science"	3.16
Micro-Teaching	4.46
"Objectives of Science Education and SCIS"	3.78
Laboratories (working with the kits)	4.78

*N = 33

activities with which the teachers could get more physically involved. The results of Form 2 are summarized in Table 9.

Results of workshop evaluation, form 3. Workshop Evaluation, Form 3 was administered on Thursday of the third week. By this time, all of the different workshop activity areas had been presented to the teachers. The weather had been extremely hot and humid during all but one day of the three-week Workshop. This fact was repeatedly mentioned by the teachers in questionnaire responses and, therefore, influenced the author's decision not to administer the questionnaire on Friday afternoon, August 23.

The responses to Form 3 revealed the teachers thought the time during the summer at which the workshop had been scheduled, August 5th through August 23rd, was most valuable. As a second choice the teachers said either a week earlier or in June would also be valuable.

Although fifty-six (56) per cent of the teachers thought the facilities of the Science and Mathematics Teaching Center would be of moderate value during the following school year, personal observation by the SCIS staff indicated that very little use was made of the facilities by the SCIS teachers. The number of topics covered during the workshop was considered satisfactory by seventy (70) per cent of the teachers. The selection of topics was felt adequate by seventy-six (76) per cent. Others felt that (1) less time should have been spent on the nature of science, (2) more time should be

Table 9. 1968 workshop participants' mean ratings of the second week of workshop activities.

Workshop Activity	Mean Rating*
"Overview of the SCIS Program"	4.90
"The SCIS Life Science Program," and "The Role of the Teacher in SCIS Life Science"	4.03
"Principles of Learning"	4.12
Demonstration Teaching Laboratory	4.51
Demonstration of Piaget's Developmental Stages	4.94
Micro-Teaching: T_3, T_1	4.43
Inquiry Laboratory (classification)	4.22
Piaget's Developmental Theory Films	
a. Classification	4.16
b. Conservation	4.19
Discussion before and after Piaget films	3.91

*N = 33

devoted to the study of Piaget's Developmental Theory, and (3) there were too many general lectures. Two weeks was thought to be a more appropriate length for the Workshop with three weeks the most frequent second choice.

Ninety-seven (97) per cent of the teachers indicated the Workshop had brought about changes in their ideas concerning science and the teaching of science in the elementary school. Most frequently listed as changes were: (1) the importance of objects in children's learning and (2) the importance of the "discovery approach."

The length of the Workshop was listed most often as a weak point. Most of the teachers felt the Workshop was too long. The teachers felt the strong points of the Workshop included: (1) inquiry laboratories, (2) the general organization, and (3) the opportunity to become familiar with the SCIS program materials. At the end of the Workshop only one teacher felt her preparation to teach the SCIS program had not been adequate.

The change in role most often reported as having been caused by the Workshop was a lessening of the "authoritative " role to allow for more "freedom to learn." Many teachers indicated they had always agreed with the role of the SCIS teacher, and the Workshop had only reinforced previous ideas.

All of the teachers responded that (1) they would recommend the Workshop to others, (2) an adequate number of staff had been used, and (3) sufficient opportunity was provided for comments and discussion of specific problems.

The teachers mentioned the heat frequently on the questionnaires, indicating that it should be considered when planning a workshop.

One of the questions on Form 3 asked the teachers to rank the seven (7) categories of workshop activities according to how they might contribute to the teaching of the SCIS program. The same question was repeated on the questionnaire administered in April. A mean ranking was computed for each activity for each of the questionnaires. The results appear in Table 10. The same information is presented in graphic form in Figure 1. The lectures on the

Table 10. The SCIS teachers' August and April mean rankings of workshop activity areas.

Activity Area	Mean Rankings	
	August	April
a. Lectures on the "Nature of Science"	5.93	5.69
b. Films and lectures on "Modes of Teaching SCIS"	2.62	3.28
c. "Psychology of Jean Piaget" activities	2.83	4.59
d. Inquiry laboratories	4.07	3.86
e. Micro-teaching	3.76	3.45
f. Demonstration teaching of specific lessons	3.28	2.41
g. Planning for the 1968-1969 school year	5.45	4.66

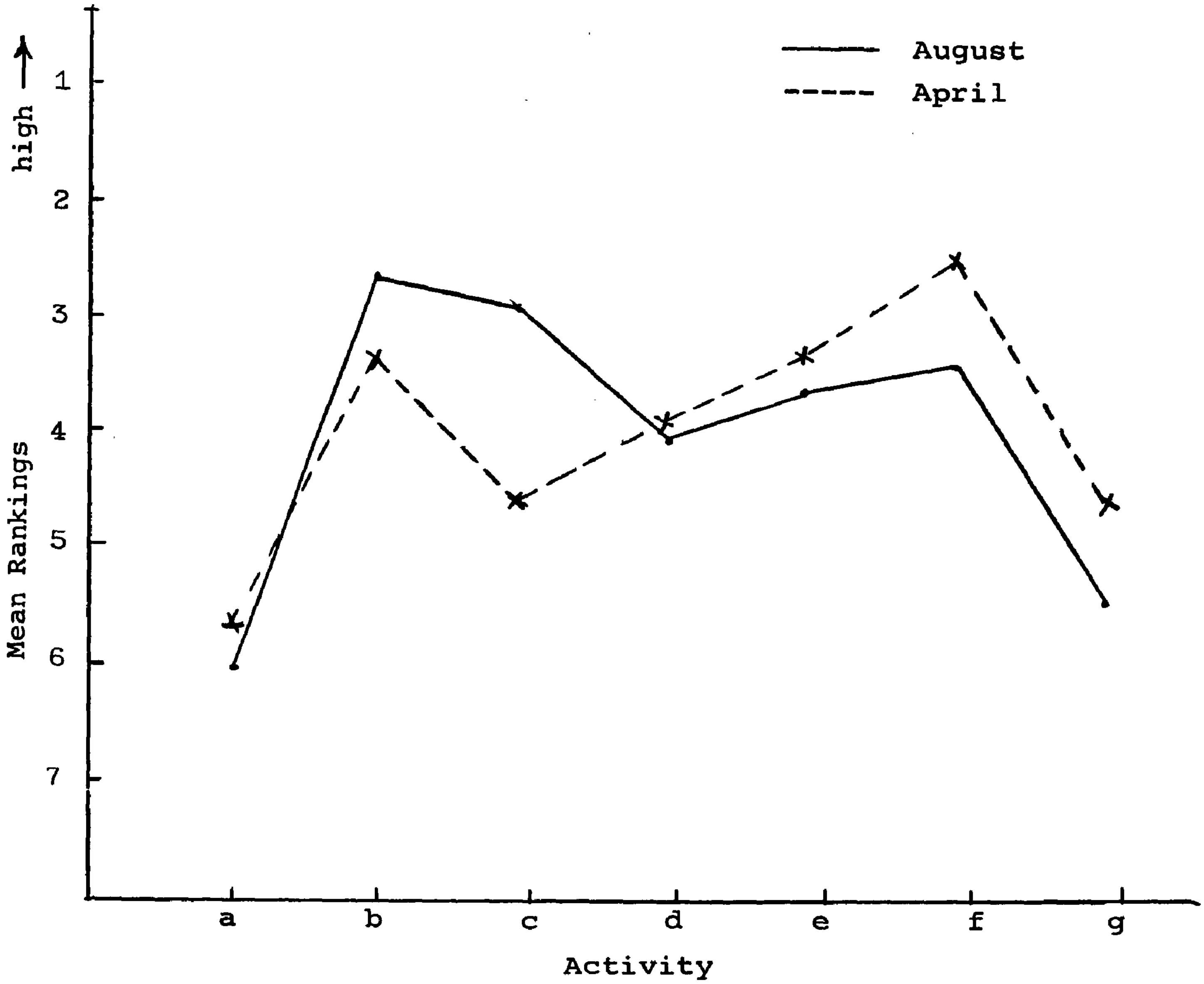

Figure 1. Graphic comparison of the August and April mean rankings of workshop activity areas.

"Nature of Science" were ranked last on both questionnaires. In August at the end of the Workshop, the films and lectures on "Modes of Teaching SCIS" were ranked highest with the Piaget-related activities second. In April the demonstration teaching was ranked highest with "Modes of Teaching SCIS" second. The data derived from the ranking of workshop activity areas were used in testing hypotheses one through four later in this chapter.

Results of questionnaire on teacher reaction to training, materials, and implementation of the SCIS program. This questionnaire was administered on April 19, 1969. The questions covered all phases of the training for the implementation of the SCIS program.

One question asked the teachers which portions of the SCIS training program; workshop, bi-weekly meetings, consultant services, or week-end conferences, were most helpful to them. In seventy-eight (78) per cent of the responses, a workshop related activity was indicated as most helpful. A similar question asked the teachers to list the least helpful portion of the training program. Forty-nine (49) per cent of the responses to this question were also workshop activity related. These responses would seem to indicate that the workshop activities were dominant and recalled most often as either most or least helpful in the training. The frequencies of the responses to the two questions are summarized in Tables 11 and 12.

Table 11. Portions of the SCIS training program perceived as most helpful by the teachers.

Response	Frequency
1. Workshop related activities	47
2. Consultant services	7
3. Bi-weekly meetings	3
4. Week-end conferences	2
5. Teaching the SCIS program	1

Table 12. Portions of the SCIS training program perceived as least helpful by the teachers.

Response	Frequency
1. Workshop related activities	26
2. Bi-weekly meetings	12
3. Week-end conferences	8
4. Research related activities	3
5. Feedback forms	3

During the 1968-1969 school year, the SCIS teachers frequently communicated with each other concerning the SCIS lessons. Sixty-four (64) per cent of the teachers reported that they often discussed the SCIS lessons with each other at times other than during feedback meetings.

Eighty-eight (88) per cent of the teachers reported that they regularly used certain procedures for distributing and collecting SCIS materials before and after teaching a science lesson. The method most frequently listed was "cafeteria style" for both distribution, sixty-eight (68) per cent, and collection, sixty (60) per cent. The use of students for distributing materials was reported by twenty-three (23) per cent of the teachers and thirty-two (32) per cent reported students aided in the collection of materials.

Eighty (80) per cent of the teachers reported on April 19, 1969, they had taught ten (10) or fewer science lessons which were not a part of the SCIS units. Of the eighty (80) per cent, sixteen (16) per cent reported teaching less than four (4) lessons.

To determine if the SCIS training had transferred to other areas, the teachers were asked if they had noted any changes in teaching methods in other subject areas which may have been caused by the SCIS training. Eighty-four (84) per cent of the teachers reported that changes had occurred. Of those reporting changes, forty-six (46) per cent reported they had asked different types of questions, forty-two (42) per cent used more of an inquiry approach, and the remaining twelve (12) per cent reported less teacher talk but more use of key words such as "evidence."

When asked about the average amount of class time per week used for science during the current year, seventy (70) per cent of the teachers indicated between one and two hours. In response to the same question for the 1967-1968 school year, eighty-eight (88) per cent reported less than one hour per week. Information from the Teacher Reaction Sheets was used to determine the mean time reported as required to prepare a SCIS lesson and the mean class time reported as used for a lesson. The results are summarized in Tables 13 and 14.

Table 13. Time used by the teachers to prepare SCIS lessons.

Unit	Number of Lessons Reported	Total Time	Mean Time per Lesson
Material Objects	320	4596 min.	14.4 min.
Interaction	366	7433 min.	20.3 min.

Table 14. Time used by the teachers to present SCIS lessons.

Unit	Number of Lessons Reported	Total Class Time	Mean Time per Lesson
Material Objects	328	9,340 min.	28.5 min.
Interaction	356	11,572 min.	30.6 min.

The questionnaire responses of the first grade teachers indicated that the preparation time required for an Organisms lesson was slightly more than for a Material Objects lesson. The second grade teachers' responses indicated that the Life Cycles lessons required less preparation time than Interaction lessons.

Questionnaire responses of the first grade teachers indicated that the SCIS program required less preparation time than they would normally expect to spend for science. The second grade teachers felt the SCIS program required more preparation time. When asked to compare preparation time for SCIS lessons with other subject areas, the first grade teachers felt SCIS lessons required less time, while the second grade teachers felt SCIS lessons required more time. The teachers at both grade levels were in agreement concerning the amount of time they would devote to the SCIS program if they taught it again during the following year. The teachers indicated they would not change the amount of time used for science. All of the teachers said they would use the SCIS materials again the next year if given a choice.

The first grade teachers reported that student interest in the Material Objects unit was higher than for Organisms. Ninety-four (94) per cent indicated equal or higher interest, sixty-nine (69) per cent indicated much higher interest. The responses of the second grade teachers indicated little difference between the Interaction and Life

Cycles units concerning student interest. Eighty-eight (88) per cent of the teachers felt the units were equally appropriate to all ability level students. Generally, student interest in science was rated as higher than the previous year by the teachers at both grade levels.

Throughout the year the student interest did not remain constant. Factors such as the shipments of living organisms which arrived in poor condition, contributed to a decline in student, as well as, teacher interest. Figure 2 shows how the teachers at both grade levels perceived the change in student interest throughout the school year.

