DOCUMENT RESUME

ED 043 514 SE 009 788

AUTHOR Avdul, Richard N.
TITLE An Investigation of the Status of the New Elementary Science Programs in Teacher Training Institutions of Ohio, Kentucky, Pennsylvania, and West Virginia.
INSTITUTION Ohio Univ., Athens. Coll. of Education.
PUB DATE 14 Jun 70
NOTE 141p.; Ph.D. Thesis

EDRS PRICE EDRS Price MF-$0.75 HC-$7.15
DESCRIPTORS *Curriculum, Doctoral Theses, *Elementary School Science, *Methods Courses, Program Descriptions, *School Surveys, *Science Education, Teacher Education, Teacher Educators

ABSTRACT

This is the report of a study designed to (1) examine the status of teacher-training preparation in the new elementary science programs in methods classes of institutions in Ohio, Kentucky, Pennsylvania, and West Virginia, (2) identify characteristics of the methods courses, and (3) examine opinions of the instructors about the new science programs. A two-part questionnaire was sent to selected instructors of elementary science methods courses at 118 institutions. Results of the study showed that (1) the AAAS, ESS, SCIS, and MINNEMAST programs are the most widely taught new courses in the methods classes, (2) institutions with greater enrollments expended more funds for science than smaller universities, and (3) 40 percent of the instructors had attended a workshop in the new science programs. Factors influencing the teaching of the new science programs, and in their implementation into the schools were identified. Several recommendations are offered by the investigator as guidelines for additional action and research in the area of new science education. The names of institutions sampled, the distribution of sampling, the questionnaire, and the investigator's correspondence with the institutions are included in the appendices. Bibliography. (LC)

ED043514

AN INVESTIGATION OF THE STATUS OF THE NEW ELEMENTARY SCIENCE PROGRAMS IN TEACHER TRAINING INSTITUTIONS OF OHIO, KENTUCKY, PENNSYLVANIA, AND WEST VIRGINIA

A Dissertation Presented to
The Faculty of the Graduate College of
Ohio University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Richard N. Avdul
June 14, 1970

SE 009 788

This dissertation has been approved
for the College of Education
and the Graduate College by

Professor of Education

Dean of the Graduate College

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to his dissertation committee for their suggestions and advice: Dr. Lester C. Mills, chairman, for his careful supervision, guidance, and sustaining interest; Dr. Albert Leep; Dr. Kenneth Light; Dr. Milton Ploghoft; and Dr. James Rodgers. Without the interest and assistance of this committee, the dissertation would never have come into being.

The author also wishes to acknowledge his indebtedness to the many college and university instructors who so generously responded to the questionnaires which provided the basic material for this investigation.

To all others who assisted directly or indirectly in this study, I express sincere appreciation.

And finally, the writer is especially grateful to his wife, Matoula, for her patience, understanding, and encouragement during the long process.

TABLE OF CONTENTS

CHAPTER	PAGE

LIST OF TABLES

CHAPTER I

INTRODUCTION

Present emphasis on the reappraisal of teacher education in the United States is but a phase of the nation's present and urgent concern for substantial improvement in the whole spectrum of education. The massive reformulation for improving course content in the range of the academic disciplines has received support from various governmental organizations and, to a lesser degree, from private philanthropic foundations.

The need for a new approach in science education is no exception. Recognizing that the traditional courses are at too great a variance with modern concepts of science and too far removed from the educational needs of contemporary society to meet the demands of the period ahead, educators and scientists are making a concerted effort to concentrate upon new directions in science education.[1]

The need for a new approach to science teaching has been recognized by scientists and science educators during the past few years. It is anticipated by the National Science Foundation that improvement in elementary school

---

[1] The New School Science, A Report to School Administrators on Regional Orientation Conference in Science (Washington, D.C., 1962), p. 2.

teachers' knowledge of and competency in their roles as science teachers will lead to the increase in both the quantity and quality of science teaching called for by the various agencies, groups, and commissions which have analyzed the needs of the elementary school. In its 1965 report to the Congressional Subcommittee on Science Research and Development, the Foundation reported:

> In the past, science played only a minor role in the elementary school program and all too often did not go beyond "nature study" for both student and teacher alike. Trends toward an introduction to the basic concepts of "real" science in elementary schools have made it necessary for teachers to know more science than was previously required . . . . Many non-scientists in the educational system have come to accept the point-of-view that science is not a "special" interest of a few; that instead it now is a requisite to a liberal education for all.[2]

Groups such as the National Science Foundation have recently embarked in programs to develop new curricula for elementary science. Their efforts have resulted in a myriad of new science programs for the elementary schools. However, it is recognized that the curriculum reform is neglecting content and pedagogy in the education of new teachers. If improvement is to occur, it must occur in the individual colleges both in careful planning of courses to be offered

---

[2] Science Education in the Schools of the United States, A Report of the National Science Foundation to the Subcommittee on Science, Research, and Development (Washington, D.C., 1965), p. 17.

and in the intellectual and philosophical orientation of courses which students will experience.[3]

I. BACKGROUND OF THE STUDY

Many individuals, committees, and agencies have investigated the quality and quantity of science preparation received by prospective elementary school teachers. It is becoming widely recognized that elementary school teachers need improved pre-service education training in science to teach it adequately. Many science educators recommend that colleges and universities make changes in the teacher-learning process in science to improve this phase of education. This change in emphasis calls for teachers with different skills and knowledge than had heretofore been required.[4] Findings by Matala indicated widespread interest in the improvement of science in the elementary school, but very little work being done to solve the problems involved at the pre-service level.[5]

---

[3] John I. Goodlad, School Curriculum Reform in the United States (Los Angeles: Fund for the Advancement of Education, 1964), p. 86.

[4] Peter C. Gega, "The Pre-Service Education of Elementary Teachers in Science and the Teaching of Science," School Science and Mathematics, LXVIII (January, 1968), p. 11.

[5] Dorothy C. Matala, "Current Activity in Elementary and Junior High School Science," School Science and Mathematics, LXI (May, 1961), p. 363.

Ordinarily, the science training teachers receive is predominantly subject matter centered with little or no emphasis on the physical and mental operations scientists use to attain some particular end associated with the acquisition of new knowledge.[6]

Today, however, the objectives and basic principles for elementary science are being reinterpreted. Skills in the scientific method are being thought of as skills of inquiry. It is considered open-ended and often unstructured--a process whereby students systematically gather data, hypothesize, and experiment.

To achieve these objectives, science curriculum groups composed of scientists, educators, and psychologists have developed, or are presently developing and testing, experimental units written especially for the elementary schools. These units stress new methods in the scientific processes of problem-solving and inquiry.

There is no question that careful planning, adequate funds, and capable leadership are necessary prerequisites for development and implementation of curricular changes. However, the element that holds the key to the success of any new program is the classroom teacher. Consequently, the

---

[6]William C. Curtiss, "Teacher Training for Process Oriented Science," Science Education, LI (December, 1967), p. 494.

importance of adequate teacher preparation for staffing elementary school science programs is well established. Changes in science teaching will come only when teachers want to make changes, and when they are adequately trained to carry out those changes.[7]

Accepting that science-process teaching is desirable in the elementary schools, the question becomes, "What approach to science teaching should be encouraged?" According to the National Science Teachers Association, the style of teaching prescribed by a new curriculum is one that is consistent with the goals of instruction and which relates to the structure of the discipline.[8]

The Educational Policies Commission identified the values of science in seven basic rational behaviors which they regarded as the "scientific spirit." They included:

1. Longing to know and to understand
2. Questioning of all things
3. Search for data and their meaning

---

[7] Edward Victor, "Why Are Our Elementary School Teachers Reluctant to Teach Science?" *Science Education*, XLVI (March, 1962), pp. 191-92; and Gerald R. Rising, "Recommendations for the Preparation of Elementary Teachers in Science," *Science Education*, XLIX (October, 1965), p. 359.

[8] *Theory Into Action*, A Report Prepared by the National Science Teachers Association (Washington, D.C.: 1964), p. 13.

4. Demand for verification

5. Consideration of premises

6. Respect for logic

7. Consideration of consequences.[9]

The Commission stated that these values cannot be acquired by indoctrination, but rather come about as a result of experience. Accepting these values as goals, the Commission summarized the point of view in the following statements:

> It cannot be assumed that the addition of science courses to a curriculum would necessarily contribute to the achievement of these goals. Indeed, science can be so taught as to be irrelevant or even opposed to their achievement. Efforts to discourage challenges to traditional beliefs and attempts to indoctrinate are probably widespread in every school system, however advanced the content of science courses. What is needed is an education which turns the child's curiosity into a life-long drive and which leads students to consider seriously the various possibilities of satisfying that curiosity and the many limitations on those possibilities.[10]

The seven behaviors identified by the Commission underlie the discipline of science and represent important and lasting outcomes of science education--namely, the ability to think. The spirit-of-science goal can be achieved when science is taught as a form of investigation.

---

[9] Education and the Spirit of Science, A Report Prepared by the Educational Policies Commission (Washington, D.C.: 1966), p. 15.

[10] Ibid., p. 23.

As a result, Renner pointed out that the responsibility with which science teachers should be most concerned is teaching pupils this spirit.[11]

Furthermore, to use the seven values effectively will require the rethinking of many well-established attitudes and procedures. Wolfe called it a change so great that it "will require a revolution in attitudes and methods of teaching and in the methods of educating teachers."[12]

With the present emphasis on elementary school science and the development of new programs, new materials and new methods of teaching science, the pre-service training of prospective teachers gains new significance.

II. STATEMENT OF THE PROBLEM

It was the purpose of this study to (1) examine the status of teacher-trainee preparation in the new elementary science programs in methods classes of institutions from Ohio, Kentucky, Pennsylvania, and West Virginia; (2) Identify characteristics of the methods courses at the institutions; (3) examine opinions of the instructors about the new

---

[11] John W. Renner, The New Responsibility of Science Education (Randolph, Wisconsin: Educators Progress Service, 1967), p. 5.

[12] Dael Wolfe, "The Spirit of Science," Science, CLII (June 24, 1966), p. 1697.

science programs; and (4) to apply appropriate statistical tests to determine whether there are significant differences in terms of the instructors' beliefs about the new science programs.

The following null hypotheses were assumed:

1. There is no significant difference of total frequencies for each question in comparing instructors' opinions regarding the new science programs.
2. There is no significant difference in comparing the sample frequencies in terms of academic rank with instructors' beliefs about the new science programs.
3. There is no significant difference in comparing the sample frequencies in terms of the location of the universities by state with instructors' opinions about the new science programs.

III. SIGNIFICANCE OF THE STUDY

There has been much research in elementary school science education. Checklists, questionnaires, and other techniques have been developed and used to determine the status of the many aspects of elementary school science education. Findings, however, are of little consequence unless those concerned with teacher education use them in ways which will make a positive impact on elementary school teaching.

This study was undertaken to ascertain the responsibilities felt toward the new programs by those concerned with teacher preparation. Ways and means should be found whereby all teachers will become familiar with contemporary content, methods, and techniques before they assume their first teaching assignment.

It is anticipated that this study will bring a new awareness of the responsibility of other agencies concerned with the preparation of science teachers and with their improvement. Assisting teachers in a continuing education is a mutual responsibility shared by local districts, state departments of education, and professional organizations.

It is also anticipated that this study will result in a "status quo" survey of current practices in science education methods instruction in Ohio to provide a basis by which comparisons and contrasts may be drawn between those institutions reported in the study and those practiced in any given institution. Furthermore, since the Ohio State Department of Education reports that the greatest number of teachers from out of state come from Kentucky, Pennsylvania, and West Virginia, respectively, it is felt appropriate to investigate the extent to which professional courses in those states are exerting influences on the instructional programs in Ohio.

Finally, inasmuch as skills of abstract thinking, nonverbal communication, and motor orientation characterize the new science programs, experience to date seems to indicate that they do provide a way of meeting some of the differences in children's achievement, including the disadvantaged.[13] Thus, the relevance of this study becomes significant because Ohio, Kentucky, Pennsylvania, and West Virginia are considered a part of Appalachia, and it becomes increasingly important to determine if individuals concerned with teacher education are cognizant of the role the new sciences can contribute to meeting the needs of rural disadvantaged youth.

IV. LIMITATIONS OF THE STUDY

The following limitations have been recognized in this study:

1. This study is limited by its use of the instrument, which, by its very nature, precludes total

---

[13]Paul DeHart Hurd and James J. Gallagher, New Directions in Elementary Science Teaching (Belmont, California: Wadsworth Publishing Company, 1968), p. 125.

objectivity and is at the same time subject to the possibility of non-response.

2. The population is limited to elementary science methods instructors from teacher training institutions of Ohio, Kentucky, Pennsylvania, and West Virginia. Generalizations of the results of this study to other populations in other geographical areas will necessarily be limited.
3. This study included reference to twelve of twenty-nine new elementary science programs.

V. DEFINITION OF TERMS USED

New Science

For the purpose of this study, new science is defined as the major experimental programs in elementary school science. They include:

AAAS. American Association for the Advancement of Science. Science: A Process Approach. John R. Mayor, Director. Washington, D.C. A K-6 sequential program of instruction to provide a developmental progression of increasing competencies in the science processes.

COPES. Conceptually Oriented Program for Elementary Science. Morris H. Shamos, Director. New York University.

A K-6 program based upon selected conceptual schemes in science.

ESP. Elementary Science Project. Mrs. Barbara Ragle, Project Supervisor. Norwich, Vermont. A project designed to introduce new science curriculum materials into a small school system, and also aimed as a model for implementation of the new materials for teacher training.

ESS. Elementary Science Study. Randolph R. Brown, Director. Newton, Massachusetts. A K-8 program of open-ended materials for use by children in the form of units which can be sequenced for individual requirements.

ESSP. (California) Elementary School Science Project. Project discontinued in 1966. The major activity of the project was the development of units of study in specific areas of science.

ESSP. (Illinois) Elementary School Science Project. J. Myron Atkin, Director. University of Illinois. A science program designed for students from grades five through nine around concepts considered central to an understanding of astronomy.

ESSP. (Utah) Elementary School Science Project. John K. Wood, Director. Utah State University. The purpose of this project is to provide lessons in basic science, stressing observation and changes of interacting objects.

ISCS. Intermediate Science Curriculum Study. Ernest R. Burkman, Director. Florida State University. A comprehensive science program for grades seven through nine based on a gradual building of process skills and written in "self-pacing" style.

