DOCUMENT RESUME

ED 195 401 SE 033 240

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TITLE	Status Study of Graduate Science Education in the United States, 1960-80. Final Report.
INSTITUTION	Iowa Univ., Iowa City. Science Education Center.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	15 Sep 80
CONTRACT	NSF-79-SP-0698
NOTE	176p.
EDRS PRICE	MF01/PC08 Plus Postage.
DESCRIPTORS	College Science; *Educational Trends; Graduate School Faculty; Graduate Students; *Graduate Study; Higher Education; *National Surveys; *School Surveys; *Science Education

ABSTRACT

This study presents results from a survey of all graduate institutions in the United States and then takes a closer look at 35 programs responsible for most of the research and production of doctoral graduates in science education. Identified are several trends, which are discussed and represented graphically, in the areas of: (1) growth of science education as a discipline; (2) change in the graduate programs within the past 20 years; (3) financial support for science education; (4) commitment to personal research productivity of graduate faculty; (5) individual characteristics of faculty members; (6) agreement as to definition for science education, a rationale or framework for the discipline, and a theory-base for research; (7) autonomy of science education programs at graduate institutions; (8) research interests in science education; (9) goals for the discipline; and (10) status of professional dialogue and cooperative research efforts. (Author/CS)

Status Study of Graduate Science Education in the United States, 1960-80

Final Report

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STATUS STUDY OF GRADUATE SCIENCE EDUCATION

IN THE UNITED STATES, 1960-80

Final Report

for

NSF Contract #79-SP-0698

September 15, 1980

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This material was prepared with the support of the National Science Foundation. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author and do not necessarily reflect on the views of the National Science Foundation.

STATUS STUDY OF GRADUATE SCIENCE EDUCATION

IN THE UNITED STATES, 1960-80

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ACKNOWLEDGEMENTS

Many persons were involved with this study. The suggestions and interest of Dr. Alphonse Buccino (Director of the Office of Program Integration) and Dr. Marjorie Gardner (Director of the Division of Science Education Resources Improvement) of the Science Education Directorate of the National Science Foundation, are gratefully acknowledged. Dr. Paul DeHart Hurd, Professor Emeritus of Stanford University, was especially helpful in providing structure, ideas, encouragement, assistance with all facets of the project. Without his involvement the results would surely have been less complete and less useful.

Other members of the Steering Committee involved with the week long writing effort that resulted in the paper, "Crisis in Science Education" (Technical Report #21, Science Education Center, University of Iowa) as a first attempt at fulfilling the contract obligation also contributed significantly to the format and the content of this report. Rodger Bybee (Carleton College), Jane Butler Kahle (Purdue University), James Joseph Gallagher (Michigan State University), David P. Butts (University of Georgia) and John W. Renner (University of Oklahoma) were generous with their time, talent, support, encouragement, and assistance.

Without the 132 Deans from graduate institutions who responded with data, the study could not have been completed. Also the thirty-five contacts from the largest institutions provided great quantities of information - often after long hours of searches (See Appendix F for listing of these persons). The 168 faculty members also provided assistance with their vitae and other information used in Part IV (See Appendix G for listing of all 168 faculty). The nine persons assisting with extensive information used in the Case Studies of Nine Graduate Science Education Programs (Technical Report #22, Science Education Center, University of Iowa) provided immeasurable assistance with completing the total task.

Three doctoral students at the University of Iowa also provided major amounts of time with the tabulations, the preparation of tables and graphs, and last minute contacts for information. Robert R. Telfer was instrumental in completing the analyses included in Parts II and III. Eric E. Zehr worked diligently with the faculty vitae information included in Part IV. James R. Dallas was responsible for the analyses of research reports included in Part V.

In addition to the Steering Committee mentioned above, my faculty colleagues at the University of Iowa provided assistance with proofing and editing the final draft of this report. Several members of the office staff, especially Joan Crowe, provided invaluable assistance with communications, maintaining records over a long period of time, and preparation of the various editions of the final report.

To all of these persons, and others not specifically identified, a thank you is inadequate. Without so many interested and helpful persons a study such as this would be impossible. All of these contributions are hereby acknowledged with sincere appreciation.

Robert E. Yager

EXECUTIVE SUMMARY

This study of the status of science education during the 1960-80 period includes a survey of all graduate institutions in the United States and a closer look at thirty-five programs responsible for most of the research and production of Doctoral graduates. The study identifies several trends for the discipline of science education. Some of these follow:

1) Science education as a discipline grew swiftly from 1960-70 (and slowly from 1970-75) in terms of institutions offering programs, faculty employed, and graduates at all levels. Since 1975 there has been a gradual decline in all categories.