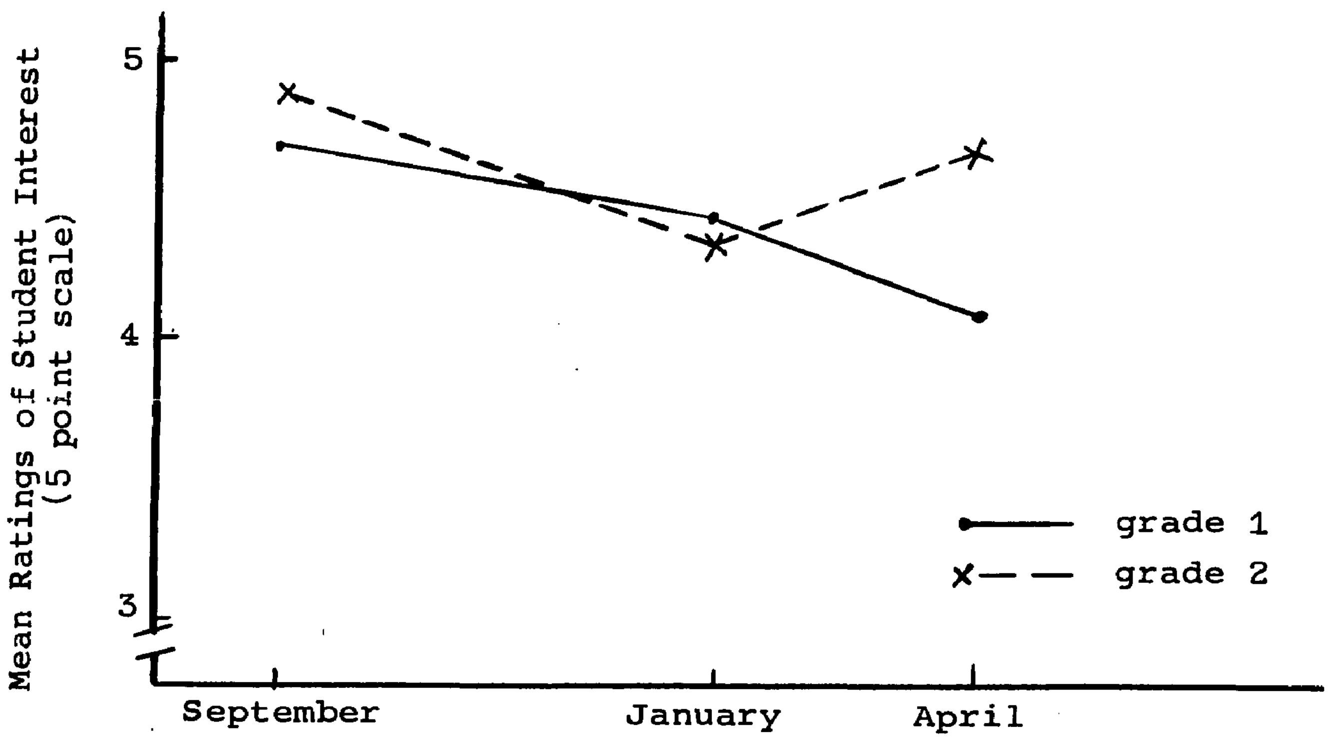

Figure 2. Teachers' perception of student interest in science during the school year.

The teachers at both grade levels indicated that it was much easier to get student participation during SCIS lessons than during lessons in other subject areas. Also, there was much greater student participation in science this year than last year, and, with the greater student participation, the teachers perceived a slightly greater discipline problem.

The amount of outside interest in the SCIS program is reflected in numbers of teachers wishing information about the SCIS program. Sixty-six (66) per cent of the SCIS teachers reported talking to four (4) or more teachers specifically about the SCIS program. Most of the questions asked were of the general interest nature with many wishing to know about student reaction to the SCIS program. All but four (4) of the SCIS teachers had visitors, who were not connected with the SCIS program, in their classrooms during science lessons. Of these teachers, eighty-six (86) per cent reported the visitors had not detracted from the lessons.

Only two (2) teachers had not had conferences with parents concerning the SCIS program. Three (3) of the teachers had talked with over twenty (20) parents each. The parents usually asked general interest questions or expressed positive reactions to the SCIS program. None of the teachers expressed any negative comment from any source.

Forty-five (45) per cent of the teachers reported their principals had not visited their classrooms during SCIS lessons, although only eighteen (18) per cent said they had not talked with the principal concerning the program. Again, the comments expressed general interest or positive reactions to the program.

The consultants visited each of the teachers with whom they worked approximately once every two weeks. Occasionally it was necessary for a teacher to contact a consultant for additional help or advice. On the average each teacher contacted her consultant about twice during the school year. An indication of the availability of the consultants was the response of seventy-five (75) per cent of the SCIS teachers that they had never tried and failed to contact a consultant. The teachers were asked to rate four (4) areas of consultant services on a five-point scale from "very helpful" to "not helpful at all." The four (4) areas of consultant services, along with the mean ratings of the teachers, by grade level, are presented in Table 15. The scale has been reversed so that "very helpful" corresponds to a rating of five. This was done to aid in interpretation and make the scale consistent with others used in the questionnaire.

The presence of the consultant in the classroom was felt to have an aversive effect on the teaching by eighteen (18) per cent of the teachers. Forty-eight (48) per cent of the teachers felt the presence of the consultant had no effect and thirty-three (33) per cent reported a positive effect.

Table 15. Teacher rating of the helpfulness of consultant services.

Area of Consultant Service	Teachers' Mean Ratings	
	Grade 1	Grade 2
1. Use of materials and equipment	4.89	4.80
2. Delivery of materials	4.83	4.86
3. Scientific factual information	4.59	4.60
4. Teaching methods	4.18	4.27

<u>SCIS teaching materials</u>. The teacher's guides for the SCIS units were designed to aid the teacher when preparing and teaching a SCIS lesson. The teachers were asked to rate the "science content information" and "teaching suggestions" with respect to their helpfulness in preparing to teach a SCIS lesson. On a five-point scale, five was the top rating. A summary of the results from this rating is found in Table 16. For each unit the teachers rated the guides higher for "science content information" than for "teaching suggestions."

Most of the teachers, eighty-one (81) per cent, felt that the number of concepts developed per unit was "about right," although five teachers indicated that more concepts should be developed. The general feeling of the teachers was that the total amount of material per unit was also "about right."

During the Summer Workshop, considerable time was devoted to reading and discussion of information found in the

Table 16. SCIS teachers' ratings of the helpfulness of the teacher's guides.

Unit	Mean Rating of	
	Science Content Information	Teaching Suggestion
Grade 1		
Material Objects	4.27	4.00
Organisms	4.27	3.67
Grade 2		
Interaction	4.22	3.89
Life Cycles	4.33	3.83

SCIS Elementary Science Sourcebook.[1] Questionnaire responses in April indicated the teachers seldom used the Sourcebook during the school year. Four (4) teachers stated they did not use the Sourcebook at all during the school year.

The time required for locating materials in the kits is an important factor determining the amount of preparation time for the SCIS lessons. The teachers were asked to rate the kits according to ease of locating materials. The means of the ratings for each kit are summarized in Table 17. A five-point scale corresponding to a range from poor to excellent was employed.

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[1]Willard Jacobson and Allan Kondo, SCIS Elementary Science Sourcebook, Trial Edition (Berkeley, California: University of California, 1968).

Table 17. Teachers' ratings of kit organization.

Kit	Teachers' Mean Ratings	
	Grade 1	Grade 2
Material Objects	4.33	--
Organisms	4.33	--
Interaction	--	3.82
Life Cycles	--	4.35

Eighty-five (85) per cent of the teachers reported stressing "processes" more this year than last year, while seventy-three (73) per cent indicated stressing "factual information" less than the previous year. Questionnaire responses also indicated the teachers felt they asked fewer convergent type questions than the previous year, but the total number of questions asked was greater.

Seventy-five (75) per cent of the teachers felt that Piaget's Developmental Psychology had been of moderate or greater value in planning and teaching a SCIS lesson. Specific examples of their pupils' classroom behavior, which were related to the developmental psychology, were listed by fifty-five (55) per cent of the teachers.

Starting in September and continuing through the middle of April, audio-tape recordings of the SCIS lessons were made by the consultants during classroom visitations. The questionnaire administered in April included four (4) questions designed to sample the teachers' feelings as to the possible effects of the recording. The responses to the questions indicated that the sixty-four (64) per cent of the teachers who thought their teaching had been either positively or negatively affected, were evenly divided. Only one teacher responded that her teaching was negatively affected "a great deal." The most frequently mentioned ways in which the teaching had been affected were listed as: (1) less discipline, (2) "more careful of what I said," and (3) self-conscious. The recording equipment was reported to have affected the students' behavior by fifty-five (55) per cent of the teachers. Of the fifty-five (55) per cent, half of these reported a positive effect. Despite the inconveniences which may have occurred, eighty-eight (88) per cent of the teachers felt research was important enough to tolerate the distractions.

The greatest problem reported in filling out the SCIS Teacher Reaction Sheets was finding the time to do it. The other responses indicated the teachers felt some of the information required was irrelevant to the lesson. Determining the lesson type and remembering what had happened during the lesson were also indicated as problems. The general feeling of the teachers was that they did not benefit a great deal from completing the feedback forms. Those who did report a benefit indicated that completing the forms brought the lesson into focus and forced the teachers to evaluate what had occurred during the lesson.

Forty-two (42) per cent of the teachers reported completing the Reaction Sheets within a day after teaching a SCIS lesson. Most of the remaining teachers indicated the sheets were completed within a week of when the lesson was taught. Fifty-three (53) per cent of the time, the sheets were returned by the teachers to the Michigan State University Trial Center via a consultant. The rest of the time the sheets were returned by mail in the stamped, self-addressed envelopes which were supplied to the teachers. The teachers also indicated that sixty-four (64) per cent of the time they had conversed with a consultant about feedback on the SCIS program rather than writing it on the Reaction Sheets. Perhaps this is one reason why two (2) teachers felt the bi-weekly meetings were very valuable, and eighty-four (84) per cent of the teachers rated the meetings as more moderate in value. Only three (3) SCIS teachers felt the bi-weekly meetings were of no value as an exchange of teaching ideas.

The majority of the SCIS teachers attending the fall week-end conference indicated that it was of moderate value as an aid to teaching science. One teacher felt the conference was not helpful at all, while five (5) teachers reported that it had helped a great deal.

The rating of the week-end conference activities by the teachers reveal the field work to be most valuable, and laboratory work was judged next in value. The slides and lectures were thought to be of least value. On a five-point scale the field work, laboratory work, and lectures had mean ratings of 4.06, 3.82, and 3.65 respectively. The specific conference information, which the teachers reported as using in the classroom, was: (1) ideas on conducting a field trip, and (2) how to set up a terrarium.

Results of the SCIS teacher reaction sheets. A total of 721 sheets were returned by the teachers. One teacher returned no sheets, while the most returned was fifty-five (55) by one of the first grade teachers. The mean number of sheets returned by the teachers was 22.5. On the sheets the first grade teachers completed sixty (60) per cent of the blanks and the second grade teachers responded to sixty-three (63) per cent of the items. Few comments were made concerning the Teacher's Guide directions. The second grade teachers had a mean of 4.1 comments per teacher compared to 2.9 for the first grade teachers. The second grade teachers also rated the Teacher's Guide directions higher. The mean rating was 3.99 for the Interaction Teacher's Guide compared with 2.96 for the Material Objects Teacher's Guide. The mean number of comments concerning materials was also greater for the second grade teachers, 3.8 compared to 2.5, even though the first grade teachers rated the materials slightly higher, 4.39 compared to 4.35. The information derived from the SCIS Teacher Reaction Sheets, for each teacher, is presented in Table 18.

Table 18. Information derived from teacher reaction sheet data.

Teacher	Total Sheets	Total Feedback	Feedback Intex	Mean Interaction Student-Materials	Mean Interaction Student-Student
1	30	361	.70	4.59	4.31
2	6	63	.62	5.00	5.00
3	7	73	.61	4.60	4.67
4	55	514	.55	4.33	3.75
5	32	370	.68	4.91	4.22
6	22	247	.66	4.47	3.55
7	12	108	.52	4.57	4.63
8	18	230	.75	4.78	4.06
9	18	171	.55	4.33	3.94
10	31	337	.63	4.17	3.77
11	33	298	.53	5.00	4.96
12	30	286	.56	5.00	4.12
13	33	280	.49	4.38	4.46
14	8	77	.56	4.67	4.67
15	8	79	.58	3.71	3.50
Means	22.8	232.9	.60	4.52	4.20
20	27	319	.69	3.23	3.63
21	2	19	.55	5.00	4.00
22	30	245	.48	4.67	4.00
23	24	265	.64	4.72	4.48
24	26	292	.66	4.95	4.45
25	18	190	.62	4.40	4.20
26	18	192	.62	4.79	4.33
27	14	143	.60	4.69	4.29
28	35	418	.70	4.74	4.14
29	17	195	.67	4.69	4.73
30	22	243	.64	4.84	4.67
31	0	---	---	----	----
32	25	306	.72	4.54	4.13
33	28	267	.56	4.25	4.00
34	21	213	.59	4.21	3.79
35	27	294	.64	4.58	4.57
36	26	291	.65	3.58	3.85
37	18	204	.66	4.39	4.28
Means	22.2	240.9	.63	4.42	4.15

Ratings	Mean Ratings		Comments		
Teacher-Student	Teacher's Guide Directions	Materials	Teacher's Guide Directions	Materials	General
4.28	4.50	4.33	8	9	40
4.80	0.00	3.75	0	1	8
4.83	0.00	3.60	0	1	8
3.95	4.09	4.76	4	1	40
4.13	4.64	4.75	8	3	26
3.45	3.94	4.58	7	4	23
3.88	3.67	4.80	1	2	5
4.12	4.44	3.72	6	9	22
3.83	2.88	4.67	1	1	4
3.62	3.00	3.74	4	4	28
4.92	4.67	4.54	1	2	18
2.95	4.89	4.65	1	0	13
4.46	4.29	5.00	1	0	24
4.67	0.00	5.00	0	1	3
2.88	0.00	4.67	1	0	13
4.00	2.96	4.39	2.9	2.5	18.3
3.52	4.64	4.16	4	7	16
5.00	0.00	4.00	1	0	2
4.54	4.67	4.50	3	1	34
4.63	4.11	4.44	3	6	20
4.67	4.30	4.50	12	4	18
4.33	4.82	4.67	4	3	6
4.38	3.82	4.50	8	2	17
4.30	4.40	4.57	0	2	12
3.51	4.04	4.79	8	6	43
4.44	4.25	4.60	0	6	27
4.72	4.83	4.70	1	0	25
----	----	----	-	-	--
3.77	4.14	4.40	4	3	42
4.24	5.00	4.75	4	6	26
3.94	4.19	4.00	1	2	8
4.44	3.89	4.42	1	1	26
2.56	3.60	4.50	7	7	33
4.59	4.00	3.14	8	8	26
4.16	3.99	4.35	4.1	3.8	22.4

<u>Results of recordings made at the end of the summer workshop</u>. After listening to the tape recordings of the conversations between the SCIS teachers and consultants and comparing the comments with the information derived from the questionnaires, the writer concluded the information was nearly identical. A separate presentation would only be redundant as almost all of the comments had been previously written on the questionnaires.