MINNEMAST. Minnesota Mathematics and Science Teaching Project. James H. Werntz, Jr., Director. Minneapolis, Minnesota. A coordinated mathematics and science curriculum for grades K-6, and material for in-service education of teachers.

SSCP. School Science Curriculum Project. Richard F. P. Salinger, Director. University of Illinois. This project is an inquiry-oriented science curriculum developed around specific units.

SCIS. Science Curriculum Improvement Study. Robert Karplus, Director. University of California, Berkeley. A sequential physical and life science curriculum suggested for grades K-6. The basic objectives of the program are oriented toward scientific literacy.

Quantitative Approach to Elementary Science. Clifford E. Swartz, Director. State University of New York. A K-6 program developed around natural science topics and based on measured and quantitative analysis.[14]

Instructor

The term "instructor," as used in this study, will refer to professors, associate professors, assistant professors, instructors, and other personnel involved in teaching elementary science methods to teacher trainees.

VI. ORGANIZATION OF THE REMAINDER OF THE THESIS

In the next chapter the origin of the problem is examined and a survey of the literature relating to the various aspects of this study is presented. This is followed by a report in Chapter III of the methods of procedure used. In Chapter IV the quantitative data from the entire population is presented, as well as the results of the statistical tests. This chapter also presents an examination of data comparing frequencies of Ohio respondents with those from Kentucky, Pennsylvania, and West

---

[14] J. David Lockhard (ed.), Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments (College Park, Maryland: University of Maryland, 1968), pp. 150-331; and Albert Piltz and Robert Sund, Creative Teaching of Science in the Elementary School (Boston: Allyn and Bacon, 1968), pp. 89-106.

Virginia, along with the statistical analyses. Chapter V is devoted to the statement of certain conclusions and recommendations based on the findings of the study.

CHAPTER II

ORIGIN OF THE PROBLEM AND REVIEW OF SELECTED LITERATURE

I. ORIGIN OF THE PROBLEM

An examination of current literature revealed an increasing emphasis upon changes for science education as well as responses to demands for upgrading elementary science instruction. First, within the last eight years, twenty-nine new programs have appeared in elementary school science, and educational journals have been devoting a great deal of attention to them.[15] These science programs can best be characterized as different from traditional ones in both rationale and content, and are leading the way toward curricular changes more in keeping with the increasing demands of our society.

Science teaching has taken a new direction as a result of the new emphasis on improving instruction at the elementary level. Ploutz recognized eight trends that have received attention and change as a result of this new emphasis. Some of the trends represent a move away from complete dependence on the use of conventional science

---

[15] Lockhard, _op_. _cit_., pp. xii-xiii.

textbook series toward individualization of instruction and greater emphasis on the use of equipment. He also noted that greater emphasis is continuously being placed on individualized instruction in science and increased attention to the importance of acquiring skills in the process methods.[16]

The American Association for the Advancement of Science reported that the behavior of scientists constitutes a highly complex set of intellectual activities--processes which, beginning with the simplest ones, can be built into more complex ones. The Association believed that a reasonable sequence of instruction can be constructed which aims to have children acquire process skills, beginning with simple kinds of observation and building progressively to making inferences and predictions. As further building continues, one finds it possible to learn how to make operational definitions, formulate hypotheses, and interpret data. This progressive building of more complex intellectual processes from simpler ones, the Association contended, is one of the key ideas of the process approach.[17]

---

[16] Paul F. Ploutz, "Trends in the Elementary Science Curriculum," Science and Children, XIII (February, 1966), pp. 39-40.

[17] The Psychological Bases of Science: A Process Approach, A Report Prepared by the Commission on Science Education (AAAS Publication 65-8, 1965), pp. 4-5.

Second, there has been an increasing number of articles appearing in professional periodicals and magazines for elementary education in which problems of upgrading science are discussed.

Jacobson, in commenting on teacher education in the future, projected that the future elementary school science teacher should have considerable training in both the processes and the conceptual structures of science. Experiences in processes related to scientific enterprise, he felt, will provide the intellectual foundations for teachers to achieve some of the potentials inherent in elementary science programs.

He also believed that future teachers will give considerable time to preparation for the use of the new elementary science programs and materials. In effective science teaching, Jacobson contended the teacher will need foundational understanding of the new sciences which can come about only in specially designed teacher education programs that work cooperatively with the new programs.[18]

Lee stated that one of the problems in training teachers to handle the new science materials lies in the inadequacies of their undergraduate preparation. He felt

---

[18] Willard J. Jacobson, "Teacher Education and Elementary School Science--1980," Journal of Research in Science Teaching, V (Issue No. 1, 1968), pp. 75-77.

that the trend has been to leave all subject matter preparation in science up to the science departments while the burden falls upon the teacher-training departments to inform students of the new developments in science education. He believed that most of the teachers who need preparation for the new science materials must receive it outside the college in other training programs.[19]

Burnett suggested that to change teacher behavior, the method by which teachers are prepared needs to be changed. He went on to say:

> Even today, we continue to teach teachers in science courses and in pedagogy largely through nonheuristic means although we apparently suppose that this will somehow make them into effective teachers of the newer programs which are based largely on the diametrically opposed set of assumptions.[20]

Abelson more blatantly stated that if transfer of information were enough, society could dispense with most professors, and education could be almost completely mechanized.[21]

---

[19]Eugene C. Lee, New Developments in Science Teaching (Belmont, California: Wadsworth Publishing Company, 1967), pp. 43-44.

[20]Will R. Burnett, "Circles, Pendulums, and Progress in Science Education," Journal of Research in Science Teaching, II (Issue No. 1, 1964), p. 37.

[21]Philip H. Abelson, "What Are Professors For?" Science, CXLVIII (June 18, 1965), p. 1545.

Third, there has been an increasing number of institutes specifically designed for elementary school personnel. The Cooperative College-School Science Program (CCSS) of the National Science Foundation, for example, provides opportunities for colleges, universities, and similar institutions to work with schools for improving science and mathematics programs. Many of the CCSS projects have as their purpose the introduction of new instructional programs that have been recently developed. The directory published by the National Science Foundation lists thirty-two projects offered by the CCSS in twenty-one states and the District of Columbia.[22]

Also, twenty-seven colleges and universities, the ERIE educational laboratories, the Xerox Corporation, and one school system, in nineteen states and the District of Columbia, announced thirty-six conferences and courses for the summer of 1969 for educators involved with the AAAS program and those preparing to teach it.[23]

Fourth, new textbooks for the college methods courses, as well as for teachers' use in the classroom, have appeared.

---

[22] *Cooperative College-School Science Program: Projects to Improve Science and Mathematics in the Schools* (Washington, D.C.: National Science Foundation, 1969).

[23] Commission on Science Education, *News Letter*, American Association for the Advancement of Science, Vol. 5, No. 1 (April, 1969), p. 1.

Piltz and Sund reported that textbook publishers have, in recent years, made many revisions to meet the objectives of modern science education. They also indicated that inquiry is more apparent in the current textbooks, though the process approach is not clearly reflected.[24]

The text by Carin and Sund includes frequent use of the term "process," and in their Teaching Science through Discovery, they said:

> Science education should stress the spirit of discovery . . . concepts, theories, principles, and content areas are only products of the process of inquiry and can be learned better when approached from a discovery method.[25]

The changing role of science is also described in other professional books. Lee wrote:

> New courses in science should give the student a feel for science . . . show how scientists work, the kinds of problems they attack, and the kinds of intellectual processes required for solution.[26]

Renner and Ragan, in their book, stated:

> Helping children learn to use the methods of inquiry, of discovery, and of problem solution, required a different conception of the role of facts.[27]

---

[24]Piltz and Sund, op. cit., p. 106.

[25]Arthur Carin and Robert B. Sund, Teaching Science through Discovery (Columbus: Charles E. Merrill Publishers, 1964), p. 12.

[26]Lee, op. cit., p. 5.

[27]John W. Renner and William B. Ragan, Teaching Science in the Elementary School (New York: Harper and Row Publishers, Inc., 1968), p. 35.

One example from a science textbook publisher which illustrates its contemporary program reads as follows:

> One technique used by the authors is that of presenting ideas in a manner illustrating the science processes in use.[28]

Finally, the impact of the experimental elementary science programs is beginning to be felt in the public schools. For example, the AAAS program Science: A Process Approach is being used in twenty school systems in Ohio, with fifteen new programs commencing in 1969.[29]

Robert C. Campbell, Director of Curriculum, Bradford Area Schools, Pennsylvania, indicated that his schools are committed to the "alphabet" programs of the new sciences. He believed that the new sciences are process-oriented, and that the only way to get teachers to teach these courses is by selecting people who themselves have experienced this type of learning environment in their college classroom.[30]

---

[28] Herbert A. Smith, Milo K. Blecha, and John Sterling, Science (River Forest, New Jersey: Laidlaw Brothers Publishers, 1966), p. v.

[29] Personal letter written by James E. Walker, Xerox Education Representative, June 25, 1969.

[30] Stanley N. Miller (mod.), "Needs of Teacher Education in Science," Guidelines for Improving College Science Programs, A Report of a Conference on Science Education, editor (Harrisburg: Pennsylvania Academy of Science, April, 1964), p. 14.

Charles F. Hensley, principal in Wilkes-Barre, contended that the greatest need in his school system is finding beginning teachers who are qualified to teach the "alphabet" courses. He believed that colleges should acquaint prospective teachers with the underlying philosophy of the new courses.[31]

These five trends seem to indicate that the philosophy of inquiry teaching has generally been accepted by many educators as an integral part of science education. As a prerequisite for effective science teaching, it appears plausible to deduce that teachers must therefore understand the content, instructional strategies, and rationale of the new science programs.

It is evident that the crux of the problem of providing large numbers of competent teachers to cope effectively with the rapidly evolving course materials lies in the adequate education of pre-service teachers. Thus, educators concerned with teacher preparation must face squarely the task of reforming the curricula and courses.

Barnard believed that it is imperative to evaluate college programs for the education of science teachers. As a panel moderator in a discussion on new trends in science education, he pointed out that improvement of science

---

[31] Ibid., p. 18.

courses at the college level has been slow in coming. Where new courses or new materials have been developed, Barnard reported that teachers had to be re-educated in science and methods of teaching before they could expect to be successful teachers of the new courses.[32]

Oshima believed that the huge investments involved in the improvement of science education will be largely wasted unless adequate numbers of teachers are educated to teach the contemporary materials and the emerging new programs. He regarded the education of pre-service teachers as the most effective approach to this problem.[33]

II. REVIEW OF SELECTED LITERATURE

Much has been written concerning the nature and purpose of methods courses. The 59th Yearbook of the National Society for the Study of Education indicated that methods courses should be more than merely reading, talking, and writing about how to develop competencies in identifying

---

[32] J. Darrell Barnard (mod.), "New Trends in Science Education," Guidelines for Improving College Science Programs, A Report of a Conference on Science Education, Albert Eiss, editor (Harrisburg: Pennsylvania Academy of Science, April, 1964), p. 6.

[33] Eugene A. Oshima, "Changes in Attitudes toward Science and Confidence in Teaching Science in Prospective Elementary Teachers" (unpublished Doctoral dissertation, Oklahoma State University, Stillwater, Oklahoma, 1966), p. 15.

and using needs and interests of pupils as bases for learning experiences. Decker recommended that teachers devise and try out new techniques for dealing with different kinds of learning situations. Methods courses, Decker felt, should also be taught in laboratories in which a variety of science materials are available for the use of prospective teachers.[34]

A review of selected literature showed that there is widespread belief that teachers tend to teach as they have been taught.

Renner wrote that we are asking our teachers to teach in a manner completely different from the manner in which they were taught. He stated that after being lectured to about facts and tested about facts in college, the graduates then enter the classrooms and are expected to structure and teach courses which will demand that a pre-college student develop the ability to think. Renner went on to say that the majority of our teachers graduate with little or no idea about the central purpose of education.[35]

---

[34] Donald G. Decker, "Implications for College and University Programs," Rethinking Science Education, Fifty-ninth Yearbook of the National Society for the Study of Education, Part I (Chicago: University of Chicago Press, 1960), pp. 318-19.

[35] John W. Renner, "Lockstep Teaching," The Clearinghouse, XL (November, 1965), p. 165.

Smith, Scott, and Sternlicht indicated that teachers' ability to use the methods of science and acquiring science attitudes are not obtained by reading about them.[36] They pointed out that science attitudes are acquired only through doing science, and subsequently engaging in science activities.

Richardson, Williamson, and Statler considered the following for the student preparing to teach science:

> He cannot be considered simply as a purveyor of information. That those under his guidance should gain valuable and useful information goes without saying. But the science teacher must approach his professional responsibility from his own basis of reflection; in fulfilling his responsibility through action, he must be able to create learning situations in which the student finds motivation and values in action. The situation should bring the student vis-a-vis with a decision making, with self-motivated postulation of the consequences of "if-then" logic.[37]

Renner and Ragan, in discussing science teaching in the elementary school, pointed out that it has frequently been ineffective because of the emphasis on learning facts and the products of science rather than processes, and

---

[36] Eugene H. Smith, "An Analysis of Some Prominent Viewpoints on Teaching Elementary School Science," Science Education, XLVII (March, 1963), p. 192; Lloyd Scott, "Science Is for the Senses," Science and Children, II (March, 1965), p. 19; and Manny Sternlicht, "Undergraduate Educational Mythology," Science Education, XLIX (April, 1965), p. 225.

[37] John S. Richardson, et al., The Education of Science Teachers (Columbus: Charles E. Merrill Publishers, 1968), pp. 10-11.

because science teaching does not provide sufficient opportunities for students to investigate. They believed that pupils can experience the joy of discovery if they can discover science facts, principles, and generalizations themselves. It was their contention that children in elementary school could begin the process of exploration with methods similar to those used by scientists in a manner whereby the problem they explore must grow out of what they already know.[38]

The American Association for the Advancement of Science reported that science is best taught as a procedure of inquiry. It recognized that the discipline is more than a collection of facts, principles, or sets of machines for measurement, but rather a structured and directed way of asking and answering questions. The Association recognized that the process approach in science demands an attitude of intelligent caution, the restraint of commitment, the belief that difficult problems are susceptible to scientific analysis, and the courage to maintain doubt will be learned best by the child who is given an opportunity to become involved in scientific inquiry.[39]

---

[38] Renner and Ragan, op. cit., p. 35.

[39] The Psychological Bases of Science--A Process Approach, op. cit., p. viii.