2) Graduate programs have changed little over a twenty year period in spite of national guidelines adopted in 1966 and 1974 which suggested specific features; more advanced preparation in science represents half of the typical course requirements for graduate degrees.

3) Financial support for science education increased during the 1960-70 decade; the increase continued gradually until 1975; since then there have been declines. Major declines in support have occurred with respect to externally funded projects and internal funding for graduate students.

4) Graduate faculty in science education have little commitment to personal research productivity; most have a greater commitment to specific research involving graduate students and their thesis/dissertation research; relatively few faculty members have a prolonged and field specific line of research.

5) Faculty members of major centers for science education are fairly homogeneous as to sex, age, academic preparation, previous professional experience, teaching, and service responsibilities.

6) There is little agreement as to definition for science education, a rationale or framework for the discipline, and a theory-base for research.

7) Relatively few science education programs exist as formal departments and/or centers; most are special programs within a larger curriculum and instruction unit. In recent years there has been a trend to less autonomy for science education programs at graduate institutions.

8) Most research in science education has been concerned with entry conditions for the study of science; a more recent emphasis has been the study of instruction and the results of instruction.

9) There has been little attention to goals for the discipline; there have been few attempts at defining science education in any way other than the science that is taught in schools and the preparation of teachers for such efforts.

10) There is a high level of professional isolation in the discipline of science education. There are few examples of cooperative research and all too few mechanisms for promoting professional dialogue.

Recommendations for alleviating and correcting professional problems are proposed. These have been related to several professional exchanges, syntheses of surveys and position papers, and prospective syntheses and/or indicators for the future. The information available in the status study of science education at graduate institutions, 1960-80, is valuable only as a data base for future planning and action. Many have viewed 1980 as a time of crisis for the discipline of science education. It is important to remember that crisis means a turning point. The decade of the 80's can be a time for further deterioration of the discipline or a time of restoration and change.

STATUS STUDY OF GRADUATE SCIENCE EDUCATION IN THE UNITED STATES, 1960-80

I. Introduction

Late in the Summer of 1978, science educators participating in an international conference met to discuss some unique professional problems in the field of science education at graduate centers throughout the U.S. [1] Following this meeting, contact was made with a faculty member at each of the twenty-eight institutions identified by Butts in 1974 as a part of the Doctoral Guidelines follow-up study for the Association for the Education of Teachers in Science (Butts, 1977). These twenty-eight institutions were reported to be responsible for nearly all of the doctorates awarded in science education <u>per se</u>. A list of the twenty-eight institutions with the contact person indicated is included as Appendix A.

During the winter months, several specific contacts were made with the institutional contacts. One of these was a questionnaire distributed in advance of a telephone interview. Demographic information was collected that would enable a specific comparison of the programs, faculties, student enrollments, and other features of science education at these centers. The results of this study have been published by Butts and Yager (1980, 1981). The problems as perceived by the science education contacts and their faculty colleagues at the twenty-eight centers were also collected. Later the set of problems was shared with the entire group before individual suggestions for solving the major professional problems were also collected

[1] Planning group included Marjorie Gardner (Maryland), Fletcher Watson (Harvard), and Robert Yager (Iowa)

and shared with the group. These activities preceded a meeting of the institutional contacts in March of 1979 at the annual meeting of the National Association for Research in Science Teaching where Hurd made a presentation focusing upon discipline problems (Hurd, 1980). The original statement of problems and proposed solutions to them have been published as a Technical Report (Yager, 1979). These problem statements have been analyzed, reported, and compared to similar perceptions by other science educators (Gallagher and Yager, 1980a; Gallagher and Yager, 1980b; Gerlovich and Yager, 1980; Bybee and Yager, 1980). In a similar fashion, the proposed solutions have been analyzed (Renner and Yager, 1980; Bybee and Yager, 1980). From the open forum and other direct correspondence, Kahle and Yager (1980) synthesized the professional indicators for the discipline of science education for the 1980's. Summaries of manuscripts arising from these activities are included as Appendix B since they formed the setting for this study.

The National Science Foundation awarded a small contract (79-SP-0698) in the spring of 1979 for the preparation of a report that would consider the current status of science education at graduate institutions. This study was viewed as an extension of the three status studies for K-12 science (Helgeson, et al, 1978; Stake and Easley, 1978; Weiss, 1978) and as a logical next step following the series of activities and reports outlined above. Some of the funds permitted a summer writing group to assemble on the University of Iowa campus. A paper entitled "Crisis in Science Education" resulted from this effort; it has been published as Technical Report 21 in the University of Iowa Science Education Technical Report Series (Yager, 1980).