<u>Testing of the hypotheses</u>. The hypotheses tested were related to two (2) of the major purposes of the study. The first was to ascertain teacher reaction to the SCIS training program or, more specifically, to examine the teachers' rankings of workshop activities. The second major purpose was to investigate the quantitative aspect of the teachers' reactions, in the form of feedback on the SCIS Teacher Reaction Sheets, in relation to selected teacher characteristics.

The first four hypotheses were related to the Summer Workshop. Hypotheses 1-3 were tested with a repeated measures analysis of variance model. A table of random numbers was used to omit one second grade teacher and, thereby, provide the equal number of observations per cell necessary under this model. The ANOVA Table, Table 19, was derived with the Millman-Glass Rules of Thumb for Writing the ANOVA Table. The main effect sources of variance listed in the ANOVA Table are: (1) grade level (G), (2) time of ranking (T), and

Table 19. ANOVA table for the repeated measures analysis of variance model used to test hypotheses 1-3.

Source*	df	SS	MS	F
G	1	0.01	0.01	1
T	1	0.01	0.01	1
A	6	385.99	64.33	13.4[1]
S:G	26	0.26	0.01	----
GT	1	0.01	0.01	1
GA	6	37.20	6.20	1.29
TA	6	73.13	12.19	6.2[2]
TS:G	26	0.26	0.01	----
AS:G	156	751.52	4.82	----
ATG	6	6.49	1.08	0.55
TSA:G	156	305.09	1.96	----
Total	391	1559.99	3.99	

* derived with the Millman-Glass Rules of Thumb for Writing the ANOVA Table.

[1] significant at the .01 level (conservative test) $F_{.99} = 7.72$ [1,26] df.

[2] significant at the .05 level (conservative test) $F_{.95} = 4.22$ [1,26] df.

(3) activity (A). The S stands for subjects or teachers. Each of the hypotheses is stated in the null form.

$H_{O,1}$: There is no significant agreement among the SCIS teachers' rankings of workshop activities made at the conclusion of the 1968 Summer Workshop.

$H_{O,2}$: There is no significant agreement among the SCIS teachers' rankings of the 1968 Summer Workshop activities made the following April.

The F value of 13.4 for the main effect of activities (A) is significant at the .01 level using the conservative test.[2] This significant main effect means either $H_{O,1}$ or $H_{O,2}$ or both, must be rejected. The F value of 6.2 for the time-activity (TA) interaction is significant at the .05 level using the conservative test. The significant TA interaction means the activity main effect is significant for both the rankings in August and also those in April. There was significant agreement among the teachers' rankings at both times. $H_{O,1}$ and $H_{O,2}$ are, therefore, both rejected.

All pair-wise comparisons of mean activity rankings were made for August and for April to determine which activities had mean rankings significantly different from other activity mean rankings at each time. The method of Tukey[3]

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[2]S. W. Greenhouse and S. Geiser, "On Methods in the Analysis of Profile Data," Psychometrika, Vol. 24, 1959, pp. 95-112.

[3]William C. Guenther, Analysis of Variance (Englewood Cliffs, New Jersey: Prentice Hall, 1964), p. 107.

was used and tested at the .05 level of significance. Tables 20 and 21 show which pairs of activities had mean rankings which were significantly different.

$H_{0,3}$: There are no significant differences between the SCIS teachers' rankings of the 1968 Summer Workshop activities made at the conclusion of the workshop and the corresponding rankings made the following April.

In addition to indicating a significant activity main effect in August and April, the significant time-activity (TA) interaction reveals that the teachers ranked the activities differently in April than in August. To determine which activities were ranked significantly different at the two times, pair-wise comparisons were again made using the Tukey method. The pairs consisted of one activity for two different times, August and April. The only significant difference, at the .05 level, was for activity c (Piaget). The findings for all of the pair-wise comparisons across times are summarized in Table 22.

$H_{0,4}$: There are no significant correlations between the teachers' rankings of the workshop activities and specified teacher characteristics.

$H_{0,4}$ must be rejected, because a number of significant correlations were found. All of the Pearson product-moment correlations between teacher characteristics and activity rankings are listed in Table 29, Appendix H, page 177.

Table 20. Tukey post hoc comparisons of mean activity rankings in August.

Activity**	Activity**					
	b	c	d	e	f	g
a	3.31*	3.10*	1.86*	2.17*	2.65*	0.48
b		0.21	1.45	1.14	0.66	2.83*
c			1.24	0.93	0.45	2.62*
d				0.31	0.79	1.38
e					0.48	1.69*
f						2.17*

Table values greater than 1.47 are significant at the .05 level.
* significant at the .05 level.
** refer to Table 10, page 75 for a listing of activities.

Table 21. Tukey post hoc comparisons for mean activity rankings in April.

Activity**	Activity**					
	b	c	d	e	f	g
a	2.41*	1.10	1.83*	2.24*	3.28*	1.03
b		1.31	0.58	0.17	0.86	1.38
c			0.73	1.14	2.18*	0.07
d				0.41	1.45	0.80
e					1.04	1.21
f						2.25*

Table values greater than 1.47 are significant at the .05 level.
* significant at the .05 level.
** refer to Table 10, page 75 for a listing of activities.

Table 22. Tukey post hoc comparisons between August and April mean activity rankings.

Activity**-April	a	b	c	d	e	f	g
	Activity**-April						
a	0.24						
b		0.66					
c			1.76*				
d				0.21			
e					0.31		
f						0.87	
g							0.79

Table values greater than 1.47 are significant at the .05 level.
* significant at the .05 level.
** refer to Table 10, page 75 for a listing of activities.

Age was found to correlate significantly with the August ranking of workshop activities c (Piaget), d (inquiry labs.), and e (micro-teaching). The negative correlations between age and activities c and d indicate the older teachers ranked these activities higher than the younger teachers. The opposite was true for activity e (micro-teaching).

In August the knowledge of science process skills had a significant negative correlation with activity d (inquiry laboratories) and a significant positive correlation with the ranking of activity g (planning for the 1968-69 school year). The teachers with the greatest knowledge of processes ranked activity d high and activity g low.

Examination of Table 23 reveals that significant correlations seem to be paired. For example, personality factor Q_3 (see Appendix J, page 181) is negatively correlated, at the .01 level with activity b (modes of teaching SCIS) and positively correlated at the .01 level with activity d (inquiry laboratories). If it is true that the ipsative nature of the data forces positive and negative correlations to be somewhat paired, the actual number of significant correlations may be less than had first appeared. This interpretation may cast some doubt as to whether there is an overall significant relationship between specified teacher characteristics and ranking of workshop activities. Sixteen (16) correlations would be expected to be significant by chance alone.

The possible relationships between the feedback information derived from the SCIS Teacher Reaction Sheets and the specified teacher characteristics were investigated through hypotheses 5-8. Table 30 of Appendix I, page 179, contains all the correlations run in connection with hypotheses 5-8. The Pearson product-moment correlation statistic was used in all cases.

$H_{O,5}$: There are no significant correlations between the teachers' total feedback and specified teacher characteristics.

The total amount of feedback returned by the teachers on the Teacher Reaction Sheets was significantly correlated

Table 23. Significant correlations between the ranking of workshop activities in August and specified teacher characteristics.

Teacher Characteristics	Workshop Activities						
	a	b	c	d	e	f	g
Age			-.3910*	-.4765**	.4566**		
Process Test--August				.3623*			.3486*
Personality factor A	-.3599*				.3572*		.3528*
Personality factor E	.3411*						
Personality factor I						.4567**	
Personality factor M			-.3862*			.4328*	
Personality factor N		-.6276**		.3910*			
Personality factor Q_1			-.4054*				
Personality factor Q_3		-.4593**		.4493**			

* .05 level.
** .01 level.

Table 24. Significant correlations between the ranking of workshop activities in April and specified teacher characteristics.

Teacher Characteristics	Workshop Activities						
	a	b	c	d	e	f	g
Process Test--August		-.3717*	-.3826*				.4144*
Process Test--April			-.3597*				
Personality factor L	-.3844*						
Personality factor Q_1			-.4675**			.3477*	
Personality factor Q_3					.4021*		

* .05 level.
** .01 level.

with four (4) teacher characteristic factors. The MTAI scores from the April testing and the Process Test scores from the August testing were positively correlated at the .05 level with total feedback. Sixteen PF factors C and O (see Appendix J, page 181) were significantly correlated with total feedback at the .01 level. The teachers who were "mature" and "confident" according to the Sixteen PF scores, returned a greater quantity of feedback data.

$H_{O,6}$: There are no significant correlations between the teachers' feedback indices and the specified teacher characteristics.

One significant correlation at the .05 level was found to exist between the feedback indices and the specified teacher characteristics. The teachers with high scores on personality factor N, "shrewd" and "polished," returned more information on each Reaction Sheet.

$H_{O,7}$: There are no significant correlations between specified teacher characteristics and the teachers' mean ratings of:

a) student-materials interaction
b) student-student interaction
c) student-teacher interaction
d) teacher's guide directions
e) materials.

The teachers' mean ratings of student-materials interaction and personality factor C correlated negatively at the .05 level of significance. The student-materials interaction was rated lower by the teachers whose Sixteen PF score on factor C would classify them as "calm" and "mature." No significant correlations were found at the .05 level between the specified teacher characteristics and the mean rating of student-student interaction. Three (3) significant correlations at the .05 level existed between the teacher characteristics and the mean ratings of student-teacher interaction. The MTAI scores from the April testing and Sixteen PF factor C were negatively correlated, while Sixteen PF factor L correlated positively.

Mean ratings for teacher's guide directions and teacher characteristics correlated significantly at the .01 level for Sixteen PF factor A and factor O. Also, the correlation between teacher's guide directions and Sixteen PF factor C was significant at the .05 level. Teachers whose scores indicated they were "warm," "mature," and "confident" rated the teacher's guide directions higher.

The two (2) significant correlations between the mean ratings of the materials and teacher characteristics revealed that "submissive" and "trustful" teachers rated the materials higher.

$H_{O,8}$: There are no significant correlations between specified teacher characteristics and the total number of SCIS Teacher Reaction Sheet comments concerning:

a) teacher's guide directions

b) materials

c) the lesson in general--items 5 and 6, additional ideas and activities used, problems, or suggestions.

The number of comments concerning teacher's guide directions was positively correlated at the .05 level with the April MTAI scores and personality factor C. A negative correlation, significant at the .05 level, was found with personality factor O. Teachers who were "mature," "confident," and scored high on the MTAI comment more on teacher's guide directions. Those teachers with greater knowledge of processes in April had also commented more on the teacher's guide directions.

The greatest numbers of comments concerning the SCIS materials were made by teachers who scored high on the MTAI and Process Test in April, had high scores on personality factors E and H, and low scores for personality factor O. The greatest numbers of general comments on the SCIS Teacher Reaction Sheets were made by teachers, who scored high on the MTAI in April, had the most teaching experience, had high scores on personality factor C, and scored low on personality factor M. A brief description of the factors in the Sixteen Personality Factor Questionnaire is presented in Appendix J, page 181.

Table 25. Significant correlations associated with hypothesis 5.

Teacher Characteristics	Total Feedback
MTAI--April	.3750*
Process Test--August	.3703*
Personality Factor C	.5709**
Personality Factor O	-.4618**

* .05 level.
** .01 level.

Table 26. Significant correlations associated with hypothesis 7.

Teacher Characteristics	Mean Ratings of:				
	Interactions			Teacher's Guide Directions	Materials
	Student-Materials	Student-Student	Student-Teacher		
MTAI--April			-.3541*		
Personality factor A				.4826**	
Personality factor C	-.3889*		-.3741*	.3745*	
Personality factor E					-.3512*
Personality factor L			.3580*		-.3446*
Personality factor O				-.5684**	

* .05 level.
** .01 level.

Table 27. Significant correlations associated with hypothesis 8.

Teacher Characteristics	Comments		
	Teacher's Guide Directions	Materials	General
MTAI--April	.3877*	.3633*	.3408*
Teaching Experience			.4030*
Process Test--April	.3419*	.4474*	
Personality factor C	.3842*		.5396**
Personality factor E		.3418*	
Personality factor H		.3816*	
Personality factor M			-.3735*
Personality factor O	-.4297*	-.4817**	

* .05 level
** .01 level

Summary. The results of the MTAI from the August and April testing, means of 61.0 and 60.0 respectively, indicate little, if any, change in attitude. Process Test scores from the two testings revealed similar findings. The mean scores of 21.0 and 20.3 on the Process Test show little change in knowledge of science process skills had occurred. The Sixteen Personality Factor Questionnaire and the SCIS Test were administered during August only. The scores on these two (2) tests were utilized as teacher characteristic data for the correlations run to test the hypotheses.

Questionnaire results from the first two weeks of the Summer Workshop indicated a decided preference for activities which elicited teacher involvement rather than the passive attendance at lectures. The final questionnaire, administered during the workshop, revealed a preference for a two-week rather than three-week workshop, although all of the teachers felt the Workshop was very beneficial. Of the seven (7) categories of workshop activities, those related to the demonstration teaching of specific SCIS lessons were ranked highest at the Workshop's conclusion. Lectures on the "Nature of Science" were ranked lowest.