The inquiry process entails careful guidance by teachers, and it requires a different conception of the role of facts in the educative process from that held by many of them.[40]

Karplus and Thier recognized four levels of involvement in the education of prospective teachers. The first and minimal level of involvement is limited to reading about or being told about science; the second level includes teacher-pupil and pupil-pupil discussions about science; the pupil is involved in a third level when the teacher or another pupil conducts a demonstration; and on the fourth level the individual pupil confronts the object and systems he is studying. The student, therefore, learns and experiences science firsthand. Karplus and Thier recommended placing major emphasis on the role of the teacher in the classroom in preparing teachers to teach effectively on all four levels of involvement. They also indicated that this change in the teachers' view of their role in the classroom will require major changes in the structure of pre-science education.[41]

---

[40]Renner and Ragan, op. cit., p. 35.

[41]Robert Karplus and Herbert Thier, "Science Teaching is Becoming Literate," Education Age, II (January-February, 1966), p. 445.

Perhaps the role of the science educator can best be summarized by Scott in his review of the University of California Elementary School Science Project:

> It is doubtful that the philosophy of experimental science can be transmitted through verbal communication in any case. It is likely that the teachers must experience the philosophy and methods of experimentation through active participation in science in the same manner that is hoped children will experience these attributes in their program.[42]

There have been a number of recent experimental studies comparing the new science programs with those of the traditional approaches. Wilson attempted to investigate and analyze one group of teachers receiving instruction in the inquiry-discovery approach to elementary school teaching with another group which had not received instruction in the new approach. His study indicated that the teachers receiving training in the inquiry-discovery approach (Science Curriculum Improvement Study, SCIS) were encouraging a significantly larger number of experiences dealing with science processes than the traditional science teachers. The SCIS teachers were also using a significantly larger number of questions requiring more analytical thinking.

Wilson's study also concluded that the teachers of the new science were encouraging use of the learners'

---

[42]Scott, *op. cit.*, pp. 19-20.

higher cognitive powers because of the nature of the questions asked in their classrooms.[43]

In a study sponsored by the Center for Urban Education, seventy-five first grade teachers were trained in the use of one of six different science programs. One aspect of the project was to analyze the verbal behavior of twenty-two first grade teachers as they taught science.

The study indicated that teachers and pupils in the experimental group used science materials to a greater extent than did the teachers and pupils in the control group.

The fact that pupils in the experimental group spoke frequently while using materials would seem to be a direct result of the stress in the training sessions upon allowing pupils to use materials and encouraging them to talk with each other at these times.[44]

The study concluded that process training would help teachers use materials and programs as the originators

---

[43]John Harold Wilson, "Differences between the Inquiry-Discovery and the Traditional Approaches to Teaching Science in Elementary Schools," Dissertation Abstracts, XXVIII (No. 3, 1967), p. 887-A.

[44]Elizabeth Hunter, "The Effect of Training in the Use of New Science Programs upon the Classroom Verbal Behavior of First Grade Teachers as They Teach Science" (New York: Hunter College, 1967), p. 11. (Mimeographed.)

intended because training in verbal interaction skills changes verbal behavior of teachers.[45]

A study conducted by the Harvard Graduate School of Education, Research on Science Education Survey (ROSES), sought to investigate the status of teacher-education programs in the sciences for the years 1965-1967. The study revealed that in the AAAS and ESS programs approximately 40 per cent of the elementary methods instructors spend "some" time in them, while less than 10 per cent of them studied the new curricula "intensively." Approximately 30 per cent of the instructors spend "some" time in SCIS, but less than 5 per cent of them regarded the time spent as intensive. The ROSES study concluded that the attention given the new courses would have to be described as "descriptive" or "introductory."[46]

Even though the instructors reported spending little attention to the "new" sciences, the ROSES study indicated that the science educators generally support the philosophy of inquiry teaching and the new programs. Interviews with instructors also revealed that less than 10 per cent failed

---

[45] Ibid., p. 13.

[46] David E. Newton and Fletcher G. Watson, The Research on Science Education Survey (Cambridge, Massachusetts: Harvard Graduate School of Education, 1969), p. 62.

to express at least a commitment to inquiry teaching as a desirable teaching style.[47]

Partin, in a study comparing students taught by the AAAS process method and those taught by the textbook method, discovered that training in scientific inquiry does increase the process skills of students using the new approach. Examination of the data revealed that children who participate in science activities which involve the process approach to learning tend to have greater interest in science than do pupils in classes where textbooks are primarily utilized.[48]

In a study designed to determine if pre-service teachers would show significant achievement in two processes of science, Menzel found that significant gains were made in the scientific processes of classification and measurement with the various types of experimental instruction as compared to groups receiving traditional instruction.[49]

---

[47] Ibid., p. viii.

[48] Melba S. Partin, "An Investigation of the Effectiveness of the AAAS Process Method upon the Achievement and Interest in Science for Selected Fourth Grade Students," Dissertation Abstracts, XXVIII (No 3, 1968), pp. 3569-70.

[49] Ervin Wesley Menzel, "A Study of Preservice Elementary Teacher Education in Two Processes of Science," Dissertation Abstracts, XXIX (October, 1968), p. 1152.

Kriebs, using video tapes, found that pre-service teachers who had watched tapes of elementary science classroom situations encouraged the use of more processes by the pupils they taught. More pupils were involved in such processes as interpreting data by drawing imaginative and comprehensive conclusions from scientific data, or the planning, executing, and communicating of simple experiments than were the pupils of other pre-service teachers who had viewed a lecture-demonstration video tape dealing with similar science content.[50]

Hiack found pre-service teachers with low "scientific sophistication" were able to accomplish the objectives stated in fourteen "experiments" given in a science methods course when the organization of the content was based in the processes of science. The processes used in this study were those identified by the Commission on Science Education of the American Association for the Advancement of Science.[51]

Some research with in-service teachers on certain processes of science has also been reported. Fischler and Anastasiow reported that the group they studied, using

---

[50]Jean Kriebs, "The Effect of Videotaped Elementary School Science Classroom Demonstrations on Science Teaching Performance of Preservice Teachers," Dissertation Abstracts, XXVIII (September, 1967), p. 988.

[51]Paul S. Hiack, "Laboratory Experiments in College Physical Science," Dissertation Abstracts, XXVIII (March, 1967), p. 2915.

material from various science projects, showed an increase in the number of questions calling for observations, and that "the number of questions which _ask children to relate facts but do not go beyond_ was also reduced."[52]

Kurtz and Walbesser reported on the effects resulting from in-service elementary teachers using curriculum materials from _Science--A Process Approach_. During a school year, a group of 262 in-service teachers showed high gains as measured on a pretest and post-test instrument. The instrument, _The Process Measure for Teachers--Forms A and B_, measured selected behaviors in eight basic process hierarchies.[53]

In an effort to meet the demands of changes in elementary school science, groups of science educators met to consider the problems of preparing elementary school teachers to teach science effectively. Guidelines developed by participants at the Pennsylvania Conference for Improving College Science Programs recommended that teacher preparation

---

[52] Abraham S. Fischler and N. Anastasiow, "In-Service Education in Science: The School within a School," _Journal of Research in Science Teaching_, III (Issue No. 3, 1965), p. 284.

[53] E. B. Kurtz and Henry W. Walhesser, "Construction of an Instrument for Measuring Behavioral Competencies of Teachers of Science--A Process Approach," Paper read at the National Council of Measurement in Education, New York City, February 18, 1967.

for prospective teachers should include an understanding of the philosophy which is common to all the new courses in science. The participants also noted that experience in the classroom is necessary for learning them.[54]

Eiss, reporting on the Long Beach, California conference of the Commission on the Education of Teachers of Science of the National Science Teachers Association, listed the following basic principles:

1. Content and process in science are inseparable. Methodology should be consistent with the nature of science.

2. A sequential science program for prospective elementary teachers begins with so-called general education science courses.

Under each principle several recommendations were made. Some of these were:

1. The process approach should be used and defined in teaching content.

2. Open-ended laboratory work should be an integral part of the instructional program.

3. Group analysis of laboratory experience is a requi-ite.

4. Adequate time for planning and experimenting with new course content and teaching approaches should be scheduled in the college teachers' program.[55]

---

[54]Albert F. Eiss (dir.), Guidelines for Improving College Science Programs, A Report of a Conference on Science Education (Harrisburg, Pennsylvania: Department of Public Instruction, April, 1964), p. 31.

[55]Albert F. Eiss, "Science Preparation for Elementary Teachers," Science and Children, II (May, 1965), pp. 17-18.

Similar recommendations were made at the Harrisburg, Pennsylvania Conference. One of the guidelines outlined at the Harrisburg Conference stated that the science education of teachers should take into account the recommendations for curricular improvement currently being made by the various national groups.[56]

The National Association of State Directors of Teacher Education and Certification (NASDTEC), in cooperation with the American Association for the Advancement of Science, proposed a series of guidelines for the preparation of pre-service elementary teachers of science and mathematics. In their report, as reprinted by Victor and Lerner, it was recommended that science methods courses prepare teachers along the following lines:

> In the area of science an essential ingredient in the proper education of elementary teachers is the development of skills in scientific inquiry. Such skills include: investigations; observing accurately and reporting concisely results of investigations; formulating and stating questions clearly; designing and executing experiments; conducting field studies; using equipment for counting, measuring, and weighing; documenting findings with evidence; classifying materials and ideas; organizing and interpreting data; and analyzing and critically reviewing scientific literature.[57]

---

[56] Eiss (dir.), Guidelines for Improving College Science Programs, op. cit., p. 22.

[57] Edward Victor and M. S. Lerner, "Guidelines for the Science and Mathematics Preparation of Elementary School Teachers," Readings in Science Education for the Elementary School (New York: The Macmillan Company, 1967), p. 257.

A preliminary report of the American Association for the Advancement of Science (AAAS) designed to stimulate discussion and study of pre-service education stated that there is widespread concern about the quality of college science teaching now that the new science programs for elementary schools are becoming available. In science programs proposed by the report, it was suggested that the instructional materials should emphasize the processes of science as well as science concepts. Rather than accumulating knowledge, the proposed emphasis should be on developing the skills of inquiry.[58]

In another study, the Association, with the aid of a grant from the National Science Foundation, wrote that the appreciation of science can be developed only through understanding the qualities of scientific enterprise--the process of science. The study indicated that science education at all levels should deal largely with concept formation and validation.[59]

Watson reported that little has been done to improve the pre-service education of new science teachers. Any

---

[58] Preservice Science Education of Elementary School Teachers, A Report of the Project on the Preservice Science Education of Elementary Teachers, Sponsored by the American Association for the Advancement of Science, February, 1969, p. 34.

[59] "Science Teaching in Elementary and Junior High Schools," Science, CXXXIII (June 23, 1961), pp. 2020-21.

improvements in the preparation of future teachers, he stated, must occur in the individual college through more careful planning of programs and in the philosophical and intellectual orientation of courses students will experience. Watson believed that students should not merely be trained to teach a particular course package because of replacement or change which may occur in the future.[60]

To improve present college courses, another AAAS Committee Report offered the following suggestion: profess-ional educational experience for prospective elementary teachers should include opportunities to observe the work of well qualified teachers who like science and who like children. Prospective teachers should also be provided with opportunities to gain experience in formulating questions that are meaningful to children, in developing methods for using quantitative approaches, in using audio-visual and laboratory materials, and in adapting to science instruction materials found in the surroundings of children.[61]

In a survey concerning opinions and attitudes of elementary science methods teachers on a variety of questions regarding teaching and behavioral objectives in methods

---

[60]Eiss (dir.), Guidelines for Improving College Science Programs, op. cit., p. 31.

[61]"Science Teaching in Elementary and Junior High Schools," op. cit., p. 2022.

courses, Vannan found that many instructors consider the use of new science curricula as a factor to ameliorate pre-service programs. He also found that 85 per cent of the respondents indicated that they "taught" or had their students "research" the new elementary science programs.[62]

A study of undergraduate programs for science teachers conducted by the National Science Teachers Association to develop criteria for identifying desirable practices in the pre-service education of science teachers found that students generally see a need for more clinical experience with their methods instruction. It was found that the clinical function is nearly completely divorced from the methods instruction at a majority of the institutions involved in the study.[63]

The study also concluded that the students' perception of science subject matter outweighed professional instruction. Many graduates, as reported in the study, went out to teach science employing much the same style as that by which they were taught science, in spite of the possible impact that

---

[62] Donald A. Vannan, "Food for Thought," Science and Children, VII (September, 1969), pp. 10-11.

[63] A Study of Undergraduate Programs for Science Teachers, Report of the U.S. Office of Education (Washington, D.C.: U.S. Department of Health, Education, and Welfare, October, 1968), p. 13.

the professional aspect of the preparation might have had, had they perceived it as being important to them.[64]

Regarding the adequacy of the provisions for methods instruction, the study found that these were generally wanting. The inadequacies were reflected in the needs of the beginning teachers and the product of the preparation programs, and were found in the following areas: (1) narrowness of focus aimed primarily at teaching academic content, and (2) inadequate preparation for motivating students.[65]

Lerner found that nearly 95 per cent of the instructors involved in her study taught primarily science content in their methods classes. She also reported that an area of learning given little emphasis in methods courses was the study of elementary science curricula.[66]

Goodlad, in his report on the curriculum reform movement, also emphasized the importance of teacher education for the implementation of new science programs.[67]

---

[64] Ibid., p. 16.

[65] Ibid., p. 30.

[66] Marjorie S. Lerner, "An Investigation of the Status of the Methods Course in Elementary School Science in Selected Teacher-Training Institutions" (unpublished Doctoral dissertation, Northwestern University, Evanston, Illinois, 1964), p. 177.

[67] Goodlad, op. cit., p. 85.

An examination of recent professional textbooks revealed an increasing emphasis toward the new laboratory-centered approaches to science teaching. Many are designed to acquaint educators with the background, philosophy, and samples of the new projects. Thier pointed out that the emphasis in science education during the 1970's will be in relation to the critical need for pre- and in-service education in the process methods.[68]

Gega wrote that the traditional textbook approach in elementary science has a declining function, especially at the primary level. He indicated that future efforts to improve science instruction will continue to stress the process approach. It was Gega's contention that traditional textbooks are inadequate to provide practice in the new methods.[69]

Although no study has determined the most effective means of presenting a methods course in science to solve the problem of providing teachers adequately trained to teach the new sciences, the methods course can at least be presented in ways that are strengthening to the total program of pre-service education.

---

[68]Herbert D. Thier, Teaching Elementary School Science (Lexington, Massachusetts: D.C. Heath and Company, 1970), p. iv.

[69]Peter C. Gega, Science in Elementary Education (second edition; New York: John Wiley and Sons, Inc., 1970), p. 607.