Early in the fall of 1979 it became apparent that much more information was needed from graduate institutions, from major science education centers, and from individual faculty members at such centers if a national status study were to be completed. The information that had been collected during the preceding year was simply too sketchy, incomplete, and inconsistent. New data sources were sought and new contacts were made in an effort to provide a comprehensive assessment of the current status of science education in graduate centers in the United States.

II. Survey of 365 Graduate Institutions in the United States

Early in November of 1979, all 365 institutions included in the Council of Graduate Schools Directory (1979) were contacted with a brief letter and a questionnaire designed to determine the existence of graduate programs in science education, number of graduates, names and brief qualifications of faculty, location of the program within the institution, institutional policies, and the research interests of the science education faculty. Follow-up letters, one of which included a second copy of the questionnaire, were forwarded to all non-respondents in December and again in January. Several telephone contacts were made and personal letters were written to contacts at colleges with known graduate programs (members of the National Association for Research in Science Teaching) during February urging them to help with a response to the questionnaire. A final written appeal was sent to all non-respondents early in March 1980. A copy of the questionnaire is included as Appendix D.

After five months response was received from 328 of the 365 institutions for a 90% response rate. Appendix C lists the 365 institutions in the study with an "o" indicating non-respondents, an asterisk (*) indicating no graduate program of any kind in Science Education, a double asterisk (**) indicating the existence of a Master's degree only, and a triple asterisk (***) indicating the existence of a Doctoral program.

Of the 328 deans responding (or their designated representative) only 132 reported the existence of any graduate program in science education *per se*. Hence, only 40% of the graduate institutions responding to the questionnaire indicated the existence of a graduate program that could be used for further study and analysis. The information from the 132 institutions providing data concerning their respective graduate programs in science education is presented in six sets of tables and graphs, 1.1 through 1.6.

Table 1.1 and Graph 1.1 provide information concerning graduates in science education at the 132 institutions. It is interesting to compare these figures with national enrollment trends in U.S. colleges. The twenty year trends reported in the Digest of Educational Statistics 1979 and projected from the report "The 1980's Higher Education's 'Not-Me' Decade" in The Chronicle of Higher Education (January 7, 1980) are:

Year	Graduate Enrollment	Undergraduate Enrollment
1960	356,000	3,227,000
1970	1,031,000	6,889,000
1976	1,085,000	9,927,000
1980	1,145,000	10,467,000

The number of Bachelor's degree recipients in science education at the 132 institutions has decreased by nearly one quarter during the 1969-79 decade while the national number of all students in all institutions is increasing significantly. The Master's degree recipients in science education over the ten year period coincide with the national enrollment trends which show a tremendous increase in graduate enrollment during 1960-70 and a leveling between 1970-80. The Doctoral recipients in science education provide contrast. While national figures show only a slight increase in graduate enrollment, the number of Doctorates awarded in science education for the 1969 to 1979 decade increased by 40%.

Table 1.2 and Graph 1.2 provide data about changes in the number of Bachelor's, Master's, and Doctoral programs in science education during the decade, 1969-79. There is an increase in terms of institutions in the sample offering each degree. The rate of increase is all but negligible between 1974-79. With the programs phased out or made inactive at two leading centers (Harvard and Stanford) the 67 institutions reported with the doctorate in 1979 do not include these two institutions which are included throughout the status study because of their impact and importance for most the the twenty year period, 1960-80.

Table 1.3 and Graph 1.3 provide information as to the primary administrative attachment of graduate science education programs at the 132 institutions. Nearly half of the programs can be characterized as being a unit in a larger Curriculum and Instruction department and/or a specific program area designation. Relatively few programs are designated as a formal department and/or a science education center.

Table 1.4 and Graph 1.4 provide information about changes in course requirements, number of faculty, and graduate enrollments at the 132 institutions. The number of specific courses in the science education programs has tended to increase while the number of faculty members has remained fairly stable. As programs have changed and faculty size has stabilized, graduate student enrollments have decreased.

Table 1.5 and Graph 1.5 provide information about administrative perceptions of the responsibilities of the science education faculties. The primary responsibility reported was pre-service teacher education; this responsibility was listed by the administrators responding as requiring nearly one-third of the time of the faculty. Teaching graduate science education courses, teaching science courses, and conducting research (both funded and that considered part of load) each composed about one-sixth of the responsibility of the faculty members at the 132 institutions.