The results of the final questionnaire, administered in April, indicated that Summer Workshop activities dominated the thinking of the teachers when they were asked to list the most and least beneficial portions of the SCIS teacher training experiences. The first grade teachers rated instruction in the use of materials and equipment as the most helpful of the services provided by the consultants. The second grade teachers felt that delivery of materials was the most helpful service.

For all of the units taught, at both grade levels, the teachers rated "science content information" above "teaching suggestions," for usefulness of the Teacher's Guides. The SCIS Elementary Science Sourcebook was seldom used by any of the teachers.

Forty-two (42) per cent of the teachers reported completing the SCIS Teacher Reaction Sheets, most often, within a day after teaching a SCIS lesson. Finding the time required to complete the sheets was the most often reported problem encountered with them.

The Gull Lake Week-end Conference held in the fall was rated as moderate in value by most of those attending. Rated as most valuable were the field work activities.

A total of 721 SCIS Teacher Reaction Sheets were completed and returned by the teachers at both grade levels. This represents an average of 22.5 sheets per teacher. For the 721 sheets, 61.4 per cent of the blanks contained information from the teachers. Items concerning classroom interactions and lesson type were completed most often, while ratings and comments concerning Teacher's Guide directions and materials were less often completed.

The hypotheses tested involved two (2) areas of the study: (1) the ranking of the seven (7) categories of workshop activities, and (2) the quantity of selected lesson feedback and its relation to specified teacher characteristics. The hypotheses, along with the statistics used for analysis, and the decision to reject or fail to reject, are summarized in Table 28.

Table 28. Summary of hypotheses tested, statistics used, and decision reached.

	Hypotheses	Statistic used for analyzing data	Decision based upon α = .05
$H_{0,1}$	There is no significant agreement among the SCIS teachers' rankings of workshop activities made at the conclusion of the 1968 Summer Workshop.	Analysis of variance	Reject
$H_{0,2}$	There is no significant agreement among the SCIS teachers' rankings of the 1968 Summer Workshop activities made the following April.	Analysis of variance	Reject
$H_{0,3}$	There are no significant differences between the SCIS teachers' rankings of the 1968 Summer Workshop activities made at the conclusion of the workshop and the corresponding rankings made the following April.	Analysis of variance	Reject
$H_{0,4}$	There are no significant correlations between the SCIS teachers' rankings of the workshop activities and specified teacher characteristics.	Pearson product-moment correlation	Reject

$H_{0,5}$	There are no significant correlations between the teachers' total feedback and specified teacher characteristics.	Pearson product-moment correlation	Reject
$H_{0,6}$	There are no significant correlations between the teachers' information indices and specified teacher characteristics.	Pearson product-moment correlation	Reject
$H_{0,7}$	There are no significant correlations between specified teacher characteristics and the teachers' mean rankings of: a) student-materials interaction b) student-student interaction c) student-teacher interaction d) teacher's guide directions e) materials.	Pearson product-moment correlation	Reject
$H_{0,8}$	There are no significant correlations between specified teacher characteristics and the total number of SCIS Teacher Reaction Sheet comments concerning: a) teacher's guide directions b) materials c) the lesson in general--items 5 and 6.	Pearson product-moment correlation	Reject

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to gather quantitative and qualitative data concerning selected elementary teachers' reactions to the training for and implementation of the SCIS program into four (4) mid-Michigan school districts. Also, under investigation were the possible relationships which may exist between teacher reactions and specified teacher characteristics.

Review of the literature. A selected review of the literature revealed a lack of research in the area under investigation and established a need for such research. No studies were found which attempted to investigate the specific area of this study.

Design of the study. The study involved thirty-three (33) first and second grade teachers selected to participate in an NSF Cooperative College-School Science Program between Michigan State University and the East Lansing, Grand Ledge, DeWitt, and Perry, Michigan, School Districts. Teacher data were collected beginning with a 1968 Summer Workshop. The teacher characteristics considered important to the study were: (1) age, (2) years of teaching experience, (3) knowledge of the SCIS program, (4) personality, (5) academic background in science, (6) attitude toward the teacher-pupil relationship, and (7) knowledge of science process skills. The instruments which were utilized to collect data were: (1) NSF Applicant Information Sheet; (2) Minnesota Teacher Attitude Inventory; (3) Sixteen Personality Factor Questionnaire; (4) Science Curriculum Improvement Study, Workshop Content Achievement Evaluation; (5) Science Process Test for Elementary School Teachers; (6) SCIS Workshop Evaluation, Forms 1, 2, and 3; (7) Questionnaire on Teacher Reaction to Training, Materials, and Implementation of the SCIS program; and (8) SCIS Teacher Reaction Sheets.

The 1968 Summer Workshop was designed to acquaint the participants with newer elementary science programs, especially the SCIS. Following the Workshop, the participants taught the SCIS lessons in their classrooms during the 1968-1969 school year. Each teacher was visited by a SCIS consultant approximately once every two weeks during the school year. The teachers returned lesson feedback to the SCIS Trial Center throughout the year. Finally, all the feedback was coded by the writer and transferred to key punch cards.

Analysis of the data involved tabulation, repeated measures analysis of variance, and the Pearson product-moment correlation coefficient. All computation was carried out on the Control Data Corporation 3600 and 6500 computers.

<u>Hypotheses tested</u>. The hypotheses tested were that: (1) the teachers' rankings of workshop activities during August and April would be random and no differences would exist between the rankings of the two dates; (2) there are no significant correlations between teacher characteristics and the ranking of workshop activities, total feedback, information indices, or other specific data related to feedback.

Data for each hypothesis tested were required to show significance at the .05 level for rejection of the hypothesis. In addition to .05 as the minimum criterion, the .01 level was also reported on several occasions.

<u>Results and conclusions</u>. Hypothesis $H_{O,1}$ tested the agreement among the SCIS teachers' rankings of workshop activities which were made at the end of the workshop. This hypothesis was rejected indicating the teachers were in agreement as to the relative value of the workshop activities.

Hypothesis $H_{O,2}$ tested the agreement among the SCIS teachers' rankings of the same workshop activities made the following April. This hypothesis was also rejected. The teachers were still in agreement concerning the relative value of the workshop activities.

Hypothesis $H_{O,3}$ tested the agreement between the SCIS teachers' rankings in August and those of April. The rejection of this hypothesis indicates a change in relative value placed upon the activities from August to April.

The relationship between teacher characteristics and ranking of workshop activities was investigated by hypothesis $H_{O,4}$. Some doubt exists as to the interpretation of the results, although the writer believes sufficient significant correlations were revealed to reject the hypothesis.

Hypothesis $H_{O,5}$ tested the strength of the relationship between specified teacher characteristics and the total amount of feedback returned to the Trial Center by the SCIS teachers. The data indicated the rejection of the hypothesis. A significant relationship does exist. The MTAI scores from the April testing and the Process Test scores in August were positively correlated at the .05 level, while 16 PF factors C and O were positively and negatively, respectively, correlated at the .01 level.

The amount of feedback information, per SCIS Teacher Reaction Sheet returned, was tested by hypothesis $H_{O,6}$. A significant positive correlation was found between personality factor N and the teachers' feedback indices. Those teachers who were scored as "shrewd" and "polished" had higher feedback indices.

Hypothesis $H_{O,7}$ investigated the relationships between teacher characteristics and the teachers' mean ratings of the lesson interactions, teacher's guide directions, and the materials. Sufficient significant correlations were found to reject the hypothesis.

The numbers of comments concerning teacher's guide directions, materials, and the lesson in general, which the teachers returned on the SCIS Teacher Reaction Sheets, were examined in hypothesis $H_{O,8}$. Significant correlations were found between the numbers of comments and the April MTAI scores, personality factor C, and personality factor O. The hypothesis was thus rejected.

The teachers' responses to questionnaires administered after each of the first two weeks of the Summer Workshop indicated a decided preference for workshop activities with which they could become physically involved. Lectures were rated low on both questionnaires. On the final questionnaire administered during the workshop, all of the teachers expressed the belief that the Workshop had been very beneficial but could have been condensed into a two-week period. Of the seven (7) workshop activity areas, the developmental "Psychology of Jean Piaget" and "Modes of Teaching SCIS" ranked highest. Lectures on "Nature of Science" ranked lowest both in August and again in April.

The Summer Workshop was only a portion of the teachers' preparation to teach the SCIS materials. However, the Workshop was most often listed as both most and least beneficial of the training experiences, thus indicating the importance attached to the Workshop by the teachers. The consultant services were highly rated by the teachers with instruction in the use of materials and equipment, and delivery of materials valued most highly.

The average number of SCIS Teacher Reaction Sheets returned per teacher was 22.5 for a total of 721. Of the SCIS

Teacher Reaction Sheet blanks of interest in this study, sixty-one (61) per cent had been completed.

Educational implications. In view of the findings, the following educational implications seem justified.

1. Elementary teachers do agree on the relative merit of educational experiences and could, therefore, be utilized in such matters as workshop planning.
2. Immediate reactions are not always identical to those elicited at a later time. Both should be taken into consideration when planning a workshop.
3. Elementary teachers may not be taught most effectively by the "lecture" method. Methods utilizing the active participation of the teachers are perceived as more effective.
4. Teacher reaction to educational experiences may be, in part, related to the specified teacher characteristics investigated in this study. These characteristics may be worthy of consideration when planning in-service educational experiences.
5. More extensive use could be made of methods and techniques such as micro-teaching, which may more directly transfer to the classroom situation.

Some areas which seem worthy of further research. The review of the literature indicated the lack of research in the area of in-service education of elementary teachers in science. Especially noticeable was the absence of research associated with the newer science programs developed within the last ten years. This study considered some teacher reactions to such an in-service program and the relationship of the reactions to teacher characteristics.

Additional research in this area would add considerably to the knowledge necessary if in-service education in science is to increase in efficiency. Some questions raised are:

1. What results would be produced if the same teachers were studied during their second year of teaching the SCIS program?
2. What would be the results of a qualitative analysis of lesson feedback in relation to teacher characteristics?
3. How would elementary teachers respond to teaching a newer science program without the benefit of a preceding workshop experience?
4. What is the minimum length of time needed to accomplish the objectives of a workshop such as the one under consideration in this study?
5. What is the extent to which the methods employed, rather than the subject matter content, influence teachers' reactions to in-service education experience?
6. Did the teachers benefit from completing the SCIS Teacher Reaction Sheets after each lesson?

7. Was the elapsed time between the completion of a lesson and the filling out of a SCIS Teacher Reaction Sheet related to the elicited responses?
8. How would the teachers have reacted to the Summer Workshop had it not been followed by consultant services throughout the school year?
9. Does the accessibility of kit materials rather than the psychological and scientific bases of the SCIS program influence teacher reaction to the program?
10. Do the students benefit from their teachers' participation in an in-service experience such as the SCIS Summer Workshop?

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APPENDICES

APPENDIX A

SCIS SUMMER WORKSHOP SCHEDULE

Week I

Monday, August 5

9:00 - 10:00 a.m.	"Demonstration Lesson" Christina Kageyama Discussion McDonel Hall Kiva
10:00 - 10:45 a.m.	"Orientation to the 1968 SCIS Summer Workshop" Berkheimer
	Break
11:00 - 11:45 a.m.	"Overview of Interaction and Material Objects Kits" Berkheimer
	Lunch
12:45 - 2:00 p.m.	"The Role of the Teacher in Teaching SCIS" "Reactions and Experiences of the SCIS Teacher" Christina Kageyama
	Break
2:00 - 4:00 p.m.	Introduction to the SCIS Kits Grade 1 teachers, Organisms Grade 2 teachers, Interaction

Tuesday, August 6

9:00 - 10:15 a.m.	"What are the Purposes of the Elementary School?" Berkheimer, Bruce, Moon
	Break
10:30 - 11:45 a.m.	Laboratory: Grade 1 teachers, Material Objects Grade 2 teachers, Life Cycles
	Lunch

12:45 - 1:45 p.m.	<u>The Science Process Test</u> Moon
	Break
2:00 - 4:00 p.m.	Inquiry Laboratory (Observed by College Science Educators)

<u>Wednesday, August 7</u>

9:00 - 10:00 a.m.	"SCIS Scope and Sequence," Slides Berkheimer
	Break
10:15 - 11:15 a.m.	"Role of the SCIS Teacher" Berkheimer
11:15 - 11:45 a.m.	"Operating Procedures for the 1968-69 School Year" Berkheimer
	Lunch
12:45 - 1:30 p.m.	<u>Minnesota Teacher Attitude Inventory</u> Bruce
	Break
1:45 - 2:30 p.m.	"Introduction to Micro-Teaching" Berkheimer
2:30 - 4:00 p.m.	Laboratory: Grade 1, <u>Organisms</u> Grade 2, <u>Interaction</u>

<u>Thursday, August 8</u>

9:00 - 10:15 a.m.	"The Nature of Science" Dr. Sherwood Haynes
	Break
10:30 - 10:45 a.m.	Study SCIS Sourcebook, pp. 18-24 Discussion Berkheimer
10:45 - 11:45 a.m.	Preparation for Micro-Teaching Lessons
	Lunch

12:45 - 2:45 p.m.	Micro-Teaching by SCIS Teachers
	Break
3:00 - 4:00 p.m.	Laboratory: Grade 1, <u>Material Objects</u> Grade 2, <u>Life Cycles</u>