CHAPTER III

PERSONNEL AND RESEARCH PROCEDURES

I. SAMPLE INCLUDED IN THE STUDY

The Sample

The sample for this study consisted of faculty members in teacher-training institutions of Ohio, Kentucky, Pennsylvania, and West Virginia. The sampling was restricted to institutions offering programs in elementary science methods.

Preliminary Procedures

Research of the literature revealed no comprehensive list of elementary science methods instructors. In order to ascertain the names of educators from the institutions, a letter, along with a self-addressed stamped post card was sent to all elementary education department chairmen requesting the names of their faculty members involved in science methods instruction. A total of 210 letters and post cards were sent to all colleges, universities, and academic and branch centers that come within the stated delimitations.

Distribution of the Sampling

The first mailing of the questionnaire was made during the second week in July, 1969. From a total of

210 post cards mailed to elementary department chairmen, 194 responses were received. Responses from mailings to the participants totaled 79 per cent. Eight weeks after the original mailing had been made, a follow-up letter with a questionnaire was sent to all current non-respondents.

Twenty-one returns were rejected because of incorrect responses or the respondents felt unqualified to answer. Table I presents the responses according to state. Nineteen individuals made no response.

A total of 133 re pondents, representing 69 per cent of the original mailing, comprised the population for this study.

II. EVALUATIVE INSTRUMENT

The purpose of the questionnaire survey was to collect data on three major items:

1. Examination of the status of teacher-trainee preparation in the new sciences.
2. Identification of characteristics of methods classes.
3. Examination of opinions of instructors about the new sciences.

Questions in all three areas were constructed and submitted to the dissertation advisor, then revised and rewritten a number of times by the writer. Finally, the

TABLE I

RESPONSE RATES BY STATE

State	Questionnaires mailed, number	Total response		No reply, number	Rejected responses, number	Usable responses	
		Number	Per cent			Number	Per cent
Ohio	68	55	81	7	6	49	72
Kentucky	22	16	74	4	2	14	64
Pennsylvania	87	69	79	5	13	56	66
West Virginia	17	14	82	3	0	14	82
TOTALS	194	154	79	19	21	133	69

draft version of the completed questionnaire was submitted to the author's dissertation committee for constructive comments and suggestions.

The questionnaire consists of two parts (see Appendix B). The first section directed to the attention of the instructors requested information on items one and two listed above. The questions were of two types: (1) open-ended, and (2) multiple-choice. The second portion of the questionnaire was fashioned according to techniques recommended by Van Dalen, in which the subjects respond to each statement by selecting one of four responses labeled "Very significant," "Moderately significant," "Slightly significant," or "Not at all significant."[64]

III. ANALYSIS OF THE DATA

Most of the questions in the questionnaire called for multiple-choice responses. These data could be translated directly from the questionnaires to IBM punch cards for computer analysis. The answers to the open-ended questions were listed in appropriate categories, coded and key-punched along with the other data. Frequency distributions were collected, and percentages were calculated.

---

[64]Deobold B. Van Dalen, Understanding Educational Research (New York: McGraw Hill Book Company, 1962), pp. 249-75.

In the treatment of responses obtained, one is concerned with whether differences are significant. Nonparametric techniques of hypotheses testing were used in analyzing the raw data, because they do not require assumptions of a normally distributed population. The methods of treating the samples and statistical procedures used are appropriately indicated.

The totals for each response under each question in the second part of the questionnaire were grouped into contingency tables, and chi square tests of independence were applied at the .05 level of confidence to test the various null hypotheses originally stated. The chi square technique is a test of comparison between frequencies, and was also employed to determine the significance of the differences by academic rank and state of instructors' beliefs regarding the new science programs.

The formula for the chi square statistic is as follows:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

wherein O = an observed frequency, and
E = an expected or theoretical frequency.[65]

---

[65] George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw Hill Book Company, 1965), p. 192.

Tables illustrating the data and the results of the statistical tests will be presented in the ensuing two chapters.

CHAPTER IV

RESULTS OF THE STUDY

It will be recalled that the purpose of this study was four-fold: (1) to examine the status of elementary teacher-training preparation in the new sciences; (2) to identify characteristics of the methods courses; (3) to examine instructors' opinions on the new sciences; and (4) to apply appropriate statistical tests of independence.

The first portion of this chapter will present the quantitative data from the entire sample population, and will describe the statistical treatment of it according to the procedures described in the preceding chapter. The remaining portion of the chapter will present data with reference to each of the states and by academic rank of the respondents.

I. ANALYSIS OF TOTAL RESPONSES

Characteristics of Methods Classes

One hundred thirty-three elementary science instructors representing 94 colleges and universities of Ohio, Kentucky, Pennsylvania, and West Virginia comprised the population for this study (see Appendix A). The distribution of respondents according to teaching position was rather unequal, as is evident in Table II. The greater number of

TABLE II

DISTRIBUTION OF RESPONDENTS BY ACADEMIC RANK

Academic rank	Ohio	Kentucky	Pennsylvania	West Virginia
Instructor	5	0	5	0
Assistant Professor	21	5	18	8
Associate Professor	13	6	19	1
Professor	7	3	12	5
Other*	3	0	2	0
TOTAL	49	14	56	14

*Lecturer, Fellow, Supervisor.

individuals (52, or 39 per cent) ranked as assistant professors. Next, in rank order, were associate professors, with 39, or 29 per cent. Other academic rankings included professors (27, or 20 per cent), and instructors (10, or 8 per cent). Relatively few of the respondents (5, or 4 per cent) ranked themselves in some other category.

Table III indicates the department affiliation of the respondents. A much larger proportion of individuals (87, or 65 per cent) were affiliated with departments of education. While 20 respondents, or 15 per cent, were combined with other departments, less than 10 per cent were associated in each of the following departments: science, science education, and joint appointments with science and education.

Table IV illustrates a striking difference occurring among the distribution of responses regarding types of methods courses taught. A much larger proportion of respondents (77, or 58 per cent) were in methods of teaching science specifically for the elementary school. Roughly one-fifth of all elementary science methods courses were taught in combination with some other subject, usually mathematics. In 48 per cent of all cases, the second subject was social studies, English, or some other subject. General methods for all elementary school teachers (22, or 16 per cent) comprised the third most frequent type of methods course,

TABLE III

DEPARTMENT AFFILIATION OF RESPONDENTS
N = 133

Department	Number
Education	87
Science Education	10
Science	14
Joint appointment	2
Other	20

TABLE IV

METHODS COURSES OFFERED BY RESPONDENTS
N = 133

Course	Number
General methods for all teachers	22
Methods of teaching science, elementary	77
Science methods combined with another subject	23
Other	11

while less than 10 per cent of the respondents taught courses different from those reported.

Science education budgets, with corresponding expenditures for new science materials, by university enrollments, are reported in Table V. Over three-fourths of the institutions with enrollments fewer than 2,000 students had less than $150 allotted for their science budgets. Of this number, 30, or 76 per cent, expended less than 25 per cent of the allotted budget on new programs. More than one-half of the 53 universities (62 per cent) spent approximately one-fourth of their budget for new science materials. Only a small number of the institutions with fewer than 2,000 students enrolled consumed more than one-half of their science allotment on new science programs.

On the other hand, only seven of these universities (14 per cent) had budgets in excess of $300, and only one school apportioned less than one-fourth of its science funds on new science materials, while three schools allotted more than one-half of their budget toward such programs.

The data on science expenditures for institutions with enrollments between 2,000 and 5,000 was somewhat reversed. Of the 25 universities included in this group, 11 (44 per cent) indicated science expenditures or less than $150. Of these 11, seven reported new science apportions at approximately less than one-fourth of their science

TABLE V

SCIENCE EDUCATION EXPENDITURES, BY UNIVERSITY ENROLLMENT

Enrollment	Number	Science education expenditures	Per cent of expenditures spent on new science materials		
			0-25	26-50	51-100
Under 2,000	53	$ 1 - 149	30	2	8
		$150 - 299	2	1	3
		$300 and over	1	3	3
2,000 - 5,000	25	$ 1 - 149	7	0	4
		$150 - 299	1	0	0
		$300 and over	4	2	7
Over 5,000	40	$ 1 - 149	4	0	1
		$150 - 299	1	0	0
		$300 and over	14	9	11

budget, whereas four schools disbursed more than 50 per cent of their science funds on the new programs.

Of the 13 institutions which reported science budgets in excess of $300, the proportion of allotments for new science materials ranged from a high of seven which expended over one-half of their funds for such programs, to a low of four which spent less than one-fourth on new science items.

Most of the 40 institutions (38, or 85 per cent) with enrollments exceeding 5,000 students had science budgets of $300 or more. Only five of these universities (13 per cent) reported expenditures in science of less than $150.

Of the 34 institutions having budgets over $300, the proportion of funds allotted for new science materials ranged from 11 (32 per cent) which designated over 50 per cent on such programs, nine (26 per cent) which allocated up to 50 per cent, and 14 (41 per cent) which assigned less than 26 per cent of their budgets on the new sciences.

The findings disclose that the smaller the institution, the smaller the budget. Correspondingly, the smaller the budget, the smaller the amount of actual funds allocated for new science materials.

To describe the degree of relationship between size of institutions and their corresponding budgets, the resulting correlation coefficient, using the Pearson product moment, was .4508. With 132 degrees of freedom, the critical value of the correlation coefficient was found to be .1950 at the .05 level. Thus, it may be concluded that the correlation indicates that larger science budgets were associated with universities of greater enrollment.

A coeffi ient correlation of .3883 was found in the relationship between budgets and money spent on the new programs. It may be concluded, on this basis, that more money was allocated on new science curricula as science budgets increase.

Fifty-three universities with less than 2,000 students reported that 40 (75 per cent) expended approximately less than one-fourth of their funds for new science materials. Only seven of the small universities had science budgets in excess of $300.

Findings of the larger universities indicated a reversal from those of the smaller universities. As university enrollment increased, science budgets were also greater. Respondents from 40 institutions with over 5,000 students reported that 34 (85 per cent) had science budgets exceeding $300, compared to five (13 per cent) of the schools which indicated less than $150. Fourteen universities (42 per cent) with budgets over $300 denoted spending less than one-fourth of their budget on new science materials, in contrast to 11 (33 per cent) which allocated over 50 per cent.

The data on new science kits revealed that the larger the institution, the greater the number of kits found in the methods classes. Eighteen (32 per cent) of the 57 universities with less than 2,000 students contained new science kits. Nineteen (68 per cent) institutions with between 2,000 and 5,000 students possessed them, and 37 (78 per cent) of the largest schools also contained kits in their classrooms.

Types of new science materials found in university classrooms varied considerably. The results appear in Table VI. Seventy-four respondents (56 per cent) specified that their classrooms contained kits in the new science programs. AAAS, ESS, SCIS, MINNEMAST, and SRA, respectively, were the most widely designated new science programs found in methods classes. When asked to specify frequency of replacement, 70 per cent of the respondents indicated the kits were replaced as often as needed.

A diversity in number of universities possessing new science kits was also found. A much larger proportion of new science materials was found in larger universities than in smaller ones. Seventy-eight per cent of the universities with over 5,000 students possessed new materials, whereas only 32 per cent of the smallest institutions commanded them.

TABLE VI

NUMBER AND PER CENT OF INSTRUCTORS POSSESSING NEW SCIENCES KITS IN THEIR CLASSROOMS, BY UNIVERSITY ENROLLMENT
N = 133

Enrollment	Total number	Number containing new sciences kits	Per cent of total number
Less than 2,000	57	18	32
2,000 - 5,000	28	19	68
Over 5,000	48	37	78

The results also indicated a relationship between science expenditures and university size. In the smaller institutions only 32 per cent contained new science materials, and approximately the same number (30 per cent) had science budgets of less than $150, of which less than one-fourth was allotted to the new programs.

On the other hand, 85 per cent of the largest universities expended over $300 for new science programs. Although 41 per cent spent less than one-fourth of their budget on new materials, 33 per cent apportioned over one-half toward such programs.

The frequency tabulation in response to instructors designating the new program with which they were most familiar is summarized in Table VII. Fourteen respondents did not react to this question. Responses ranged from a high with AAAS (112, or 84 per cent), to a low with SSCP (16, or 12 per cent).

The study of the new science courses in elementary science might be expected to be a part of the science methods classes. Almost 90 per cent of the methods instructors said they taught the new programs in their courses. A smaller number denoted not teaching about the new programs. This is illustrated in Table VIII.

The findings disclosed that 93 per cent of the full professors and 92 per cent of the associate professors were

TABLE VII

MOST FAMILIAR PROGRAMS LISTED BY RESPONDENTS
N = 133

Program	Number	Per cent
AAAS	112	84
ESS	91	68
SCIS	88	66
MINNEMAST	85	64
COPES	62	47
ESSP (Illinois)	56	42
ESSP (California)	47	36
ESP	42	32
ISCS	33	25
Quantitative Approach	26	20
ESSP (Utah)	24	18
SSCP	16	12

TABLE VIII

UTILIZATION OF NEW SCIENCE PROGRAMS AND KITS IN METHODS CLASSES, BY CLASS ENROLLMENT

Item	Classes of more than 100	Classes of less than 100
Total number	91	41
Number teaching new sciences	78	39
Classes containing kits	40*	34*
Classes teaching about new sciences but containing no kits	39	6

*One kit not utilized.

teaching the new programs in their methods classes. Eighty-six per cent of the assistant professors, and 80 per cent of the instructors, reported teaching the new sciences.

In 91 methods classes with less than 100 students, 78 (86 per cent) reported teaching the new sciences. Primary emphasis in the programs was described as introductory-descriptive. Less than one-half of the classrooms (43 per cent) did not contain any new science kits, but approximately the same number still taught them. Only one respondent disclosed possession of kits without instruction in the new materials.

Forty-one respondents reported classes with over 100 students enrolled. Thirty nine (95 per cent) indicated teaching about the new sciences. Kits were found in 34 (84 per cent) of the classrooms. The remaining six classrooms (15 per cent) did not contain kits, but instruction in the new science programs still occurred.

A positive correlation was found between size of methods classes and moneys allotted for new science programs and budgets. A coefficient correlation of .4464 was found at the .05 level (132 degrees of freedom) in the relationship between size of classes and budgets, and a correlation of .2167 was computed for the relationship between size of classes and money appropriated for the new science curricula. It may be concluded, therefore, that science budgets were higher and money apportioned for new science programs was greater as enrollment in the methods classes became larger.