Table 1.6 and Graph 1.6 provide data concerning the major interests of the science education faculty as reported by graduate administrators. By far, the greatest interest of the faculty is reported to be in the area of teacher education. (Teacher education is the primary interest of 93 faculty members.) The next most popular faculty interests include graduate teaching and service activities. Research areas of greatest interest include: "general studies", cognitive development, curriculum, attitudinal studies, methodology, and general evaluation. With such general research interests as expressed here, it is obvious that most faculty fit in generalist roles and do not focus on issues that are unique to science education as a discipline. Both the nature of research interests and the percent total time devoted to research activities represent cause for concern when the number of institutions and total faculty is so small.

The fact that administrators perceive research as a major activity for faculty members in graduate institutions in fewer than one in five situations is alarming (Table 1.5). This lack of emphasis on research in the discipline of science education is further validated by the faculty members themselves (Table 1.6) who list teacher education, graduate education, and service activities as major "interests" over research. Although writing and professional communication is viewed as desirable, it is apparent that teaching (especially undergraduate teacher education) is viewed as more central to the duties of science educators; particularly those employed at graduate institutions.

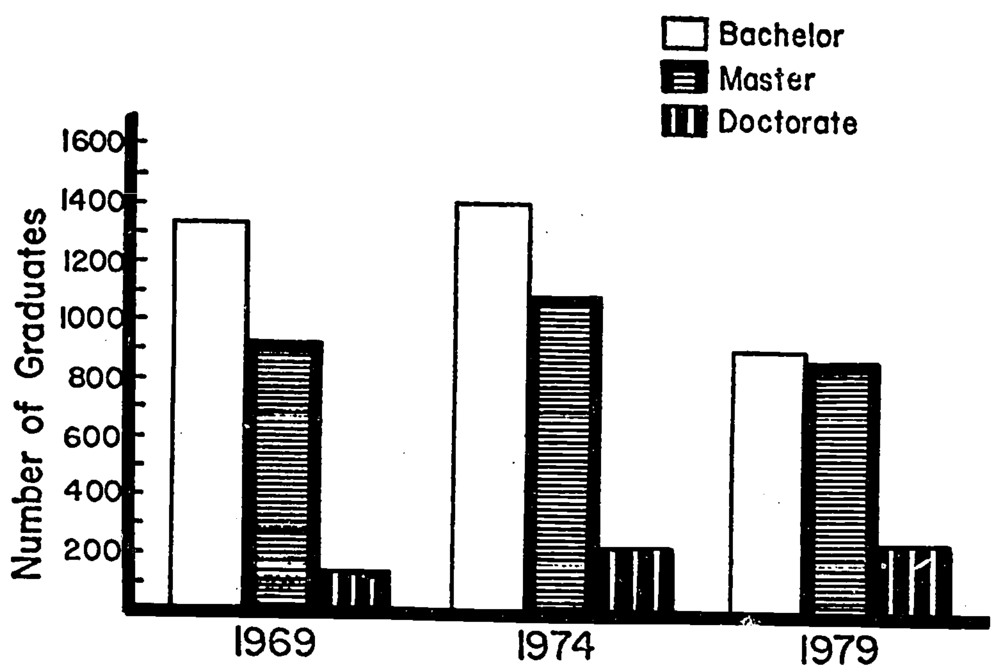
The 132 Graduate Institutions with Graduate Science Education

NUMBER OF SCIENCE EDUCATION GRADUATES, 1969-79

Table 1.1

Degree	1969	1974	1979
Bachelor's	1340	1406	970
Master's	926	1047	885
Doctoral	171	220	244