<u>Friday, August 9</u>

9:00 - 9:45 a.m.	"Objectives of Science Education and SCIS" Berkheimer
	Break
10:00 - 10:45 a.m.	Study SCIS Sourcebook, pp. 25-33
10:45 - 11:45 a.m.	Preparation for Micro-Teaching Lessons
	Lunch
12:45 - 2:45 p.m.	Micro-Teaching by SCIS Teachers
	Break
3:00 - 4:00 p.m.	Laboratory: Grade 1, <u>Organisms</u> Grade 2, <u>Interaction</u>
	<u>SCIS Workshop Reaction, Form 1</u> Barnes

Week II

<u>Monday, August 12</u>

9:00 - 9:45 a.m.	"The SCIS Life Science Program" Dr. Chester A. Lawson
9:45 - 10:15 a.m.	"The Role of the Teacher in SCIS Life Science" Dr. Chester A. Lawson
	Break
10:30 - 11:00 a.m.	"The Organisms Unit" Dr. Chester A. Lawson
11:00 - 11:45 a.m.	"The Life Cycles Unit" Dr. Chester A. Lawson

	Lunch
12:45 - 2:15 p.m.	Demonstration Teaching: Grade 1, <u>Material Objects</u> film, Activity 6, "Grandma's Button Box" Grade 2, <u>Life Cycles</u>
	Break
2:30 - 4:00 p.m.	Demonstration Teaching: Grade 1, <u>Organisms</u> Grade 2, <u>Interaction</u>

<u>Tuesday, August 13</u>

9:00 - 10:30 a.m.	"Principles of Learning" Berkheimer
	Break
11:00 - 11:45 a.m.	Study: SCIS Sourcebook, pp. 34-39 (Grade 2 teschers) Micro-Teaching Preparation (Grade 1 teachers)
	Lunch
12:45 - 2:45 p.m.	Micro-Teaching: T_3 , T_1 (T_3 - College Educator, T_1 - SCIS Teachers)
	Break
3:00 - 4:00 p.m.	Demonstration Teaching: Grade 1, <u>Organisms</u> Grade 2, <u>Interaction</u>

<u>Wednesday, August 14</u>

9:00 - 10:30 a.m.	"Demonstration of Piaget's Developmental Stages" Donald Neuman
	"The Psychology of Jean Piaget" Berkheimer
	Break

10:45 - 11:45 a.m.	Micro-Teaching Preparation (grade 2 teachers) Study SCIS Sourcebook, pp. 34-39 (grade 1 teachers)
	"Science in the Classroom," film
	Lunch
12:45 - 2:45 p.m.	Micro-Teaching: T_3 , T_1
	Break
3:00 - 4:00 p.m.	Demonstration Teaching: Grade 1, <u>Material Objects</u>, film, Activity 8, "Grouping Collections of Objects" Grade 2, <u>Life Cycles</u>

<u>Thursday, August 15</u>

9:00 - 9:45 a.m.	"Modes of Teaching SCIS" Berkheimer
	"Material Objects Overview," film
9:45 - 10:30 a.m.	"Piaget's Developmental Theory: Classification," film
	Break
10:45 - 11:45 a.m.	Study Sourcebook, pp. 40-51
	Lunch
12:45 - 1:45 p.m.	<u>16 P F Questionnaire</u> (personality test) Bruce
	Break
2:00 - 4:00 p.m.	Demonstration Teaching: Grade 1, <u>Organisms</u> Grade 2, <u>Interaction</u>

<u>Friday, August 16</u>

9:00 - 10:30 a.m.	"Piaget's Developmental Theory: Conservation," film
	"Psychological Foundations of SCIS" Berkheimer Discussion and film "Interaction Documentary"

	Break
10:45 - 11:45 a.m.	Inquiry Laboratory, "Classification" (Grade 1 teachers) Demonstration Teaching (Grade 2 teachers)
	Lunch
12:45 - 2:15 p.m.	Inquiry Laboratory, "Classification" (Grade 2 teachers) Demonstration Teaching (Grade 1 teachers)
2:15 - 2:30 p.m.	SCIS Workshop Reaction, Form 2 Barnes
2:30 - 3:00 p.m.	"Relativity Documentary," film
	Break
3:15 - 4:00 p.m.	Demonstration Teaching

Week III

Monday, August 19

9:00 - 9:45 a.m.	"Classroom Management, Modes of Teaching and Inquiry Laboratories" Berkheimer
9:45 - 10:30 a.m.	Film, Activity 9, "Invention of the Concept of Material" Modes of Teaching SCIS: An Analysis of Teaching Episodes on Film" Berkheimer
	Break
10:45 - 11:45 a.m.	Material Objects: for children who haven't had first grade (Grade 2 teachers) Material Objects (Grade 1 teachers)
	Lunch
12:45 - 2:15 p.m.	Inquiry Laboratory: Grade 1 teachers, Whirly birds Grade 2 teachers, Mealworms
	Break

2:30 - 4:00 p.m.	Demonstration Teaching: Grade 1 teachers, Material Objects
	Woodlot Fieldtrip and Discussion, Grade 2 teachers

<u>Tuesday, August 20</u>

9:00 - 10:15 a.m.	"Operating Procedures for the 1968-69 School Year--Consultants, Bi-weekly Seminar, etc." Berkheimer
	"Guiding Students to Design Experiments--The Controlled Experiment" Berkheimer
	Break
10:30 - 11:45 a.m.	Film, Activity 18, "Observing Liquids," Grade 1 teachers
	Inquiry Laboratory, <u>Systems and Subsystems</u>, Grade 2 teachers
	Lunch
12:45 - 2:00 p.m.	Woodlot Fieldtrip and Discussion, Grade 1 teachers
	<u>Interaction</u>, Grade 2 teachers
2:15 - 4:00 p.m.	Inquiry Laboratory, Pendulums, Grade 2 teachers
	<u>Material Objects</u>, Grade 1 teachers

<u>Wednesday, August 21</u>

9:00 - 9:30 a.m.	"SCIS Teachers and Public Relations" Berkheimer
9:30 - 9:45 a.m.	Teachers from each elementary school will outline plans for a PTA meeting
9:45 - 10:00 a.m.	Film, Activity 20, "Inventing the Comparison of Objects Using Signs"
	Break

10:15 - 11:45 a.m.	Inquiry Laboratory: Pendulums, Grade 1 teachers Relativity, Grade 2 teachers
	Lunch
12:45 - 1:15 p.m.	A tour of facilities of the SMTC
1:30 - 2:30 p.m.	Detailed planning for 1968-69 school year
	Break
2:45 - 4:00 p.m.	Planning (con't.)

Thursday, August 22

9:00 - 10:00 a.m.	"An Experienced SCIS Teacher's Reaction to the SCIS Program" Dianne Westfall
	Break
10:15 - 11:45 a.m.	Reports from each school district Continuation of Planning Dianne Westfall
	Lunch
12:45 - 1:45 p.m.	SCIS Workshop Content Achievement Evaluation Barnes
	Break
2:00 - 4:00 p.m.	Inquiry Laboratory Films: "Experimenting with Air" "Karplus with Children"

Friday, August 23

9:00 - 10:45 a.m.	Detailed Planning for 1968-69 School Year
	Break
11:00 - 11:45 a.m.	Planning for Bi-weekly Seminars
	Lunch
12:45 - 1:00 p.m.	Feedback
1:00 - 1:30 p.m.	Tapes of workshop reactions

APPENDIX B

SCIENCE CURRICULUM IMPROVEMENT STUDY

WORKSHOP CONTENT ACHIEVEMENT EVALUATION

Grades 1 and 2

Michigan State University Trial Center

Directions: The following questions are multiple choice. On the answer sheet, darken in the space corresponding to the best answer for each question.

1. The units which have been developed for grade 1 of the SCIS program are:

   a. Material Objects and Organisms

   b. Interaction and Organisms

   c. Interaction and Life Cycles

   d. Material Objects and Life Cycles

   e. None of the above

2. The units which have been developed for grade 2 of the SCIS program are:

   a. Material Objects and Organisms

   b. Interaction and Organisms

   c. Interaction and Life Cycles

   d. Material Objects and Life Cycles

   e. None of the above

3. The primary evaluation emphasis of SCIS has been:

   a. Comparing students who have had SCIS with those who have not.

   b. A definitive measure of the scientific literacy of the pupils emerging from SCIS.

   c. Evaluating the program by collecting feedback information from teachers and trial center co-ordinators.

d. Through the use of teacher-made tests.

e. None of the above.

4. The major psychological influence on the SCIS program is:

   a. Bruner

   b. Gagne

   c. Piaget

   d. Skinner

   e. Karplus

5. The primary purpose of the SCIS curriculum is:

   a. the development of competent scientists

   b. to develop more meaningful science materials for children

   c. the development of specified process skills

   d. the development of scientific literacy

   e. none of the above

6. In the "discovery" lesson in SCIS:

   a. experiences are provided that present further examples of a previously described concept.

   b. materials are provided whereby children can arrive at a scientific principle without teacher prompting.

   c. students study the history of famous scientific discoveries.

   d. none of the above is correct.

7. The average amount of time required to teach one of the SCIS units (e.g., Organisms) is about:

   a. 11-12 months

   b. 8-10 months

c. 6-7 months

d. 3-5 months

e. none of the above

8. The title of the first unit commonly used in SCIS is:

   a. Interaction

   b. Material Objects

   c. Organisms

   d. Subsystems

   e. None of the above

9. By "invention" lesson in SCIS, we mean:

   a. the children recognize a scientific principle when presented with various examples of a concept.

   b. the children create new solutions to problems.

   c. the teacher introduces the science concept that describes what the children have observed.

   d. none of the above is correct.

10. The main purpose of using Mr. O in SCIS is:

   a. to aid in identifying similarities and differences among animals outside the classroom.

   b. to enable students to describe properties of an entire organism.

   c. to experiment with; to find the origin of detritus.

   d. to act as a reference frame.

11. In studying magnetism a child used an electromagnet to attract some paper clips. Which of the following would best describe the "system" under study?

   a. child, electromagnet, and paper clips.

   b. child and electromagnet.

c. electromagnet.

d. electromagnet and paper clips

12. In SCIS, the purpose of the activity in which the children compare similarly shaped pieces of aluminum, brass, pine, walnut, and polystyrene is:

    a. to lead to the identification of the concept of material.

    b. for identification and naming of two or more characteristics of an object (such as color and texture).

    c. for the construction and demonstration of the use of a single-stage system for classifying materials.

    d. to gain a better understanding of the concept of inequalities.

13. The <u>best</u> operational definition of the term "mass" is:

    a. quantity of matter.

    b. the size of an object whether it is in space or on earth.

    c. that property of an object which determines the acceleration imparted to it by a given force.

    d. that quantity of matter that, when acted upon by a force, will not change its velocity.

14. The modern view of science is:

    a. there is an interaction between the scientist and his work

    b. science is an organized body of knowledge

    c. facts exist and are only to be discovered

    d. none of the above

15. Of the following, which is <u>not</u> a scientific mode of inquiry?

    a. basic assumptions are made

b. terms are defined

c. evidence is collected

d. hypotheses are formed

e. theories are verified

16. Which of the following is not an implication of the modern view of science education?

a. Children need direct experiences with phenomena.

b. Children should engage in investigations.

c. Scientific statements are considered as tentative in nature.

d. The child develops his own conceptual structure of science.

e. None of the above.

17. The concepts included in the SCIS program are arranged in a hierarchy so that:

a. the children encounter a higher level abstraction only after they have had considerable direct and concrete experience with it at a lower level of abstraction.

b. a branching process is used to develop new concepts.

c. the inverted concept skills are presented in the proper sequence.

d. the chaining technique of Piaget is maximized.

e. none of the above is correct.

18. The SCIS program attempts to present the concepts to the children in pace with their developing comprehension. Accordingly, it relies most heavily upon:

a. the judgment of the teacher

b. the prescription of fixed procedures for every lesson

c. those lessons which contain the major concept chain links

d. none of the above.

19. The highest developmental stage at which the child is unable to conserve is:

    a. sensory-motor

    b. pre-operational

    c. concrete operations

    d. formal operations

20. Which of the following is not considered important for the transition from one developmental level to the next?

    a. maturation

    b. experience with the physical world

    c. social experience

    d. synaptic nerve differentiation

21. The basic intent of the "invention" lesson is to provide:

    a. operational definitions

    b. verbal definitions

    c. the "right" answers to questions

    d. a method of determining what types of questions should be asked

    e. none of the above

22. The goal of "discovery" lessons is to:

    a. teach the children to discriminate so as to reduce diversity of responses

    b. to get the "right" answers to questions

    c. to find out what the children think and what progress they are making in understanding

    d. none of the above

23. Divergent questions tend to:

    a. narrow the scope of the materials being studied

    b. increase the possible answers to a question

    c. weaken the interest in the topic under study

    d. none of the above

24. Which of the following is <u>not</u> an example of a divergent question?

    a. "How can we find out?"

    b. "What do some other people think?"

    c. "Is <u>this</u> in the system?"

    d. "What other kind of experiment could we try?"

25. Which of the following is <u>not</u> true concerning the effective ways of storing and distributing SCIS materials?

    a. Children are inefficient in handling materials and should, therefore, be used infrequently.

    b. Plastic bags and shoe boxes may be useful for storing materials.

    c. Kits which are shared should be stored in one area agreeable to both teachers.

    d. Materials can be distributed during recess while children are out of the room.

26. The central concept in the SCIS life science program is:

    a. ecosystem

    b. biotic potential

    c. habitat

    d. organisms

27. Interactions lead to changes in systems. These systems may be:

    a. physical

    b. chemical

    c. biological

    d. all of the above

    e. none of the above

28. Micro-teaching can be an effective teaching technique for it:

    a. emphasizes some of the subtle but important details in the teaching process

    b. allows the teacher to focus on specific aspects of teaching

    c. may be done in teams with the teachers taking turns in observing and commenting upon the others' teaching

    d. all of the above

29. One of the most pronounced characteristics of a child in the pre-operational stage is:

    a. Multiplication of relations

    b. Centration

    c. Reversibility

    d. Addition and Subtraction

30. Children make the transition from sensory-motor to pre-operational at the age of approximately:

    a. 6 months

    b. 18 months

    c. 3 years

    d. 6-7 years

    e. 14-16 years

31. It is at times advantageous to use a particular part of the room for discussions during:

    a. exploration lessons

    b. invention lessons

    d. discovery lessons

32. By having the children work in small groups, the teachers may want to encourage:

    a. student-materials interaction

    b. teacher-student interaction

    c. student-student interaction

33. Which of the following is an example of a divergent question?

    a. "How many sides does it have?"

    b. "What other possibilities are there?"

    c. "Do the guppies eat the daphnia?"

    d. "How many know the answer to that question?"