Table IX summarizes the findings with reference to the new sciences receiving the most attention in methods classes. Each instructor was asked to indicate which of the new courses he taught in his methods classes. The four new programs receiving the most attention, by per cent of respondents, were: AAAS, 78 per cent; ESS, 64 per cent; SCIS, 58 per cent; and MINNEMAST, 39 per cent.

Although over one-half of the respondents gave attention to AAAS, ESS, and SCIS, the attention, as mentioned earlier, was described as primarily introductory-descriptive.

Only 53 instructors (40 per cent) from the sample population attended a workshop in the new science programs, and all individuals but two taught them in their courses. Workshops were attended in primarily the AAAS, ESS, and SCIS programs.

Workshops in the new science programs were attended mainly by associate professors. Twenty-seven (69 per cent) attended workshops. Fifteen (56 per cent) of the professors, and 14 (27 per cent) of the assistant professors attended new science workshops. Only 20 per cent of those with the rank of instructor attended a workshop.

TABLE IX

NEW SCIENCE PROGRAMS RECEIVING ATTENTION IN METHODS CLASSES

Program	Number	Per cent
AAAS	103	78
ESS	85	64
SCIS	77	58
MINNEMAST	52	39
COPES	37	28
ESSP (Illinois)	34	26
ESP	28	21
ESSP (California)	25	19
ISCS	19	15
ESSP (Utah)	15	11
SSCP	15	11
Quantitative Approach	15	11
Other	11	8

With the exception of the instructors, few of the respondents conducted their own workshops in new science programs. Fifty per cent of the instructors reported administering new science workshops, while 35 per cent of the full professors and 23 per cent of the assistant and associate professors conducted programs. The workshops were held primarily in AAAS, ESS, SCIS, and MINNEMAST, respectively.

Although 80 respondents (60 per cent) did not attend any workshops in the new science programs, 65 of these instructors (81 per cent) taught the new materials in their classrooms. Ten professors (13 per cent) did not attend any new science workshop, but conducted their own. (See Table X.)

To describe the degree of relationship between attendance at new science workshops and teaching the new programs, the resulting correlation coefficient was .3653. With the critical value being .1950 at the .05 level (132 degrees of freedom), it may be concluded that the correlation indicates relationship between attendance at new science workshops and teaching the new curricula.

II. INSTRUCTORS' OPINIONS AND THE NEW SCIENCES

Analyses of the frequencies from the second part of the questionnaire revealed that there was not a great deal

TABLE X

ATTENDANCE AT NEW SCIENCES WORKSHOPS BY RESPONDENTS AND NEW PROGRAMS TAUGHT IN METHODS CLASSES

Item	Number attended	Number never attending
Number of respondents	53	80
Number teaching new sciences	51	65
Number not teaching new sciences	2	15
Number which held workshops in the new sciences	25	10

of difference in relation to the factors which have influenced teaching the new sciences. Theoretical frequencies were computed for each cell proportional to the marginal totals. The totals for each response under each question were then grouped into contingency tables and a chi square test of independence was performed on the data to test for any significant differences which might occur.

A table of chi square values showed that with one degree of freedom, the value of chi square would have to be 3.841 to be significant at the .05 level.

Factors Influencing New Science Instruction

It appears from Table XI that university training and individuals involved as consultants in new science programs had little significance as factors for teaching about the new science curricula. Thus, the discrepancies between the observed frequencies and the theoretical frequencies were not great enough to be ascribed to anything more than sampling fluctuations.

Despite the fact that being involved as a consultant in in-service training as a factor influencing the teaching of the new programs was not considered significant, 48 per cent of the respondents conducted their own workshops in the new sciences.

Personal interest in developing new programs and reading about them were significant factors which influenced

TABLE XI

FACTORS INFLUENCING THE TEACHING OF NEW SCIENCES

Factor	χ^2 value	Null hypothesis
Involved as a consultant	1.690	Retained
Involved as a participant	14.035	Rejected
Previous university/college training	1.017	Retained
Reading about the new programs	50.700	Rejected
Personal interest	57.836	Rejected

the teaching of new materials in methods classes. Participation in new science programs was not necessarily a significant factor for implementing them, primarily because few respondents were involved as consultants in the new programs.

Factors Which May Discourage New Science Instruction

Data analyzing factors which could discourage the instructors from teaching the new sciences were considered next. The findings are presented in Table XII.

It can be summarized from the analysis that instructors were committed to the value of the new programs and did not consider their implementation into the elementary schools a significant problem. However, no significant difference was found concerning the cost of the programs.

Problems in Beginning New Science Programs

Table XIII shows that costs of the new science programs, lack of classroom teacher training, and lack of a desire for change in the established programs were the elements considered as factors which could pose problems for implementing new science programs into the elementary schools. It might be pointed out that even though instructors recognize that the costs of the new science programs hinder their implementation into the schools, the costs may not necessarily deter professors from teaching about them in

TABLE XII

FACTORS DISCOURAGING THE TEACHING OF NEW SCIENCES

Factor	χ^2 value	Null hypothesis
Not committed to the value of the new sciences	89.151	Rejected
Too difficult to implement new programs into the schools	92.098	Rejected
Too costly to buy and maintain new materials	3.175	Retained

TABLE XIII

PROBLEMS IN IMPLEMENTING NEW SCIENCE PROGRAMS INTO THE SCHOOLS

Problem	χ^2 value	Null hypothesis
Costs of the new programs	51.613	Rejected
Lack of classroom teacher training	89.175	Rejected
Lack of desire for change	40.328	Rejected
Insufficient time in school day	0.648	Retained
Impractical because of administrative interference	21.146	Rejected
Lack of "right" kind of students	97.581	Rejected
"Conservatism" in elementary schools	0.203	Retained
Lack of educational theory for the new programs	12.698	Rejected
Lack of educational theory by teachers for teaching science	15.869	Rejected

their methods classes. As was reported earlier, over 75 per cent of the instructors still taught the new programs in their classes.

There were no significant differences in the instructors' responses regarding insufficient time in the school day or "conservatism" in elementary schools as factors which could be regarded as problems in implementing programs in schools.

The respondents did not consider administrative interference, lack of the "right kind" of students, and lack of educational theory for the new sciences as implementation problems.

Factors for Teaching the New Sciences

All three responses relating to factors which may be considered important for teaching the new sciences were found to be significant and, accordingly, the null hypotheses were rejected. Table XIV illustrates that teaching the new sciences was necessary to (1) stimulate the professional growth of elementary teachers, (2) promote self-confidence in classroom teaching, and (3) generally improve classroom performance.

Other Factors Related to the New Sciences

Significant responses at the .05 level of confidence were recorded on eleven questions relating to the new science

TABLE XIV

FACTORS ASSOCIATED FOR TEACHING THE NEW SCIENCES

Factor	χ^2 value	Null hypothesis
To stimulate the professional growth of teachers	68.438	Rejected
To promote self-confidence in classroom teaching	78.721	Rejected
To generally improve classroom performance	63.605	Rejected

programs. Significant differences were found for the following items:

1. It is important for elementary classroom teachers to be able to describe techniques and competencies used by scientists in the course of the process approaches. (χ^2 = 57.781)
2. It is important for students in the methods classes to be able to describe techniques and competencies used by scientists in the course of the process approaches. (χ^2 = 57.781)
3. The new sciences do contribute to the general objectives of science education. (χ^2 = 105.800)
4. It is necessary for classroom teachers to equip themselves for process-oriented science teaching. (χ^2 = 103.813)
5. The basic assumptions underlying the new sciences are attained in the programs. (χ^2 = 59.797)
6. The new sciences do provide children with learning activities closely aligned with science as a discipline. (χ^2 = 84.872)
7. The new sciences help children develop basic skills and operations that can be applied to the study of natural phenomena. (χ^2 = 76.496)
8. The new sciences meet individual needs of students. (χ^2 = 60.552)

9. The new sciences provide for stimulation of children's intellectual development. (χ^2 = 79.365)

10. A background in science is necessary for elementary classroom teachers to teach the new sciences. (χ^2 = 45.841)

11. A background in learning theory is necessary for elementary classroom teachers to teach the new sciences. (χ^2 = 75.031)

III. INSTRUCTORS' OPINIONS BY ACADEMIC RANK AND STATE

To determine whether or not the variables were independent of each other or associated, the data were comprised into paired observations on two nominal variables. Data were collected from the sample on the relationship between question items and respondents from the states. The paired observations were entered into two-by-two contingency tables to show whether or not a relationship exists between Ohio, Kentucky, Pennsylvania, and West Virginia respondents and significance or non-significance on question items. The application of chi square to study the independence or association of the two variables was comprised from the population of instructors, assistant professors, associate professors, and professors from each of the four states.

A table of chi square values showed that with one degree of freedom, the value of chi square would have to exceed 3.84 to be significant at the .05 level.

The only differentiation that existed occurred between associate professors from Ohio and the other states on the items which may discourage an instructor from teaching the new programs and those which may be problems in implementing them into the elementary schools.

Ohio respondents believed that the factor of cost and maintenance of the new materials was an element which discouraged them from teaching about the new programs. The respondents from Kentucky, Pennsylvania, and West Virginia did not consider this a significant factor.

The associate professors from Ohio did not consider administrative interference as a problem in implementing the new sciences into the elementary schools.

It appears obvious that these two discrepancies between the frequencies are not great enough to be ascribed to anything more than sampling fluctuations. The findings provided fairly conclusive evidence that the respondents, regardless of academic rank, did not differentiate on their beliefs about the new science programs. Consequently, the hypotheses that differences do not exist among respondents in terms of academic rank and location of universities by state and opinions about the new programs were retained.

IV. ANALYSIS OF RESPONSES BY STATE

Science education budgets with corresponding expenditures for new science materials by university enrollment in each of the four states are reported in Table XV.

Frequency analysis for respondents from Ohio reveals that 13 universities (73 per cent) with an enrollment not exceeding 2,000 spent less than $150 on science education. Less than one-fourth of that amount was allotted for new science programs by 10 (78 per cent) of the institutions. Only three respondents from Ohio reported science budgets in excess of $300.

Table XV indicates that Kentucky, Pennsylvania, and West Virginia appropriated similar amounts for science education. Twenty-seven institutions (58 per cent) had science budgets of less than $150, with 20 (74 per cent) having spent less than 25 per cent on new programs. Only four respondents (12 per cent) from universities in which the enrollment did not exceed 2,000 indicated science expenditures of $300 or more.

Respondents from seven Ohio universities reported enrollments of between 2,000 and 5,000, whereas Kentucky, Pennsylvania, and West Virginia numbered 18. By comparison, three Ohio respondents reported budgets of less than $150, and all apportioned 25 per cent or less on new programs;

TABLE XV

NEW SCIENCE EXPENDITURES BY INSTITUTIONS ACCORDING TO ENROLLMENT, BY STATE

Enrollment	Science budget	Expenditures by institutions in Ohio, per cent of budget			Expenditures by institutions in Kentucky, Pennsylvania, and West Virginia, per cent of budget		
		0-25	26-50	51-100	0-25	26-50	51-100
Less than 2,000	$ 1 - 149	10	0	3	20	2	5
	$150 - 299	0	1	1	2	0	2
	$300 and over	0	1	2	1	2	1
	TOTAL	10	2	6	23	4	8
2,000 - 5,000	$ 1 - 149	3	0	0	4	0	4
	$150 - 299	0	0	0	1	0	0
	$300 and over	1	1	2	3	1	5
	TOTAL	4	1	2	8	1	9
Over 5,000	$ 1 - 149	3	0	1	1	0	0
	$150 - 299	1	0	0	0	0	0
	$300 and over	6	4	4	8	5	7
	TOTAL	10	4	5	9	5	7

eight respondents from the other three states had corresponding budgets.

Fifty per cent expended one-fourth or less of their amounts on new science materials. The remaining individuals spent over one-half of their budgets on new programs.

Table XV also shows that most of the respondents from all four states with university enrollments exceeding 5,000 had science budgets in excess of $300. Six of Ohio's respondents apportioned approximately less than one-fourth of their science funds on new materials. Eight respondents from Kentucky, Pennsylvania, and West Virginia apportioned similar amounts. By comparison, however, approximately 99 per cent of the respondents from the three states had budgets over $300, against 14 (75 per cent) for Ohio.

Twenty respondents (45 per cent) from Ohio institutions indicated science budgets of less than $150. Of these, 16 (80 per cent) individuals reported expenditures for new materials at 25 per cent or less of their budgets. Twenty-one respondents (48 per cent) had science budgets in excess of $300, with seven (34 per cent) having expended 25 per cent or less on new programs, and eight (39 per cent) having spent one-half or more of their budgets.

Thirteen respondents (30 per cent) from Ohio reported spending over one-half of their science budgets on new materials. Eight of these individuals appropriated $300 or more for their science budgets.

By comparison, 36 respondents (49 per cent) from Kentucky, Pennsylvania, and West Virginia reported science budgets of less than $150. Twenty-five of these instructors (70 per cent) reported expenditures for new programs at 25 per cent or less of their budgets. Thirty-three respondents had science budgets in excess of $300, with 12 (37 per cent) having allotted not more than one-fourth on new materials, while 13 (40 per cent) appropriated 50 per cent or more of their budgets on such items.

Twenty-four respondents (33 per cent) from Kentucky, Pennsylvania, and West Virginia reported new science expenditures accounted for over 50 per cent of their science budgets. Nine were less than $150, and 13 were $300 or more.

Data on new science kits revealed that institutions with enrollments of less than 2,000 had fewer new science kits in their methods classes, in comparison to the larger schools. As can be seen in Table XVI, in the smaller universities there were not many differences in the number of new materials between Ohio, and Kentucky, Pennsylvania, and West Virginia. Of Ohio's universities with enrollments of less than 2,000, 35 per cent possessed new materials, compared to 31 per cent for the other states.

Fifty-six per cent of the respondents reported possessing new science kits within their methods classrooms. Pennsylvania (64 per cent) and Ohio (53 per cent) respondents, respectively, reported possessing the greatest number

TABLE XVI

NUMBER AND PER CENT OF INSTRUCTORS POSSESSING NEW SCIENCE KITS, BY STATE

State	Number of respondents	Classes containing new science kits	Per cent
Ohio	49	26	53
Kentucky	14	6	43
Pennsylvania	56	36	64
West Virginia	14	6	43
TOTAL	133	74	56

of kits, followed by West Virginia and Kentucky with 43 per cent.

Table XVII shows that respondents from all four states gave reference to AAAS, ESS, SCIS, and MINNEMAST, respectively, as the new programs most familiar to them. The table also reveals that the least familiar program to the respondents from Ohio and Pennsylvania was SSCP. The instructors from Kentucky and West Virginia reported that they were least familiar with ESSP (Utah), SSCP, and the Quantitative Approach.

The findings disclosed that in methods classes of less than 100 students, over 50 per cent of the instructors were teaching new programs. As Table XVIII shows, though, new science kits were found in less than one-half of the total number of universities from each of the four states. Just slightly under one half of the institutions (49 per cent) in Ohio and Pennsylvania contained new kits in their classrooms. Only two of Kentucky's respondents in methods classes of less than 100 students did not possess new program kits. Four were found in West Virginia.

In methods classes with larger enrollments (Table XIX) an increasing number of kits were found within the classrooms. Over three-fourths (83 per cent) of the respondents reported possessing new program kits. The greater number of kits were found in institutions in West Virginia,

TABLE XVII

MOST FAMILIAR NEW SCIENCE PROGRAMS LISTED BY RESPONDENTS BY STATE

Program	Ohio N = 49	Kentucky N = 14	Pennsylvania N = 56	West Virginia N = 14
AAAS	40	10	53	9
ESS	32	7	45	7
SCIS	30	7	43	8
MINNEMAST	29	6	44	6
COPES	21	3	34	4
ESSP (Illinois)	19	3	31	3
ESSP (California)	20	3	19	5
ESP	18	2	18	4
ISCS	13	5	13	2
Quantitative Approach	8	1	15	2
ESSP (Utah)	11	0	12	1
SSCP	7	1	7	1

TABLE XVIII

NEW SCIENCE PROGRAMS AND KITS IN METHODS CLASSES WITH ENROLLMENTS LESS THAN 100, BY STATE

State	Total number	Number teaching new sciences	Classrooms containing kits	Classes teaching about new science but containing no kits
Ohio	33	28	16	12
Kentucky	9	5	2	3
Pennsylvania	37	34	18*	17
West Virginia	12	11	4	7
TOTAL	91	88	40	39

*One kit not utilized.

TABLE XIX

NEW SCIENCE PROGRAMS AND KITS IN METHODS CLASSES WITH ENROLLMENTS GREATER THAN 100, BY STATE

State	Total number	Number teaching new sciences	Classrooms containing kits	Classes teaching about new sciences but containing no kits
Ohio	16	14	11*	4
Kentucky	5	5	4	1
Pennsylvania	18	18	17	1
West Virginia	2	2	2	0
TOTAL	41	39	34	6

*One kit not utilized.

Kentucky, Pennsylvania, and Ohio, respectively.

According to the respondents from the four states, the new sciences receiving the most attention in their methods classes included AAAS, ESS, SCIS, MINNEMAST, and COPES. The programs which received the least amount of attention were SSCP, ESSP (Illinois, California, Utah), ISCS, ESP, and the Quantitative Approach. These data are summarized in Table XX.

Findings with reference to workshops attended by respondents are reported in Tables XXI and XXII. The findings disclose that the greater number of individuals who attended workshops in the new programs were from Pennsylvania; 45 per cent of the Pennsylvania respondents reported attending workshops. Ohio respondents attending numbered 39 per cent; Kentucky, 37 per cent; and West Virginia, 29 per cent.

In each of the four states, over 95 per cent of the respondents who attended new science workshops reported teaching the new science curricula in their classes. On the other hand, the number is somewhat lower for those respondents not having attended a workshop and teaching the new programs. Ninety per cent of the instructors from Kentucky and West Virginia reported teaching the new science curricula even though they did not attend a new science workshop. Ohio followed, with 73 per cent, and finally Pennsylvania with 66 per cent.

TABLE XX

NEW SCIENCE PROGRAMS RECEIVING ATTENTION IN METHODS CLASSES, BY STATE

Program	Ohio N = 49	Kentucky N = 14	Pennsylvania N = 56	West Virginia N = 14
AAAS	37	9	50	7
ESS	29	5	44	7
SCIS	29	4	36	8
MINNEMAST	23	2	23	4
COPES	19	1	15	2
ESSP (Illinois)	16	0	15	3
ESP	14	0	11	3
ESSP (California)	12	0	10	3
ISCS	10	0	8	1
ESSP (Utah)	6	0	8	1
SSCP	6	0	8	1
Quantitative Approach	6	0	4	2

TABLE XXI

NEW SCIENCE WORKSHOPS ATTENDED BY RESPONDENTS AND NEW PROGRAMS TAUGHT IN METHODS CLASSES, BY STATE

State	Number attended	Number teaching new sciences	Number not teaching new sciences	Number which held new sciences workshops
Ohio	19	18	1	9
Kentucky	5	4	1	4
Pennsylvania	25	25	0	11
West Virginia	4	4	0	1
TOTAL	53	51	2	25

TABLE XXII

NEW SCIENCE WORKSHOPS NOT ATTENDED BY RESPONDENTS AND NEW PROGRAMS TAUGHT IN METHODS CLASSES, BY STATE

State	Number never attending	Number teaching new sciences	Number not teaching new sciences	Number which held new sciences workshops
Ohio	30	22	8	4
Kentucky	9	6	3	0
Pennsylvania	31	28	3	4
West Virginia	10	9	1	2
TOTAL	80	65	15	10

The totals for respondents not teaching new science programs, regardless of attendance at workshops for the new sciences, were highest for Kentucky (30 per cent). Others included Ohio, 18 per cent; West Virginia, 8 per cent; and Pennsylvania, 6 per cent.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The Problem

A widely varied position is accorded the methods courses in elementary science education. However, no study has attempted to analyze, to any great extent, the status of the new science curricula in pre-service education. It was the purpose of this study to (1) examine the status of teacher-trainee preparation in the new elementary science programs in methods classes of institutions in Ohio, Kentucky, Pennsylvania, and West Virginia; (2) identify characteristics of the methods courses at the institutions; (3) examine opinions of the instructors about the new science programs; and (4) apply appropriate statistical tests to determine the existence of significant differences among instructors' beliefs about the new science programs.

Design of the Study

This study was designed as a descriptive-normative study in which faculty members of elementary science methods courses from Ohio, Kentucky, Pennsylvania, and West Virginia comprised the sample population.

The instrument for collecting the data was in the form of a questionnaire consisting of two sections. The first portion directed to the attention of the instructors requested information on the following items:

1. the status of teacher-trainee preparation in the new sciences.
2. characteristics of methods classes.

The questions were of two types: (1) open-ended, and (2) multiple choice.

The second portion of the instrument called for responses to statements designed to examine opinions of instructors about the new programs. The subjects responded to each question by selecting one of four responses labeled "Very significant," "Moderately significant," "Slightly significant," or "Not at all significant."

The new programs referred to in the study included the following: AAAS, COPES, ESP, ESS, ESSP (California, Illinois, Utah), ISCS, MINNEMAST, SSCP, SCIS, and the Quantitative Approach.

The Sample

The sampling was restricted to institutions from the states providing the greatest number of teachers to Ohio, and those offering programs in elementary science methods. In addition to Ohio, the sample included respondents from

Kentucky, Pennsylvania, and West Virginia. A total of 133 respondents, representing 69 per cent of the mailing, comprised the population for this study.

Thirty-nine per cent of the population was made up of assistant professors. Associate professors followed, with 29 per cent. Other academic rankings included professors (20 per cent) and instructors (8 per cent).

Department affiliation of the respondents was primarily in education. Also, most of the respondents were in methods of teaching science specifically for the elementary school.

Statistical Treatment

The following null hypotheses were assumed:

1. There is no significant difference of total frequencies for each question in comparing instructors' opinions regarding the new science programs.
2. There is no significant difference in comparing the sample frequencies in terms of academic rank with instructors' beliefs about the new science programs.
3. There is no significant difference in comparing the sample frequencies in terms of the location of the universities by state with instructors' opinions about the new science programs.

The responses from the first part of the questionnaire were translated directly from the instrument to IBM punch cards for computer analysis. The answers to the open-ended questions were listed in appropriate categories, coded, and key-punched along with the other data. Frequency distributions were collected, and percentages calculated.

The totals for each response under each question in the second portion of the questionnaire were grouped into contingency tables and the appropriate chi square tests of independence were applied at the .05 level of confidence to test the null hypotheses originally stated.

Summary of Findings

The study of the new science courses in elementary education might be expected to be a part of the science methods classes. Over 75 per cent of the methods instructors reported teaching about the new programs in their classes. The findings, by academic rank, indicated the following number of respondents teaching the new sciences: professors, 93 per cent; associate professors, 92 per cent; assistant professors, 86 per cent; and instructors, 80 per cent. However, over 50 per cent of the respondents reported teaching new science curricula in only the AAAS, ESS, and SCIS programs. Thirty-nine per cent reported teaching about MINNEMAST. In each of the four states, these same four programs were the most widely taught new courses in the methods classes.

Less than 15 per cent of the respondents reported teaching the new curricula in ISCS, ESSP (Utah), SSCP, and the Quantitative Approach. These programs were also given the least amount of attention in all four states within this study.

The findings disclosed that the institutions with greater enrollments expended more funds for science than did universities with fewer students. Using the Pearson product-moment formula, it may be concluded that the correlation substantiated the relationship of larger science budgets with universities of greater enrollment.

Over 75 per cent of the respondents from institutions with less than 2,000 students reported science budgets of less than $150, whereas only 13 per cent of the participants from universities exceeding 5,000 students indicated similar budgets. Forty-four per cent of the respondents from institutions with enrollments between 2,000 and 5,000 students also reported $150 science budgets.

Only 14 per cent of the universities with enrollments less than 2,000 students had science budgets exceeding $300, compared to 85 per cent of the schools with over 5,000 students. Science budgets of over $300 were indicated by 52 per cent of the instructors from institutions with enrollments between 2,000 and 5,000 students.

A positive correlation was also found in the relationship between science budgets and money spent on the new programs. It may be concluded, on this basis, that more money was allocated on new science curricula as science budgets increased.

The proportion of funds expended for new science materials for the 53 institutions with enrollments of fewer than 2,000 students ranged from 62 per cent allocating one-fourth or less of their budget on such programs, to only 5 per cent apportioning over one-half.

Respondents from 25 universities reported enrollments between 2,000 and 5,000 students. Forty-eight per cent reported new science expenditures at 25 per cent or less of their budgets, and 44 per cent reported spending over 50 per cent on new science materials.

The proportion of funds apportioned for new science materials for the 40 institutions with over 5,000 students ranged from 30 per cent designating over 50 per cent on such programs, to 70 per cent which allocated up to 50 per cent. Forty-eight per cent assigned less than 25 per cent on the new sciences.

The comparison of science budgets for Ohio institutions with those of Kentucky, Pennsylvania, and West Virginia was relatively similar. Forty-five per cent of Ohio's respondents indicated science budgets of less than $150. Forty-nine per cent of the respondents from institutions in Kentucky, Pennsylvania, and West Virginia reported similar budgets.

Eighty per cent of the respondents from Ohio reported expenditures for new science materials at 25 per cent or less of their budgets. In contrast, 70 per cent of the instructors from other states reported similar expenditures on new materials.

Budgets over $300 were reported by 48 per cent of the respondents from Ohio. Thirty-four per cent expended one-fourth or less on new programs. Forty-five per cent of the respondents from Kentucky, Pennsylvania, and West Virginia had similar budgets, and 37 per cent allotted not more than one-fourth of their science funds on the new sciences.

In 91 methods classes with less than 100 students, 86 per cent of the respondents reported teaching about the new sciences. Less than one-half of the classrooms did not contain any new science kits. Ninety-five per cent of the respondents from methods classes where enrollments exceeded 100 students reported teaching the new sciences. Kits were found in 84 per cent of their classrooms.

A positive correlation was found between size of methods classes and money allotted for new science programs and budgets. It may be concluded that a relationship exists between higher enrollment in methods classes and greater science budgets and money spent on new science curricula.

New science kits were found in more methods classrooms in Pennsylvania and Ohio than in Kentucky and West Virginia. The findings were as follows: Pennsylvania, 64 per cent; Ohio, 53 per cent; West Virginia and Kentucky, 43 per cent.

Only 40 per cent of the sample population had attended a workshop in the new science programs. However, 81 per cent of the respondents who did not attend a workshop still taught new science curricula in their classes. Workshops were attended primarily in the AAAS, SCIS, and ESS programs. Attendance at new science workshops was primarily by associate professors (69 per cent). Fifty-six per cent of the professors and 27 per cent of the assistant professors attended new science workshops, but only 20 per cent of the instructors attended one.

University training and individuals involved as consultants in new science programs had little significance as factors for teaching about the new curricula. The resulting chi square tests indicated that the discrepancies between the frequencies were not great enough to be ascribed to anything more than sampling fluctuations.

Analysis of the chi square tests revealed that personal interest in developing new programs and reading about them were significant factors which influenced the teaching of the new materials in methods classes. Participation in new science programs was not necessarily a significant factor for implementing them.

It can be summarized from the analysis that instructors were committed to the value of the new programs. They did not consider the implementation of the new programs into the elementary schools a significant problem. Although the respondents recognized that the new programs are costly, no significant difference was found considering this factor as a problem which could discourage them from teaching the new curricula in their methods classes.

The following items were found to be significant factors as problems for the implementation of the new science programs into the schools:

1. Costs of the new programs.
2. Lack of classroom teacher training.
3. Lack of desire for change in an established science program.
4. Lack of educational theory by teachers for teaching science.

Administrative interference, lack of "right" kind of students, and lack of educational theory for the new programs were not found to be significant problems for the implementation of the new curricula into the schools. No significant differences were found for insufficient time in the school day and "conservatism" in elementary schools as implementation problems.

All three responses relating to factors which may be considered important for teaching the new sciences were found to be significant and, accordingly, the null hypotheses were rejected. The findings disclosed that the respondents considered the teaching of the new sciences necessary to stimulate the professional growth of elementary teachers, promote self-confidence in classroom teaching, and generally improve classroom performance.

Significant responses at the .05 level of confidence were recorded on questions relating to the new programs. Analyses of the chi square tests revealed that the following items were significantly shared by the respondents:

1. It is important for elementary classroom teachers to be able to describe techniques and competencies used by scientists in the course of the process approaches.
2. It is important for students in the methods classes to be able to describe techniques and competencies used by scientists in the course of the process approaches.
3. The new sciences do contribute to the general objectives of science education.
4. It is necessary for classroom teachers to equip themselves for process-oriented science teaching.