34. The basis of science is:

    a. theory

    b. deduction

    c. observation

    d. prediction

35. The type of reasoning used in theory formation is:

    a. inductive

    b. deductive

    c. cyclic

    d. empirical

36. When a child is inclined to look at objects and events as though they can be viewed only from his particular perspective, he is likely to be in which intellectual stage of development?

    a. sensory-motor

    b. pre-operational

    c. concrete operations

    d. formal operations

37. When a child has acquired the ability to handle incoming information conceptually rather than to rely more on his perceptions, he is likely to be in which intellectual stage of development?

    a. sensory-motor

    b. pre-operational

    c. concrete operational

    d. formal operations

38. When a child can make a four-fold classification among two dimensions, and understand that a class of hard objects can include objects that are rough and those that are smooth, he has truly reached the __________level of thinking.

    a. sensory-motor

    b. pre-operational

    c. concrete operations

    d. formal operations

39. _______________thought is claracterized by irreversibility.

    a. sensory-motor

    b. pre-operational

    c. concrete operations

    d. formal operations

40. In the SCIS program, the interaction considered most valuable in the classroom is:

    a. children-materials interaction

    b. children-children interaction

    c. teacher-materials interaction

    d. teacher-children interaction

41. The ranking of objects according to the degree to which they possess a certain property is called:

    a. classification

    b. serial ordering

    c. property orientation

    d. biserial correlation

ITEMS 42-50 FOR GRADE 1

42. Another way to state that object A is greater than object B but less than object C with respect to some property is:

  a. $A>B>C$

  b. $B<A<C$

  c. $B>C>A$

  d. $A<B>C$

  e. $C<B>A$

43. Which of the following is <u>not</u> an example of algae?

  a. Clamydomonas

  b. Volvox

  c. Eudorina

  d. Daphnia

  e. Seaweed

44. Guppies ⟶ Daphnia ⟶ Algae
                  ↗
            Goldfish

Above is an example of:

  a. habitat

  b. food web

  c. life cycle

  d. biotic potential

  e. diversity of organisms

45. The reason for using "aged tap water" is:

  a. The pH of "fresh" water is too high.

  b. The chlorine must be allowed to diffuse into the air.

  c. Fish prefer mature water for reproduction.

  d. Letting the water stand helps to distill it.

  e. Calcium, magnesium, and other minerals will dissolve.

46. When caring for fresh water aquaria, it is best to:

    a. add sufficient "fresh" water every week to offset evaporation

    b. clean the aquaria when they become cloudy or green

    c. not place any of them in direct sunlight

    d. place a 100-watt bulb within the aquaria if the temperature drops very low at night.

47. Daphnia are small animals which

    a. are related to lobsters

    b. can reproduce without fertilization

    c. eat by a method called "filter feeding"

    d. all of the above

    e. none of the above

48. The guppy is a small fish which

    a. lays small clear jelly-like eggs

    b. eats algae and other small plants

    c. has females larger than the males

    d. all of the above

    e. none of the above

49. When teaching the <u>Organisms</u> unit you will find that the activities follow a pattern, although <u>not</u> the following:

    1. Children experiment to answer questions stimulated by their observations.

    2. The children reinforce, refine, and develop the concept by applying it in new situations.

    3. Children observe natural events within an ecosystem.

    4. You introduce a concept based on the children's observations.

The proper order of these activities is:

a. 2, 1, 4, 3

b. 4, 2, 1, 3

c. 3, 4, 1, 2

d. 3, 1, 4, 2

50. In the Organisms unit, what activities are carried out on a given day depend upon:

a. what happens in the aquaria

b. the children's responses to these events

c. the number of aquaria with green water

d. two of the above

e. all of the above

ITEMS 42-50 FOR GRADE 2

42. The suggested length of time to be used to teach the <u>Life Cycles</u> unit is:

    a. 8 weeks

    b. 10 weeks

    c. 12 weeks

    d. 14 weeks

43. Which of the following concepts is introduced during the <u>Life Cycles</u> unit?

    a. birth and death

    b. habitat

    c. germination

    d. food web

    e. soil fertility

44. Which of the following is <u>not</u> an objective in teaching biotic potential?

    a. to infer the biotic potential of organisms

    b. to identify the three major stages of biotic potential

    c. to recognize that early death prevents the realization of biotic potential

    d. to relate biotic potential to the food web

45. When inventing the <u>systems</u> concept, tell the children that it refers to:

    a. any set of objects which have a common characteristic or property

    b. objects which are made of the same or similar materials

    c. any set of objects in which you are interested

    d. any set of objects which are related

46. In the <u>Interaction</u> unit, the plastic coat hanger is used to show:

    a. evidence of interaction

    b. interaction-at-a-distance

    c. systems

    d. interaction

47. In the <u>Interaction</u> unit, the ozalid paper and photographic paper are used to show:

    a. evidence of interaction

    b. interaction-at-a-distance

    c. systems

    d. interaction

48. "Seed ⟶ plant ⟶ seed" is an example of:

    a. sexual life cycle of a flowering plant

    b. vegetative life cycle of a flowering plant

    c. the germination cycle

    d. all of the above

49. Among many insects which pass through <u>complete metamorphosis</u> (4 stages) are:

    a. moths

    b. beetles

    c. grasshoppers

    d. two of the above

    e. all of the above

50. The stages of <u>incomplete metamorphosis</u> are:

a. egg, pupa, adult

b. larva, pupa, adult

c. egg, nymph, adult

d. egg, larva, pupa, adult

Science Curriculum Improvement Study, Workshop Content Achievement Evaluation Scoring Key

Item	Keyed Answer	Item	Keyed Answer
1.	a	Grade 1	
2.	c		
3.	c	42.	b
4.	c	43.	d
5.	d	44.	b
6.	a	45.	b
7.	d	46.	c
8.	b	47.	d
9.	c	48.	c
10.	d	49.	d
11.	d	50.	d
12.	a		
13.	c	Grade 2	
14.	a		
15.	e	42.	c
16.	e	43.	c
17.	a	44.	b
18.	a	45.	d
19.	b	46.	b
20.	d	47.	a
21.	a	48.	a
22.	c	49.	d
23.	b	50.	c
24.	c		
25.	a		
26.	a		
27.	d		
28.	d		
29.	b		
30.	b		
31.	b		
32.	c		
33.	b		
34.	c		
35.	a		
36.	b		
37.	c		
38.	c		
39.	b		
40.	a		
41.	b		

APPENDIX C

NAME____________________________

SCIS Workshop Evaluation, Form 1

Please rate the following workshop activities using a five (5) point scale. Give a rating of 5 to those activities which you feel will contribute most to your teaching of SCIS.

Rating

1. Demonstration lesson by Christina Kageyama ________
   Comments:

2. "The Role of the Teacher in Teaching SCIS" and "Reactions and Experiences of the SCIS Teacher" by Christina Kageyama ________
   Comments:

3. "What Are the Purposes of the Elementary School?" by Berkheimer, Bruce, Moon ________
   Comments:

4. Inquiry Laboratory (marble in acid) ________
   Comments:

5. SCIS Scope and Sequence (35 mm slides) Berkheimer ________
   Comments:

6. "The Nature of Science" by Dr. Sherwood Haynes ________
   Comments:

7. Micro-Teaching ________
   Comments:

8. "Objectives of Science Education and SCIS" Berkheimer ________
   Comments:

9. Laboratories (working with the kits) ________
   Comments:

At the present time how would you describe your attitude toward the SCIS program?

________	______	________	________	________
negative		neutral		positive

List below any additional comments concerning the workshop organization, content, or staff, which you wish to express at this time.

APPENDIX D

Name______________________________

SCIS Workshop Evaluation, Form 2

Please rate the following workshop activities using a five (5) point scale. Give a rating of 5 to those activities which you feel will contribute most to your teaching of SCIS.

Rating

1. "Overview of the SCIS Program," Carl Berger _______
   Comments:

2. "The SCIS Life Science Program," and "The Role of the Teacher in SCIS Life Science," Chester Lawson _______
   Comments:

3. "Principles of Learning," Berkheimer _______
   Comments:

4. Demonstration Teaching Laboratory _______
   Comments:

5. Demonstration of Developmental Stages (Piaget), Donald Neuman _______
   Comments:

6. Micro-Teaching: T_3 , T_1 _______
   Comments:

7. Inquiry Laboratory (classification) _______
   Comments:

Rating

8. Piaget's Developmental Theory Films

   a. Classification ________

   b. Conservation ________

   Comments:

9. Discussion before and after Piaget films, Berkheimer ________
   Comments:

At the present time how would you describe your attitude toward the SCIS program? (check one)

________	________	________	________	________
negative		neutral		positive

Use the space below for any additional comments concerning the workshop organization, content or staff.

APPENDIX E

SCIS Workshop Evaluation, Form 3

1. Please rank the following activities or categories of activities according to the degree to which they may contribute to your teaching of the SCIS program for the 1968-69 school year. Place a 1 after the one which you feel will be most valuable; a 2 after the next highest choice and so forth, until all are ranked.

	RANK
a. Lectures on the "Nature of Science"	_____
b. Films and lectures on "Modes of Teaching SCIS"	_____
c. "Psychology of Jean Piaget" activities	_____
d. Inquiry Laboratories	_____
e. Micro-teaching	_____
f. Demonstration teaching of specific lessons	_____
g. Planning for the 1968-69 school year	_____

2. If the workshop could be held at any time during the summer, when would it be most valuable?

   first choice -

   second choice -

3. For the 1968-69 school year, the facilities of the Science and Mathematics Teaching Center will be

   a. of little value

   b. of great value

   c. of moderate value

4. The number of topics handled during the workshop was

   a. too many for the time available

   b. too few for the time available

   c. satisfactory

5. The selection of topics was

    a. adequate

    b. should be revised to include--

    c. should be revised to omit--

6. If the workshop could be of any duration up to a full summer, how long should it be?

    first choice -

    second choice -

7. Were the actual workshop activities and outcomes consistent with your preconceptions of them? Comment:

8. Do you perceive any particular problems that may arise that were not brought out during the workshop? Comment:

9. Has the workshop brought about any changes in your own ideas concerning science and the teaching of science in the elementary school? Comment:

10. What, if any, would you consider to be the weak points of the workshop?

11. What, if any, would you consider to be the strong points of the workshop?

12. How do you feel concerning your ability to adequately teach the SCIS program?

13. Has the workshop caused you to change your perceived role in the classroom? Comment:

14. Would you recommend this workshop to others?

15. Do you feel an adequate number of staff members were used?

16. Were you given sufficient opportunity to voice any specific problems or comments during the workshop?

17. If you would care to do so, please make specific suggestions for the improvement of the workshop which could be of benefit in planning next summer's workshop.

APPENDIX F

QUESTIONNAIRE ON TEACHER REACTION TO TRAINING, MATERIALS, AND IMPLEMENTATION OF THE SCIS PROGRAM

By

Steven M. Barnes

> This questionnaire is designed to sample your reactions to the training, materials, and classroom implementation of the SCIS program. Some questions may not apply to you or the units you teach. Circle the numbers of those items to indicate that they do not apply to your situation.

Section 1 Training

This section deals the various aspects of the SCIS training program and includes the workshop, Gull Lake week-end conferences, bi-weekly meetings, and the work of the consultants.

1. What portions of the SCIS training program were most helpful to you? List two.

    1.

    2.

2. What portions of the SCIS training program were least helpful to you? List two.

    1.

    2.

3. To what extent do you feel the feedback meetings have been of value as an exchange of teaching ideas?

no value				very valuable
1	2	3	4	5

4. To what extent do you feel the feedback meetings have been of value in planning for future lessons?

no value				very valuable
1	2	3	4	5

5. Do you normally discuss the SCIS lessons with fellow SCIS teachers other than during feedback meetings?

never		sometimes		often
1	2	3	4	5

6. Did you attend the session at Gull Lake in September?

Yes_____ No_____

7. To what extent do you feel the activities you participated in at Gull Lake have aided you in teaching science?

None				A great deal
1	2	3	4	5

8. Rate the following Gull Lake activities as to their educational value and usefulness to you.

	No Value				extremely valuable
Field work	1	2	3	4	5
Laboratory work	1	2	3	4	5
Slides and lectures	1	2	3	4	5

9. What specific ideas did you gain at Gull Lake which you have used in implementing the SCIS program?

10. How many times during the year have you contacted an SCIS consultant?

_____ none

_____ 1

_____ 2-4

_____ 5-10

_____ more than 10

11. How many times have you tried and failed to contact an SCIS consultant?

_____ 1

_____ 2-4

_____ 5-10

_____ more than 10

12. Has the SCIS consultant been helpful when asked in the areas of:

A. teaching methods

very helpful		neutral		not helpful at all
1	2	3	4	5

B. scientific factual information

very helpful		neutral		not helpful at all
1	2	3	4	5

C. use of materials and equipment

very helpful		neutral		not helpful at all
1	2	3	4	5

D. delivery of materials

very helpful		neutral		not helpful at all
1	2	2	4	5

13. Did you receive adequate aid from SCIS staff when you requested assistance?

Yes ______ No ______

If not, please list specific examples:

14. Have any problems arisen during this school year (1968-69) which were not anticipated by the SCIS staff, and the problems should be considered when planning the next workshop?