5. The basic assumptions underlying the new sciences are attained in the program.
6. The new sciences do provide children with learning activities closely aligned with science as a discipline.
7. The new sciences help children develop basic skills and operations that can be applied to the study of natural phenomena.
8. The new sciences meet the individual needs of students.
9. The new sciences provide for stimulation of children's intellectual development.
10. A background in science is necessary for elementary classroom teachers to teach the new sciences.
11. A background in learning theory is necessary for elementary classroom teachers to teach the new sciences.

Paired observations of respondents from each state by academic rank and question items were entered into two-by-two contingency tables to determine whether or not the variables were independent of each other or were associated. The application of chi square was used to study the association of the variables.

The only differentiation that existed occurred between associate professors from Ohio and the other states on the items which may discourage an instructor from teaching the new programs and those which may be problems in implementing them into the elementary schools.

Ohio respondents believed that the factor of cost and maintenance of the new materials is an element which discourages them from teaching about the new programs. The respondents from Kentucky, Pennsylvania, and West Virginia did not consider this a significant factor.

The associate professors from Ohio did not consider administrative interference as a problem in implementing the new sciences into the elementary schools.

It appears obvious that these two discrepancies between the frequencies are not great enough to be ascribed to anything more than sampling fluctuations. The findings provide fairly conclusive evidence that the respondents, regardless of academic rank, did not differentiate on their beliefs about the new science programs. Consequently, the hypotheses that differences do not exist between respondents in terms of academic rank and location of universities by state and opinions about the new programs were retained.

II. CONCLUDING STATEMENTS

1. Although AAAS, ESS, SCIS, and MINNEMAST were the most familiar new science programs to the respondents, these programs were not even mentioned in their classes by 22, 36, 42, and 61 per cent, respectively, of the instructors. Over 80 per cent of the respondents gave no attention to the following programs in their methods classes: ESP, ESSP (California), ISCS, ESSP (Utah), SSCP, and the Quantitative Approach.

2. Funds for new science programs appear less than ludicrous. Only seven respondents from 53 universities with enrollments less than 2,000 students had science budgets in excess of $300. Forty reported budgets of less than $150.

Budgets for larger institutions were somewhat more realistic. Respondents from 34 of the 40 institutions with over 5,000 students reported science appropriations in excess of $300. Only five respondents reported budgets at less than $150.

3. Expenditures for new science materials were fatuous. Thirty-three respondents from 53 universities where enrollment did not exceed 2,000 students expended less than 25 per cent of their budget on new science materials. This amounts to a yearly expenditure for new science programs of less

than $40. Only 14 reported new science expenditures in excess of 50 per cent of their budgets.

Nineteen respondents from the 40 largest universities reported new science expenditures at less than one-fourth of their budgets. Only 12 reported allocations of over one-half of their science funds for new science curricula.

4. Types of new science materials found in university classrooms varied considerably. Fifty-six per cent of the respondents specified that their classrooms contained kits from the new science programs. These, however, were found primarily in the larger universities. Seventy-eight per cent of the universities with over 5,000 students had new science materials, whereas only 32 per cent of the smaller institutions possessed them. AAAS, ESS, SCIS, and MINNE-MAST, respectively, were the most widely designated new science programs found in the methods classes.

5. Only 40 per cent of the respondents attended a workshop in the new science programs. Workshops were attended primarily in the AAAS, ESS, and SCIS programs. Although 60 per cent of the respondents did not attend a new sciences workshop, 81 per cent of them taught a new science curricula in their classrooms. Forty-eight per cent of the respondents conducted their own workshops, primarily in AAAS, ESS, and SCIS.

6. Instruction in the new sciences was designated by 50 per cent of the respondents as primarily introductory-descriptive. Thirty-two per cent reported instruction in the new sciences as preparation for teaching.

7. Lack of teacher training and educational theory for teaching science, coupled with the lack of desire for changing the established science programs and the cost of the new curricula were presented by the respondents as the major obstacles for implementing the new programs into the elementary schools (see Appendix D for a cost comparison).

III. RECOMMENDATIONS

On the basis of the analyzed data and the major findings presented in this study, the following recommendations are made to serve as guidelines for additional action and research in the area of new-science education:

1. Although the respondents reported commitment to the new programs, assessing the efficacy of the programs in the methods classes needs further study. Research is needed to determine the degree to which prospective teachers are actually being trained in each of the new programs.

It is recommended that those concerned with teacher education review and reform their curricula and courses to meet their commitment to the new programs. Otherwise, the problem of training teachers is postponed until they can be re-educated through in-service education, a costly practice which is ill-affordable.

2. Forty-four per cent of the respondents in this study indicated a lack of new science materials in their classrooms. Sizes of science budgets and appropriations for new science materials, as reported in this study, are insufficient to meet the increased demands being placed on pre-service teachers for practice in process-oriented science teaching. Mere verbal communication of the content, instructional strategies, and rationale of the new courses is insufficient. It is recommended that pre-service teachers experience the philosophy and methods of the new curricula in the same manner children will experience them in the classrooms.

3. More emphasis in instruction with several of the new programs is needed at the pre-service level. With the acceptance, implementation, and publicity given the process approaches, educators must endeavor to include attention to each of the most prevalent new science programs, namely AAAS, ESS, and SCIS. Although it is unfeasible to study all the new projects in the course of the methods class, it is suggested that curriculum designers and science educators also be cognizant of the variations which exist among the

programs so that practical application can be made as the need arises. The prospective teacher needs to be aware of the philosophy common to all the new sciences.

4. Although respondents in this study indicated that the new sciences meet the individual needs of students, further research should be conducted to ascertain how teacher-trainees can learn to use the programs, to individualize instruction, and to assess students' understandings with respect to the objectives and learning experiences underlying the new curricula.

5. Additional research is needed to determine the extent to which various new science courses are being implemented into the elementary schools. These findings can then serve as guidelines for determining those programs which might be incorporated for study at the pre-service level. The lack of implementation need not be a deterrent to consideration of the new programs in the methods classes but rather an incentive toward cooperative efforts with supervising members of school districts and cooperating teachers to investigate this condition. These cooperative efforts can come about only when all educators are familiar with a variety of choices among old and new science curricula.

6. Finally, although insufficient funds, inadequate facilities, and the lack of time are discernible handicaps facing colleges today, it should be recognized that those concerned with the improvement of education must accept these disadvantages as problems to be solved, rather than as reasons for not making progress. It is recommended that educators, cognizant of their role in teacher education, endeavor to originate and experiment with new ideas. A faculty with such imagination and initiative can certainly make a contribution to science education by revealing their solutions to these problems.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Carin, Arthur, and Robert B. Sund. Teaching Science through Discovery. Columbus, Ohio: Charles E. Merrill Publishers, 1964.

Ferguson, George A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, 1966.

Gega, Peter C. Science in Elementary Education. Second Edition. New York: John Wiley and Sons, Inc., 1970.

Goodlad, John I. School Curriculum Reform in the United States. Los Angeles: Fund for the Advancement of Education, 1964.

Hurd, Paul DeHart, and James J. Gallagher. New Directions in Elementary Science Teaching. Belmont, California: Wadsworth Publishing Company, 1968.

Lee, Eugene C. New Developments in Science Teaching. Belmont, California: Wadsworth Publishing Company, 1967.

Lockhard, J. David (ed.). Sixth Report of the International Clearinghouse on Science and Mathematics Curricular Developments. College Park, Maryland: University of Maryland, 1968.

Piltz, Albert, and Robert B. Sund. Creative Teaching of Science in the Elementary School. Boston: Allyn and Bacon, 1968.

Renner, John W., and William B. Ragan. Teaching Science in the Elementary School. New York: Harper and Row Publishers, Inc., 1968.

Richardson, John S., and others. The Education of Science Teachers. Columbus, Ohio: Charles E. Merrill Publishers, 1968.

Smith, Herbert A., Milo K. Blecha, and John Sterling. Science. River Forest, New Jersey: Laidlaw Brothers Publishers, 1966.

Thier, Herbert D. Teaching Elementary School Science. Lexington, Massachusetts: D.C. Heath and Company, 1970.

Van Dalen, Deobold B. Understanding Educational Research. New York: McGraw-Hill Book Company, 1962.

Victor, Edward, and M. S. Lerner. Readings in Science Education for the Elementary School. New York: The Macmillan Company, 1967.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

A Report Prepared by the Commission on Science Education. The Psychological Bases of Science--A Process Approach. American Association for the Advancement of Science Publication 65-8, 1965.

A Study of Undergraduate Programs for Science Teachers. Report of the U.S. Office of Education. Washington, D.C.: U.S. Department of Health, Education, and Welfare, October, 1968.

Barnard, J. Darrell (mod.). "New Trends in Science Education," Guidelines for Improving College Science Programs. A Report of a Conference on Science Education. Albert Eiss, editor. Harrisburg, Pennsylvania: Pennsylvania Academy of Science, April, 1964.

Commission on Science Education. News Letter. Vol. 5, No. 1. Washington, D.C.: American Association for the Advancement of Science, April, 1969.

Cooperative College-School Science Program: Projects to Improve Science and Mathematics in the Schools. Washington, D.C.: National Science Foundation, 1969.

Decker, Donald G. "Implications for College and University Programs." Rethinking Science Education. Fifty-ninth Yearbook of the National Society for the Study of Education, Part I. Chicago: University of Chicago Press, 1960. Pp. 313-28.

Eiss, Albert F. (dir.). Guidelines for Improving College Science Programs. A Report of a Conference on Science Education. Harrisburg, Pennsylvania: Department of Public Instruction, April, 1964.

Kurtz, E. B., and Henry W. Walhesser. "Construction of an Instrument for Measuring Behavioral Competencies of Teachers of Science--A Process Approach." Paper read at the National Council of Measurement in Education, New York, February 18, 1967.

Miller, Stanley N. (mod.). "Needs of Teacher Education in Science," Guidelines for Improving College Science Programs. A Report of a Conference on Science Education, Albert Eiss, editor. Harrisburg, Pennsylvania: Pennsylvania Academy of Science, April, 1964.

Newton, David E., and Fletcher G. Watson. The Research on Science Education Survey. Cambridge, Massachusetts: Harvard Graduate School of Education, 1969.

Renner, John W. The New Responsibility of Science Education. Randolph, Wisconsin: Educators Progress Service, August 18, 1967.

Report of the National Science Foundation to the Subcommittee on Science, Research, and Development. Science Education in the Schools of the United States. Washington, D.C.: 1965.

Report of the Project on the Preservice Science Education of Elementary Teachers. Preservice Science Education of Elementary School Teachers. Washington, D.C.: American Association for the Advancement of Science, February, 1969.

Report Prepared by the Educational Policies Commission. Education and the Spirit of Science. Washington, D.C.: 1966.

Report Prepared by the National Science Teachers Association. Theory into Action. Washington, D.C.: 1964.

Report to School Administrators on Regional Orientation Conferences in Science. The New School Science. Washington, D.C.: 1962.

C. PERIODICALS

Abelson, Philip H. "What Are Professors For?" Science, CXLVIII (June 18, 1965), p. 1545.

Burnett, Will R. "Circles, Pendulums, and Progress in Science Education," Journal of Research in Science Teaching, II (Issue No. 1, 1964), pp. 33-42.

Curtiss, William C. "Teacher Training for Process Oriented Science," Science Education, LI (December, 1967), pp. 494-98.

Eiss, Albert F. "Science Preparation for Elementary Teachers," Science and Children, II (May, 1965), pp. 17-18.

Fischler, Abraham S., and N. Anastasiow. "In-Service Education in Science: The School within a School," Journal of Research in Science Teaching, III (Issue No. 3, 1965), pp. 280-85.

Gega, Peter C. "The Pre-Service Education of Elementary Teachers in Science and the Teaching of Science," School Science and Mathematics, LXVIII (January, 1968), pp. 11-20.

Hiack, Paul S. "Laboratory Experiments in College Physical Science," Dissertation Abstracts, XXVIII (March, 1967), p. 2915.

Jacobson, Willard J. "Teacher Education and Elementary School Science--1980," Journal of Research in Science Teaching, V (Issue No. 1, 1968), pp. 73-80.

Karplus, Robert, and Herbert Thier. "Science Teaching is becoming Literate," Education Age, II (January-February, 1966), pp. 440-51.

Kriebs, Jean O. "The Effect of Videotaped Elementary School Science Classroom Demonstrations on Science Teaching Performance of Preservice Teachers," Dissertation Abstracts, XXVIII (September, 1967), pp. 988-89.

Matala, Dorothy C. "Current Activity in Elementary and Junior High School Science," School Science and Mathematics, LXI (May, 1961), pp. 339-67.

Menzel, Ervin Wesley. "A Study of Preservice Elementary Teacher Education in Two Processes of Science," Dissertation Abstracts, XXIX (October, 1968), p. 1152.

Partin, Melba S. "An Investigation of the Effectiveness of the AAAS Process Method upon the Achievement and Interest in Science for Selected Fourth Grade Students," Dissertation Abstracts, XXVIII (March, 1968), pp. 3569-70.

Ploutz, Paul F. "Trends in the Elementary Science Curriculum," Science and Children, XIII (February, 1966), pp. 39-41.

Renner, John W. "Lockstep Teaching," The Clearinghouse, XL (November, 1965), pp. 162-66.

Rising, Gerald R. "Recommendations for the Preparation of Elementary Teachers in Science," Science Education, XLIX (October, 1965), pp. 359-62.

"Science Teaching in Elementary and Junior High Schools," Science, CXXXIII (June 23, 1961), pp. 2019-24.

Scott, Lloyd. "Science is for the Senses," Science and Children, II (March, 1965), pp. 19-22.

Smith, Eugene H. "An Analysis of Some Prominent Viewpoints on Teaching Elementary School Science," Science Education, XLVII (March, 1963), pp. 188-93.

Sternlicht, Manny. "Undergraduate Educational Mythology," Science Education, XLIX (April, 1965), pp. 225-29.

Vannan, Donald A. "Food for Thought," Science and Children, VII (September, 1969), pp. 10-11.

Victor, Edward. "Why are our Elementary School Teachers Reluctant to Teach Science?" Science Education, XLVI (March, 1962), pp. 185-92.

Wilson, John Harold. "Differences between the Inquiry-Discovery and the Traditional Approaches to Teaching Science in Elementary Schools," Dissertation Abstracts, XXVIII (September, 1967), pp. 887-88.

Wolfe, Dael. "The Spirit of Science," Science, CLII (June, 24, 1966), p. 1697.