Yes ______ No ______

If yes, please list.

15. Reflecting back on the summer workshop, do you now feel that three weeks was an appropriate length?

Yes ______ No ______

If no, what length would you suggest?

16. If asked, would you be willing to share your SCIS experiences with this summer's (1969) workshop participants?

    Yes ______ No ______

    If yes, to which workshop activities do you feel you could contribute most?

17. When preparing to teach a SCIS lesson, how helpful were the following portions of the Teacher's Guides. Answer only those questions which apply to the units you teach.

    a. Material Objects

    SCIENCE CONTENT INFORMATION

not helpful				very helpful
1	2	3	4	5

    TEACHING SUGGESTIONS

not helpful				very helpful
1	2	3	4	5

    b. Organisms

    SCIENCE CONTENT INFORMATION

not helpful				very helpful
1	2	3	4	5

    TEACHING SUGGESTIONS

not helpful				very helpful
1	2	3	4	5

    c. Interaction

    SCIENCE CONTENT INFORMATION

not helpful				very helpful
1	2	3	4	5

    TEACHING SUGGESTIONS

not helpful				very helpful
1	2	3	4	5

d. Life Cycles

SCIENCE CONTENT INFORMATION

not helpful				very helpful
1	2	3	4	5

TEACHING SUGGESTIONS

not helpful				very helpful
1	2	3	4	5

18. The number of concepts developed per unit appears to be

too few		about right		too many
1	2	3	4	5

19. The total amount of material to be covered per unit appears to be

too little		about right		too much
1	2	3	4	5

20. Student interest in Material Objects as compared to Organisms was (is)

much lower		about the same		much higher
1	2	3	4	5

21. Student interest in Interaction as compared to Life Cycles was

much lower		about the same		much higher
1	2	3	4	5

Section II Materials

22. To what extent have you used the SCIS Elementary Science Sourcebook during the school year?

never				very often
1	2	3	4	5

23. Would you recommend that living materials be shipped in next year or purchased locally?

_____ shipped

_____ local supply

24. The SCIS lessons appear to be most appropriate for the ________ ability student.

low	average	high	equally appropriate to all
1	2	3	4

25. Rate the kit organization according to ease of locating materials when preparing to teach a lesson.

a. <u>Material Objects</u>

poor				excellent
1	2	3	4	5

b. <u>Organisms</u>

poor				excellent
1	2	3	4	5

c. <u>Interactions</u>

poor				excellent
1	2	3	4	5

d. <u>Life Cycles</u>

poor				excellent
1	2	3	4	5

Section III Implementation

26. Have you found a method for distributing and collecting student materials which works well for you and is used most often?

Yes ______ No ______

If yes, please describe.

distribution

collection

27. How would you describe your students' interest in the SCIS lessons throughout the year? Indicate by circling one from each month.

	Low				High
September	1	2	3	4	5
January	1	2	3	4	5
April	1	2	3	4	5

28. Approximately how many science lessons have you taught this year (1968-69) which were <u>not</u> part of the SCIS program? ____________

29. Have you noticed any change(s) in your teaching methods used in areas other than science which may have resulted from the SCIS training? Yes _____ No _____

    If yes, please state the change(s).

30. Estimate the average class time per week used for science.

this year (1968-69) (check one)		last year (1967-68) (check one if applicable)
_____	less than 1/2 hour	_____
_____	1/2 - 1 hour	_____
_____	1 - 2 hours	_____
_____	2 - 3 hours	_____
_____	over 3 hours	_____

31. Indicate student interest in science <u>last</u> year (1967-68) as compared to <u>this</u> year (1968-69).

much lower (last year)				much higher (last year)
1	2	3	4	5

32. How many fellow non-SCIS teachers have talked to you specifically concerning the SCIS program?

    ________ 0

    ________ 1-3

    ________ 4-7

    ________ 8-15

    ________ 16 or over

    What has been the nature of their comments?

33. Have you had visitors other than the SCIS staff in your classroom during a SCIS lesson? Yes _____ No _____

If yes, has their presence detracted from the lesson?

none				a great deal
1	2	3	4	5

34. How many parents have commented to you concerning the SCIS program? Check one.

_________ 0

_________ 1-5

_________ 6-10

_________ 11-20

_________ 21 or over

What has been the nature of these comments?

35. How many times has your principal visited your classroom during a SCIS lesson?

_________ 0

_________ 1

_________ 2-3

_________ 4-6

_________ more than 6

36. Has he (she) made comments concerning the SCIS program?
Yes _____ No ______
If yes, what has been their general nature?

very positive				very negative
1	2	3	4	5

37. How many parents have visited your classroom during a SCIS lesson?

_________ 0

_________ 1

_________ 2-3

_________ 4-6

_________ more than 6

38. Compared to the amount of preparation time required for Material Objects lessons I found the time required for an <u>Organisms</u> lesson to be

much less		about equal		much more
1	2	3	4	5

39. Compared to the amount of preparation time required for an <u>Interaction</u> lesson, I found the time required for <u>Life Cycles</u> lessons to be

much less		about equal		much more
1	2	3	4	5

40. What are the <u>two</u> major problems you have encountered when filling out the feedback forms?

    1.

    2.

To what extend do you feel you have benefitted as a result of completing the forms?

none				a great deal
1	2	3	4	5

If you answered 2-5, in what way did you benefit?

41. How soon after teaching a SCIS lesson do you usually fill out the feedback form?

_________ the same day

_________ the next day

_________ within a week

_________ within 2 weeks

42. How do you <u>usually</u> return the forms to the Science and Mathematics Teaching Center?

_________ by mail

_________ give to a consultant

43. What means do you use <u>most often</u> to transmit feedback to the Trial Center?

_________ Teacher Reaction Sheet

_________ tell a consultant

_________ tell Dr. Berkheimer

44. In comparison to the amount of time I would normally expect to spend in preparing to teach science, the SCIS program requires:

much less time		same time		much more time
1	2	3	4	5

45. In comparison to the amount of time I spend in preparing to teach other subjects, the SCIS program requires:

much less time		same time		much more time
1	2	3	4	5

46. I have found the discipline problem during SCIS lessons, as compared to other subject area lessons, to be

much less		the same		much greater
1	2	3	4	5

47. To get student participation during the SCIS lessons, compared to other subject area lessons, is

much harder		about the same		much easier
1	2	3	4	5

48. Given the choice, would you use the SCIS materials next year?

definitely no		no opinion		definitely yes
1	2	3	4	5

49. Assuming that you will teach SCIS again next year, relative to this year, how much time would you devote to it?

much less		same		much more
1	2	3	4	5

50. I consider the ability of my students to be

below average		average		above average
1	2	3	4	5

51. What feature of the SCIS program do you like best?

52. What feature of the SCIS program do you like least?

53. To what extent have the problems with shipment of materials caused a disruption as far as your classroom is concerned?

none				a great deal
1	2	3	4	5

54. Tests should be developed for each unit to be used for student evaluation.

strongly disagree		no opinion		Strongly agree
1	2	3	4	5

55. How important has knowledge of Piaget's Developmental Psychology been to you in planning and teaching a SCIS lesson?

no importance				very important
1	2	3	4	5

56. List 2 specific examples of classroom behavior of your students which were related the developmental psychology.

1.

2.

57. To what extent have you stressed the processes of science this year (1968-69) as opposed to last year (1967-68)?

much less				much more
1	2	3	4	5

58. To what extent have you stressed factual information in science class this year as opposed to last year? Circle one

much less		about the same		much more
1	2	3	4	5

59. To what extent have your students participated in science discussions this year as opposed to last year? Circle one

much less		about the same		much more
1	2	3	4	5

60. To what extent do you feel you have asked convergent or factual type questions this year as opposed to last year? The proportion of convergent questions this year has been __________ than the proportion asked last year. (Circle one to complete the blank)

much less		about the same		much greater
1	2	3	4	5

61. To what extent do you feel adequate as an elementary science teacher this year as opposed to last year?

much less		about the same		much more
1	2	3	4	5

62. I feel the total number of questions I ask during a science lesson this year as opposed to last year is:

much less		about the same		much greater
1	2	3	4	5

63. To what extent has the presence of sound recording equipment in your classroom during SCIS lessons affected your teaching?

none		moderately		a great deal
1	2	3	4	5

64. In what ways did the recording effect your teaching?

65. To what extent do you feel that the recording equipment has directly or indirectly affected your students' behavior? ___________

none		moderately		a great deal
1	2	3	4	5

66. Was this a positive _____ or negative _____ effect? (Check one)

67. Do you feel that the presence of the consultants has either positively or negatively affected your teaching?

positively _____

negatively _____

neither ________

If either positively or negatively, to what extent?

very little				a great deal
1	2	3	4	5

68. Research is such an important aspect of curriculum development, small distractions must be tolerated.

strongly disagree		neutral		strongly agree
1	2	3	4	5

69. Please rank the following workshop activities or categories of activities according to the degree to which they contributed to your teaching of the SCIS program for the 1968-69 school year. Place a 1 after the one which you feel was most valuable; a 2 after the next highest choice and so forth until the numerals 1-7 have been used.

	Rank
a. Lectures on the "Nature of Science?	________
b. Films and lectures on "Modes of Teaching SCIS"	________
c. "Psychology of Jean Piaget" activities	________
d. Inquiry Laboratories	________
e. Micro-teaching	________
f. Demonstration teaching of specific lessons	________
g. Planning for the 1968-69 school year	________

APPENDIX G

SCIS

TEACHER REACTION SHEET

Please complete one sheet for each science session.

Unit ___________ Chapter or Activity ________________________

Date ___________ Lesson number within Activity _____________

Teacher _________________ School ___________

Preparation time __________ Class time used _________(minutes)

Complete only those items appropriate to this science session.

1. Success Rating of the Lesson (circle the number)

	High				Low
Student-Materials Interaction	5	4	3	2	1
Student-Student Interaction	5	4	3	2	1
Teacher-Student Interaction	5	4	3	2	1
Student Activity Page #______	5	4	3	2	1

	High				Low
2. Teacher's Manual Directions	5	4	3	2	1

Improvement needed on page _____ paragraph _________

Comment:

3. (Check the appropriate blank or blanks).
   This lesson was taught as a(n) exploratory lesson ______
   invention lesson ________
   discovery lesson ________

	High				Low
4. Materials	5	4	3	2	1

Comment on improvement needed:

5. Please describe additional ideas and activities you used. (Use other side if needed)

6. Other comments, problems, or suggestions. (Use other side if needed)

APPENDIX H

Table 29. Pearson product-moment correlations between specified teacher characteristics and the ranking of workshop activities.

Teacher Characteristics	Mean Activity Rank August						
	a	b	c	d	e	f	g
SCIS Test	.0780	-.1329	.1136	.1888	-.2626	.1249	-.1788
MTAI Aug.	-.2287	.0436	.0436	-.1836	.0605	.2194	.0152
MTAI April	.1594	-.2041	-.0074	-.1067	.0134	.1607	-.0532
Age	-.0210	.0843	-.3910*	-.4765**	.4566**	.3187	.0658
Total Sci.	.1175	-.3263	.1522	.1234	.0229	-.1596	.0316
Tch. Exp.	-.0673	.1254	-.2734	-.2876	.3225	.0250	.2095
Process 1	-.1941	.1639	-.1977	-.3623*	.0972	.1542	.3486*
Process 2	.0289	-.1127	.0303	.2385	-.2072	-.0602	.0325
16 PF A	-.3599*	-.0085	-.0330	-.1841	.3572*	-.1173	.3528*
16 PF B	-.0913	-.1513	.0197	-.1786	.0469	.2041	.0921
16 PF C	-.0576	-.2149	-.1617	-.0374	.3403	.0727	.0250
16 PF E	.3411*	.0844	-.0489	.2261	-.3259	-.1893	-.0480
16 PF F	-.2117	.0263	.0708	.0573	-.1236	-.1208	.2762
16 PF G	-.0865	-.1647	.1456	.0412	.2612	-.1601	-.0334
16 PF H	-.0816	-.2994	-.1289	.1461	.2113	-.1432	.2399
16 PF I	-.0209	.0010	-.3358	-.3188	.1281	.4567**	.0473
16 PF L	-.1839	.0113	-.2988	.0566	.2214	-.0070	.1858
16 PF M	-.0386	.1635	-.3862*	-.2167	.2409	.4328*	-.1912
16 PF N	.2192	-.6276*	-.1493	.3910*	-.0432	-.0373	.0975
16 PF O	-.0209	.0537	.0085	-.0610	-.0274	.0544	-.0038
16 PF Q_1	-.1761	-.0245	-.4054*	.0660	.1168	.2580	.0953
16 PF Q_2	-.0151	-.1890	.0022	.3130	.1616	-.1550	-.1410
16 PF Q_3	.1324	-.4593**	.0345	.4493**	.1745	-.1450	-.2565
16 PF Q_4	-.0321	.1934	-.0491	-.1731	-.1252	.1234	.0801

* significant at the .05 level.
** significant at the .01 level.

Mean Activity Rank April						
a	b	c	d	e	f	g
.0645	-.2009	-.2336	.2499	-.0404	.3090	-.0469
.1789	-.2233	-.1542	.0916	-.0984	-.0247	.1908
.1383	-.1776	-.1527	.0976	.0563	-.0960	.0979
.0080	.2539	.2047	-.1796	-.0380	-.0293	-.2227
-.1547	-.1262	-.0244	.0172	.3044	-.2710	.1741
-.1445	-.1248	-.1165	-.0103	.1449	.1298	-.0556
-.1539	-.3717*	-.3826*	.2650	-.0165	.0673	.4144*
.1802	-.2249	-.3597*	.3106	-.0664	-.0549	.2075
-.1797	.0666	.1572	-.3050	.0506	-.0158	.1293
-.0946	.0155	.2882	-.0922	-.2787	.0311	.1137
.0120	-.0997	-.2587	-.0006	.3353	-.1008	.0561
.2522	-.2083	-.2348	-.1803	.0118	.0986	.2618
.1564	.0833	-.1252	-.0765	-.2271	-.0624	.2364
-.1028	-.0090	.3005	-.1143	.2740	-.1080	-.2333
-.1137	-.1564	-.1680	-.1382	.2788	-.0928	.2677
.1527	-.1283	-.1020	.2292	-.3091	.1268	.0240
-.3844*	-.0046	.1128	-.0034	-.1001	.1617	.1144
.0245	-.2983	-.2281	.1362	-.1641	.2386	.2421
.0615	.0093	-.0584	-.0597	.1317	-.1851	.0769
-.0206	.0891	-.0268	.0187	-.2834	.0833	.1349
.1576	-.1907	-.4675**	-.1081	.0436	.3474*	.1630
-.2472	-.0651	-.1411	.0485	.1711	-.0181	.1131
-.0970	.1587	-.0574	.1703	.4021*	-.2878	-.2346
-.0286	.0852	.2469	-.0973	-.1355	-.0078	-.0377

APPENDIX I

Table 30. Pearson product-moment correlations between specified teacher characteristics and information derived from the teacher reaction sheets.

Teacher Character-istics	Total Feedback	Feedback Index	Mean Interaction Ratings: Student-Materials	Mean Interaction Ratings: Student-Student	Mean Interaction Ratings: Teacher-Student
SCIS Test	.2439	.1052	-.0668	-.2533	-.2802
MTAI Aug.	.2672	-.0032	-.3068	-.3119	-.3346
MTAI April	.3750*	.2434	-.2507	-.2374	-.3541*
Age	.1684	-.0291	.1864	.1570	.2217
Total Sci.	-.0856	-.0226	-.0275	.2358	.1629
Tch. Exp.	.2092	.1948	.0519	-.0050	-.0196
Process 1	.3703*	.0434	-.1121	-.1972	-.0614
Process 2	.1086	.2545	-.0549	-.2520	-.0380
16 PF A	.2451	-.0105	.1229	-.0697	.0034
16 PF B	.1756	-.1664	-.0267	-.1172	.2419
16 PF C	.5709**	.2661	-.3889*	-.3030	-.3741*
16 PF E	-.1840	.2520	-.0074	.1147	.0410
16 PF F	.1535	.1325	.1143	-.0198	-.1179
16 PF G	.2188	.0847	.0721	-.0750	-.0469
16 PF H	.1230	.1547	-.2053	-.1742	-.2799
16 PF I	.0830	-.1582	.1683	.0021	.1927
16 PF L	-.2379	-.1374	.0871	.1072	.3580*
16 PF M	-.3281	-.2646	-.1030	.1000	.1256
16 PF N	.1736	.3469*	-.3234	-.0705	-.0108
16 PF O	-.4618**	-.2413	.1956	.1038	.3386
16 PF Q_1	.0352	.1802	.1425	.0446	-.0119
16 PF Q_2	-.0955	.2116	-.2495	-.0378	-.0115
16 PF Q_3	-.0568	.2611	-.2534	-.0660	-.0213
16 PF Q_4	-.1962	-.2416	.1470	.0746	.3374

* significant at the .05 level.
** significant at the .01 level.

Mean Ratings		Comments		
Teacher's Guide Directions	Materials	Teacher's Guide Directions	Materials	General
.0246	-.3246	.1567	.2728	-.0033
.1830	.1860	.3005	.2853	.0961
.1520	-.0223	.3877*	.3633*	.3408*
.1998	.2249	-.0728	-.2187	.2890
-.1144	.1117	-.1576	.0182	-.0996
.1740	.0740	-.0511	-.0630	.4030*
.1892	.0959	.2530	.2663	.2178
-.1192	-.2117	.3419*	.4474**	.1302
.4826**	.1786	.0629	.2825	.1989
.2938	-.1324	.0544	.1342	-.1077
.3745*	.2366	.3842*	.3316	.5396**
-.1408	-.3512*	.2612	.3418*	-.0650
.2627	.0999	.1135	.2686	.1320
.2018	.3164	.1192	-.0641	.1272
.3144	.0256	.1059	.3816*	.2053
.1330	-.0147	-.0769	-.2450	.0411
-.1001	-.3446	-.3185	-.1167	.0188
-.2261	-.0051	-.1600	-.0558	-.3735*
.0650	-.2548	.2513	.2809	.1956
-.5684**	.0293	-.4297*	-.4817**	-.3303
.0475	-.1951	.1267	.3119	.2059
-.1648	-.2934	-.0134	.0643	-.0815
.1289	-.1825	-.0102	.1113	-.0626
-.2642	-.0469	-.0798	-.1815	-.0748

APPENDIX J

Table 31. Brief descriptions of factors in the 16 PF Test*

Factor	Low Score Description	High Score Description
A	Aloof, Cool, Reserved	Warm, Easy-going
B	Dull, Low Capacity	Bright, Intelligent
C	Emotional, Unstable, Low Ego Strength	Mature, Calm, High Ego Strength
E	Submissive, Mild	Dominant, Aggressive
F	Sober, Prudent, Depressed	Enthusiastic, Happy-go-lucky, Elated
G	Expedient, Casual, Low Superego Strength	Conscientious, Higher Superego Strength
H	Shy, Timid, Autonomically Over-reactive	Advanturous, "Thick Skinned"
I	Tough-minded, Realistic	Tender-minded, Over-protected
L	Trustful, Adaptable	Jealous, Paranoid
M	Conventional, Practical	Imaginative, Artistic
N	Forthright, Artless	Shrewd, Polished
O	Confident, Placid	Insecure, Guilt-prone
Q_1	Conservative, Cautious	Experimenting, Critical Radical
Q_2	Group-dependent, Imitative	Self-sufficient, Resourceful
Q_3	Lax, Low Self-concept Integration	Controlled, Integrated Self-sentiment
Q_4	Relaxed, Expressed	Suppressed Ergic Tension

*Raymond B. Cattell and Herbert W. Eber, Sixteen Personality Factor Handbook, Champaign, Illinois: Institute for Personality and Ability Testing, 1967, pp. 11-19.

APPENDIX K

September 20, 1968

To: SCIS Teachers Attending The Kellogg Gull Lake Conference, Sept. 28-29.

From: Glenn D. Berkheimer, SCIS Trial Center Coordinator.

Welcome to a busy, but rewarding weekend. Be prepared for field trips--bring boots, wear old clothes (slacks not shorts), and be ready to hike.

Most teachers will go to Gull Lake Friday, September 27, and the Gull Lake officials would like you to be there by 7:30 p.m. If this is inconvenient, please phone one of the consultants and inform him of your arrival time. We will arrange your registration.

The schedule for Saturday and Sunday:

8:00 - 9:00 a.m.	Lecture on ecology related to field work.
9:00 -12:00 a.m.	Field Work--Study ecosystems, take measurements, and collect specimens.
1:00 - 2:00 p.m.	Discussion of the morning field experiences.
2:00 - 4:30 p.m.	A study of selected specimens--identify plants and animals and study relationships within the environment.
4:30 - 5:30 p.m.	Summation of field and laboratory experiences.

Saturday evening Dr. Porter will show slides and discuss other ecosystems.

Phone numbers:

Science and Mathematics Teaching Center
355-1725

Dr. Berkheimer	337-2382
Mr. Barnes	355-9954
Mr. Bruce	355-3150
Mr. Moon	676-2979

MICHIGAN STATE UNIVERSITY EAST LANSING • MICHIGAN 48823

SCIENCE AND MATHEMATICS TEACHING CENTER • McDONEL HALL

March 7, 1969

Dear

Part of our responsibility as an SCIS trial center is to conduct research related to the SCIS program. Research can provide information upon which science education decisions can be based, but research is usually hard work for the researcher and inconvenient for the participants. Realizing this we want to sincerely thank you for your contributions to the research studies thus far.

While teaching the process of observation many of you have taught the children that you must observe before and after the event to collect evidence of interaction for comparisons. This is a fundamental notion in science which applies also to the research that Larry, Tom, and Steve are conducting.

The observations that they have made so far are of no value unless they can make the final observations. I urge you, therefore, to cooperate with them in collecting the last portion of data that is essential to their research and to the completion of their doctoral dissertations.

I assure you that all the information collected is held in the strictest confidence. Only Larry, Tom, and Steve will ever know your scores.

Thanking you for your continued cooperation in building better science experiences for children, I remain

Cordially yours,

Glenn D. Berkheimer
SCIS Trial Center Coordinator

MICHIGAN STATE UNIVERSITY EAST LANSING • MICHIGAN 48823

SCIENCE AND MATHEMATICS TEACHING CENTER • McDONEL HALL

March 7, 1969

Dear

We hope your vacation will be a pleasant one and know that you are looking forward to the remainder of the year. As you are aware, the three of us are attempting to finish our degrees and your continued help is most urgently needed. Your patience and understanding is appreciated. Without your cooperation, the attainment of our degrees is virtually impossible. We must now appeal to you for another favor.

On Saturday, April 19, we would like to invite you to a luncheon. Prior to the luncheon we would like to administer the last instruments of our studies. We will have coffee and rolls served at 9:00 a.m. after which we plan to administer the two instruments and final questionnaire at intervals throughout the remainder of the morning. We will then go to the "63" Room of McDonel Hall for lunch and visiting. Since the instruments are not overly demanding and time consuming, this should be an enjoyable as well as profitable morning.

If anyone anticipates transportation problems, one of us will be happy to pick you up and return you to your home.

The importance of your attendance on Saturday, April 19, cannot be overemphasized. We realize that the luncheon is a small thing, but it is a token of our sincere appreciation for your continued support. We say continued because without these final measures all of our research would have been to no avail and our degrees cannot be completed.

Again, thank you and may the remainder of the year be both rewarding and successful.

Sincerely,

SCHEDULE

Saturday, April 19, 1969

9:00 a.m.	Coffee and rolls at Science & Mathematics Teaching Center, McDonel Hall.
9:30 a.m.	First instrument administered.
10:15 a.m.	(or as you finish) Coffee.
10:30 a.m.	Final questionnaire administered.
11:15 a.m.	(or as you finish) Coffee.
11:30 a.m.	Second instrument administered.
12:15 p.m.	Lunch.

We will need the following for reservations:

____ I will attend Saturday morning, April 19, 1969.

____ I will need transportation to and from McDonel Hall.

Signed______________________________

Steve, Larry or Tom will personally pick up the above reservation slip.

Thank you.

Phone Numbers:

Steve Barnes	355-9954	
Larry Bruce	355-3150	
Tom Moon	676-2797	(Mason)

April 11, 1969

Dear SCIS Teachers:

This short note is a reminder of the Science Curriculum Improvement Study's conference scheduled for Saturday, April 19. Please meet in Room 101C, McDonel Hall, at 9:00 a.m. Coffee and donuts will be served in addition to the noon luncheon. We greatly appreciate your attendance and look forward to seeing you again. Please telephone us at the below number if you need transportation for that day.

Sincerely,

Steve Barnes

Larry Bruce

Tom Moon

E-37 McDonel Hall
MSU
Phone: 355-1725

May 5, 1969

TO: SCIS Teachers

FROM: Glenn D. Berkheimer, SCIS Trial Center Coordinator

SUBJECT: The Kellogg Gull Lake Conference, May 17 & 18, 1969.

Welcome to a busy, but rewarding weekend. Be prepared for field trips--bring boots, wear old clothes (slacks not shorts), and be ready to hike. Bring plastic bags or containers for specimen collection and insect repellent.

Most teachers will go to Gull Lake Friday, May 16, and the Gull Lake officials would like you to be there by 8:30 p.m. If it is necessary for you to arrive later than 8:30 p.m. please phone one of the consultants and inform him of your arrival time. We will arrange your registration.

Meals furnished will be: breakfast, lunch, and dinner on Saturday; breakfast and lunch on Sunday. We will plan to leave by 4:00 p.m. Sunday, May 18, 1969.

The schedule for Saturday:

8:00 - 9:00 a.m.	Lecture on ecology related to field work.
9:00 -12:00 a.m.	Field Work--Study ecosystems, take measurements, and collect specimens.
1:00 - 2:00 p.m.	Discussion of the morning field experiences.
2:00 - 4:30 p.m.	A study of selected specimens--identify plants and animals and study relationships within the environment.
4:30 - 5:30 p.m.	Summation of field and laboratory experiences.

Saturday evening Dr. Porter will show slides and discuss other ecosystems.

The schedule for Sunday will be similar except we will leave by 4:00 p.m.

Phone numbers:

Science and Mathematics Teaching Center	355-1725
Dr. Berkheimer	337-2383
Mr. Barnes	355-9954
Mr. Bruce	355-3150
Mr. Moon	676-2797

Please bring: Life Science Teacher's Guide
SCIS Elementary Science Sourcebook.

SCIS GULL LAKE CONFERENCE

May 17 - 18, 1969

1. The Kellogg Gull Lake Biological Station is located on the Northeast shore of Gull Lake and has a Hickory Corners telephone exchange. Phone 616-671-5116.
2. M-43 through Grand Ledge is probably the simplest route to get to Gull Lake.
3. By car it will probably take approximately 1½ hours from Michigan State University to Gull Lake.
4. Participants should be registered by 9:00 p.m. on Friday, May 16, 1969, at the station. Field studies will begin at 8:00 a.m. on Saturday, May 17, 1969. We will leave by 4:00 p.m. May 18, 1969.
5. If convenient, please form car pools to save expenses.
6. If you have any questions, please call Dr. Berkheimer, Steve Barnes, Larry Bruce, or Tom Moon at 355-1725.

I ☐ will
☐ will not

Attend the SCIS Kellogg Gull Lake Conference, May 17-18, 1969

____
(signed)