D. UNPUBLISHED MATERIALS

Hunter, Elizabeth. "The Effect of Training in the Use of New Science Programs upon the Classroom Verbal Behavior of First Grade Teachers as They Teach Science." New York: Hunter College, 1967. (Mimeographed.)

Lerner, Marjorie S. "An Investigation of the Status of the Methods Course in Elementary School Science in Selected Teacher-Training Institutions." Unpublished Doctoral dissertation, Northwestern University, Evanston, Illinois, 1964.

Oshima, Eugene A. "Changes in Attitudes toward Science and Confidence in Teaching Science of Prospective Elementary Teachers." Unpublished Doctoral dissertation, Oklahoma State University, Stillwater, Oklahoma, 1966.

Personal letter to the investigator from James Walker, Xerox Education Representative, June 25, 1969.

APPENDIX A

DISTRIBUTION OF SAMPLING

DISTRIBUTION OF SAMPLING

OHIO

	University	Location	Respondents
1.	University of Akron	Akron	1
2.	Antioch College	Yellow Springs	1
3.	Ashland College	Ashland	2
4.	Baldwin Wallace College	Berea	1
5.	Bluffton College	Bluffton	1
6.	Bowling Green State University	Bowling Green	2
7.	Central State University	Wilberforce	1
8.	University of Cincinnati	Cincinnati	2
9.	Cleveland State University	Cleveland	2
10.	Defiance College	Defiance	1
11.	Findlay College	Findlay	1
12.	Hiram College	Hiram	1
13.	Kent State University	Kent	2
14.	Lake Erie College	Painesville	1
15.	Heidelberg College	Tiffin	1
16.	Miami University	Oxford	1
17.	Muskingum College	New Concord	1
18.	Ohio Northern University	Ada	1
19.	Ohio State University	Columbus	3
20.	Ohio University	Athens	2
21.	Ohio Wesleyan University	Delaware	1

22. Otterbein College	Westerville	1
23. Edgecliff College	Cincinnati	2
24. Rio Grande College	Rio Grande	1
25. St. John College of Cleveland	Cleveland	2
26. Ohio Dominican	Columbus	1
27. University of Toledo	Toledo	2
28. Walsh College	Canton	1
29. Wilmington College	Wilmington	1
30. Wittenberg University	Springfield	1
31. Wright State University	Dayton	3
32. Youngstown State University	Youngstown	2
33. Kent State University Ashtabula Branch	Ashtabula	1
34. Kent State University Tuscarawas Branch	New Philadelphia	1
35. Ohio University Belmont County Branch	St. Clairsville	1

KENTUCKY

1. Bellarmine-Ursuline College	Louisville	1
2. Berea College	Berea	1
3. Brescia College	Owensboro	1
4. Cumberland College	Williamsburg	1
5. Eastern Kentucky University	Richmond	1
6. Kentucky State College	Frankfort	1
7. Morehead State University	Morehead	1

8.	Murray State University	Murray	2
9.	Nazareth College of Kentucky	Nazareth	1
10.	Pikeville College	Pikeville	1
11.	Union College	Barbourville	1
12.	University of Kentucky	Lexington	1
13.	University of Louisville	Louisville	1

PENNSYLVANIA

1.	Allegheny College	Meadville	1
2.	Alvernia College	Reading	1
3.	Bloomsburg State College	Bloomsburg	1
4.	California State College	California	1
5.	Chatham College	Pittsburgh	1
6.	Cheyney State College	Cheyney	1
7.	College Misericordia	Dallas	1
8.	East Stroudsburg State College	East Stroudsburg	1
9.	Edinboro State College	Edinboro	2
10.	Geneva College	Beaver Falls	1
11.	Gwynedd-Mercy College	Gwynedd Valley	2
12.	Immaculata College	Immaculata	1
13.	Indiana University of Pennsylvania	Indiana	3
14.	Lebanon Valley College	Annville	1
15.	Lock Haven State College	Lock Haven	3
16.	Lycoming College	Williamsport	3

17.	Marywood College	Scranton	2
18.	Millersville State College	Millersville	2
19.	Mount Mercy College	Pittsburgh	1
20.	Pennsylvania State University	University Park	2
21.	St. Francis College	Loretto	1
22.	Shippensburg State College	Shippensburg	2
23.	Slippery Rock State College	Slippery Rock	2
24.	Temple University	Philadelphia	3
25.	University of Pennsylvania	Philadelphia	2
26.	University of Pittsburgh	Pittsburgh	2
27.	University of Scranton	Scranton	2
28.	Waynesburg College	Waynesburg	1
29.	West Chester State College	West Chester	4
30.	Wilkes College	Wilkes-Barre	2
31.	Montgomery County Community College	Conshohocken	1
32.	Capitol Campus, Penn State University	Middletown	2
33.	Ogontz Campus, Penn State University	Abington	1

WEST VIRGINIA

1.	Alderson-Broaddus College	Phillippi	1
2.	Bethany College	Bethany	1
3.	Bluefield State College	Bluefield	1
4.	Concord College	Athens	1

5.	Davis and Elkins College	Elkins	1
6.	Fairmont State College	Fairmont	1
7.	Glenville State College	Glenville	1
8.	Marshall University	Huntington	2
9.	Morris Harvey College	Charleston	1
10.	Shepherd College	Shepherdstown	1
11.	West Virginia University	Morgantown	1
12.	West Virginia State College	Institute	1
13.	West Virginia Wesleyan College	Buckhannon	1

APPENDIX B

QUESTIONNAIRE

Questionnaire

GENERAL INSTRUCTIONS: Please answer all the questions in this form. For some questions there may be more than one appropriate response.

(Note: In the following questions, the phrase "new science" refers to the new experimental programs in elementary school science.)

1. Name of respondent: (Mr.) (Mrs.) (Miss)____________________________

2. Institution:______________________________________

3. Address:____

4. What is your present academic rank? Circle one or specify.

   a. instructor
   b. assistant professor
   c. associate professor
   d. full professor
   e. other
      Please specify:____________________

5. With what department of your institution are you affiliated? Circle one or specify.

   a. education
   b. science education
   c. science
   d. joint appointment with science and education
   e. other
      Please specify:____________________

6. What type of methods course do you teach? Circle one or specify.

   a. general methods for all elementary school teachers
   b. methods of teaching science in the elementary school
   c. science methods combined with another subject
      Please specify subject:____________________________
   d. other
      Please specify:__________________________________

7. How many students were enrolled in your methods classes last year? Circle one.

   a. 0-49
   b. 50-99
   c. 100-149
   d. 150-199
   e. over 200

8. What was the total enrollment in your college/university last year? Circle one.

   a. less than 500
   b. 500-2000
   c. 2000-5000
   d. 5000-10,000
   e. over 10,000

9. How much money was allotted by your department for science education expenditures last year? Circle one.

   a. under $50
   b. $50-$149
   c. $150-$299
   d. $300-$349
   e. over $350

10. How much of your science education funds was spent on ""new science" materials last year? Circle one.

   a. 0-10%
   b. 11-25%
   c. 26-50%
   d. 51-75%
   e. 76-100%

11. List, if any, the workshops you have attended in the "new sciences".

12. a. Have you held any in-service workshops in the "new sciences"? Circle one.

      a. Yes
      b. No

   b. If yes, please specify the program(s).

13. Do you teach about the "new sciences" in your methods classes? Circle one.

   a. Yes
   b. No

14. If you answered "yes" to number 13, please circle those that apply:

   a. AAAS
   b. COPES
   c. ESP
   d. ESS
   e. ESSP (California)
   f. ESSP (Illinois)
   g. ESSP (Utah)
   h. ISCS
   i. MINNEMAST
   j. SSCP
   k. SCIS
   l. Quantitative Approach to Elementary Science
   m. other
      Please specify: ______________

15. How would you describe the attention given to the "new sciences" in your methods classes? Circle one.

   a. introductory description
   b. analytical
   c. preparation for teaching
   d. none

16. a. Does your classroom contain any of the kits from the "new science" program? Circle one.

    a. Yes
    b. No

  b. If yes, please specify which one(s).

  c. How often are the kits replaced? Circle one.

    a. once a quarter/semester
    b. once a year
    c. every two years
    d. as often as needed
    e. other
       Please specify: ______________________________

17. Please circle the seven (7) programs with which you are most familiar.

  a. AAAS
  b. COPES
  c. ESP
  d. ESS
  e. ESSP (California)
  f. ESSP (Illinois)
  g. ESSP (Utah)
  h. ISCS
  i. MINNEMAST
  j. SSCP
  k. SCIS
  l. Quantitative Approach to Elementary Science

GENERAL INSTRUCTIONS FOR THE REMAINDER OF THE QUESTIONNAIRE: For each of the following questions, please check the response in the boxes provided which best characterizes your answer to the question.

18. To what extent have the following factors influenced your teaching the "new sciences" in your methods classes:

	Very Significant	Moderately Significant	Slightly Significant	Not at all Significant
a. your involvement as a consultant in in-service training.				
b. your involvement as a participant in a "new science" program				
c. your previous college or university training				
d. your reading about the programs				
e. your personal interest in developing the new programs				

19. How important are the following factors in discouraging you from teaching about the "new sciences":

	Very Significant	Moderately Significant	Slightly Significant	Not at all Significant
a. not committed to the value of the "new sciences"				
b. consider the introduction of the "new sciences" into the elementary schools too difficult				
c. too costly to buy and maintain the new materials				

20. How do you rate the following factors as problems in beginning the "new sciences" in the elementary schools?

a. cost of the new science programs.				
b. lack of classroom teacher training				
c. lack of desire for change in established science program				
d. insufficient time in the elementary school day				
e. impractical because of administration interference				
f. lack of "right" kind of students				
g. "conservatism" in elementary schools				
h. lack of educational theory for the new programs				
i. lack of educational theory by teachers for teaching science				

j. other
Please describe: ______________________________

21. How significant do you believe the following factors are for teaching about the "new sciences":

a. to stimulate the professional growth of elementary teachers				
b. to promote self-confidence in the classroom teaching of science				
c. to generally improve, though not assuring improved classroom performance				

d. other
Please describe: ______________________________

Question	Very Significant	Moderately Significant	Slightly Significant	Not at all Significant
22. To what extent do you believe it important for elementary classroom teachers to be able to describe techniques and competencies used by scientists in the course of the process approaches?				
23. To what extent do you believe it important for your students in the methods classes to be able to describe techniques and competencies used by scientists in the course of the process approaches?				
24. To what extent do you believe the "new sciences" contribute to the general objectives of science education?				
25. Do you believe it necessary for classroom teachers to equip themselves for process-oriented science teaching?				
26. To what extent do you believe the basic assumptions underlying the "new sciences" are attained in the programs?				
27. To what extent do you believe the "new sciences" provide children with learning activities closely aligned with science as a discipline?				
28. To what extent do you believe the "new sciences" have helped children develop basic skills and operations that can be applied to the study of natural phenomena?				
29. To what extent do you believe the "new sciences" meet individual needs of students?				
30. To what extent do you believe the "new sciences" provide for stimulation of children's intellectual development?				
31. To what extent do you believe a background in science is necessary for elementary classroom teachers to teach the "new sciences"?				

32. To what extent do you believe a background in learning theory is necessary for elementary classroom teachers to teach the "new sciences"?

Very Significant	Moderately Significant	Slightly Significant	Not at all Significan

Richard N. Avdul
P.O. Box 386
Athens, Ohio 45701

APPENDIX C

CORRESPONDENCE

P. O. Box 386
Athens, Ohio
July 19, 1969

Dear

This letter is being written as a request for your cooperation on a doctoral research study which I am currently conducting. Inasmuch as I realize how busy your schedule must be, I would indeed be thankful if you could provide me with the information requested on the enclosed questionnaire.

The problem under investigation in my study concerns analyzing opinions of methods instructors about the new elementary science programs and the extent to which prospective elementary teachers are being prepared in them. My advisor in the project is Dr. Lester C. Mills, Ohio University, Athens, Ohio.

You may be assured that all data gathered will be treated in accordance with the accepted professional practices.

Since I am very eager to complete the study, I would be most grateful for an early response. For your convenience, I am enclosing a self-addressed, self-stamped envelope. If you have any questions, please feel free to call me collect at (614) 592-1656.

Thank you very much for your time; your assistance is sincerely appreciated.

Respectfully yours,

Richard N. Avdul

RNA/edj
Enclosure

P.O. Box 386
Athens, Ohio
September 15, 1969

Dear

During the latter part of July, I wrote to you requesting your cooperation on a doctoral research study which I am conducting at Ohio University. Realizing that you may have been off campus during the summer, I am again respectfully soliciting your assistance.

If perhaps that first letter just found its way to your de k, you may have disregarded it because of the time lapse. Whatever the case may be, enclosed you will find, for your convenience, another questionnaire along with a self-stamped, self-addressed envelope.

Again, permit me to indicate that the problem under investigation in my study concerns analyzing attitudes of methods instructors about the new elementary science programs and the extent to which prospective elementary teachers are being prepared in them.

As some time has passed since my first correspondence, I would be most grateful if you could give this request your considerate attention at your earliest convenience.

Thank you again.

Respectfully yours,

Richard H. Avdul

RHA/mac

APPENDIX D

PRICE LIST ON SELECTED SCIENCE PROGRAMS

PRICE LIST ON SELECTED SCIENCE PROGRAMS

I. Elementary Science Study (ESS)
McGraw-Hill Book Company

Batteries and Bulbs, Class Kit.	$105.00
Bones, Class Skeleton Kit	110.00
Gases and Airs, Teacher's Kit	49.00
Growing Seeds, Class Kit.	16.50
Kitchen Physics, 6-student Kit.	26.50
Microgardening, Advanced Kit.	180.00
Small Things, 6-student Kit	28.50

II. Science Curriculum Improvement Study (SCIS)
Rand McNally and Company

Material Objects.	$199.80
Organisms	156.00
Interaction and Systems	186.00
Life Cycles, Preliminary Edition.	177.00
Position and Motion, Preliminary Edition.	150.00

II. Intermediate Science Curriculum Study (ISCS)
Silver Burdett Company

Grade 7 Master Set.	$750.00

IV. Science--A Process Approach (AAAS)
Xerox Corporation

Part A, Comprehensive Classroom Unit.	$123.00
Part B, Comprehensive Classroom Unit.	254.00
Part C, Comprehensive Classroom Unit.	294.00
Part D, Comprehensive Classroom Unit.	284.00
Part E, Comprehensive Classroom Unit.	430.00

IV. Minnesota Mathematics and Science Teaching Project (MINNEMAST)

Coordinated Units, Price per manual	$1.75 - 2.00