Graph 1.1

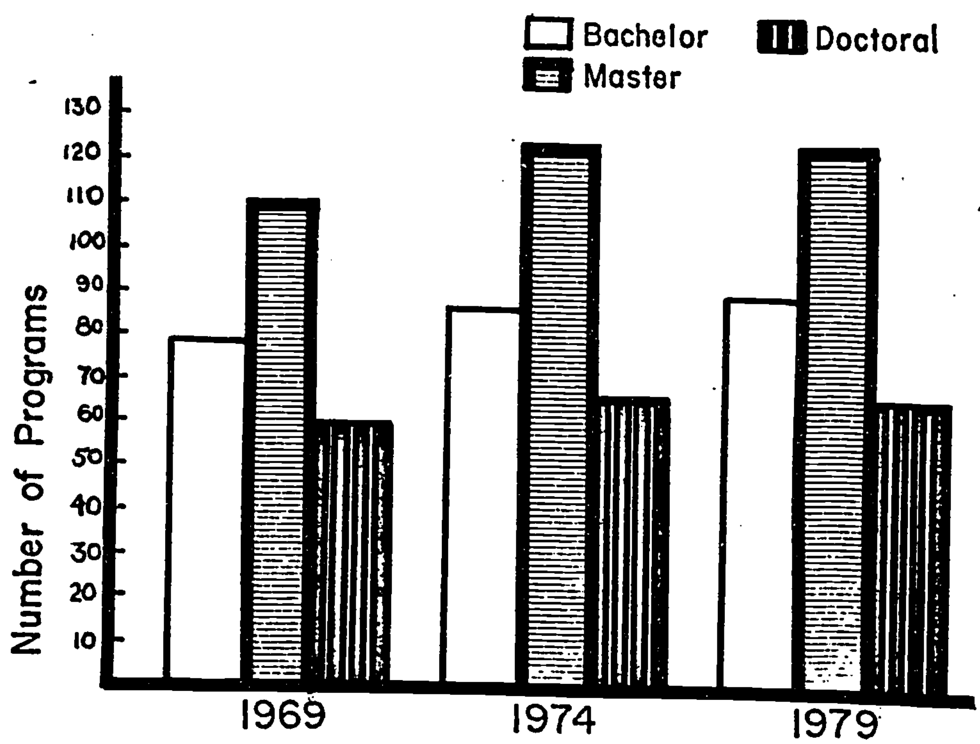


NUMBER OF UNIVERSITIES WITH SCIENCE EDUCATION PROGRAMS, 1969-79

Table 1.2

Degree	1969	1974	1979
Bachelor's	79	86	90
Master's	111	125	126
Doctoral	59	66	67

Graph 1.2

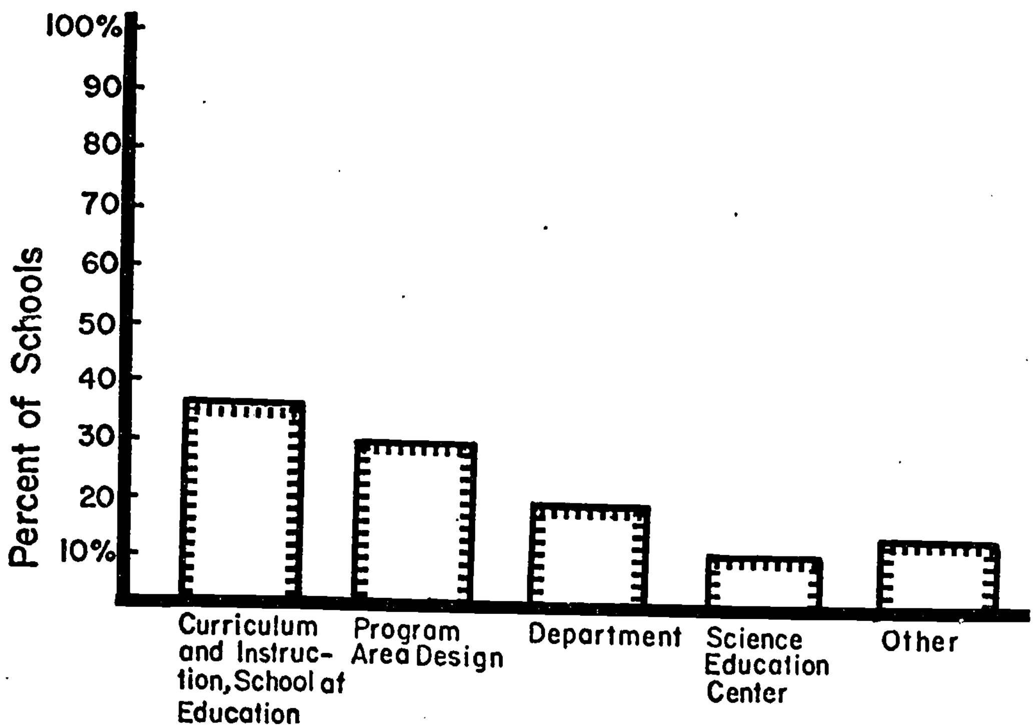


ADMINISTRATIVE LOCATION OF SCIENCE EDUCATION IN UNIVERSITY PROGRAM

Table 1.3

Unit in Curriculum and Instruction	36%
Science Education Center	8%
Formal Department in School of Education	15%
Specific Program Area Designation	30%
Other (unspecified)	11%

Graph 1.3



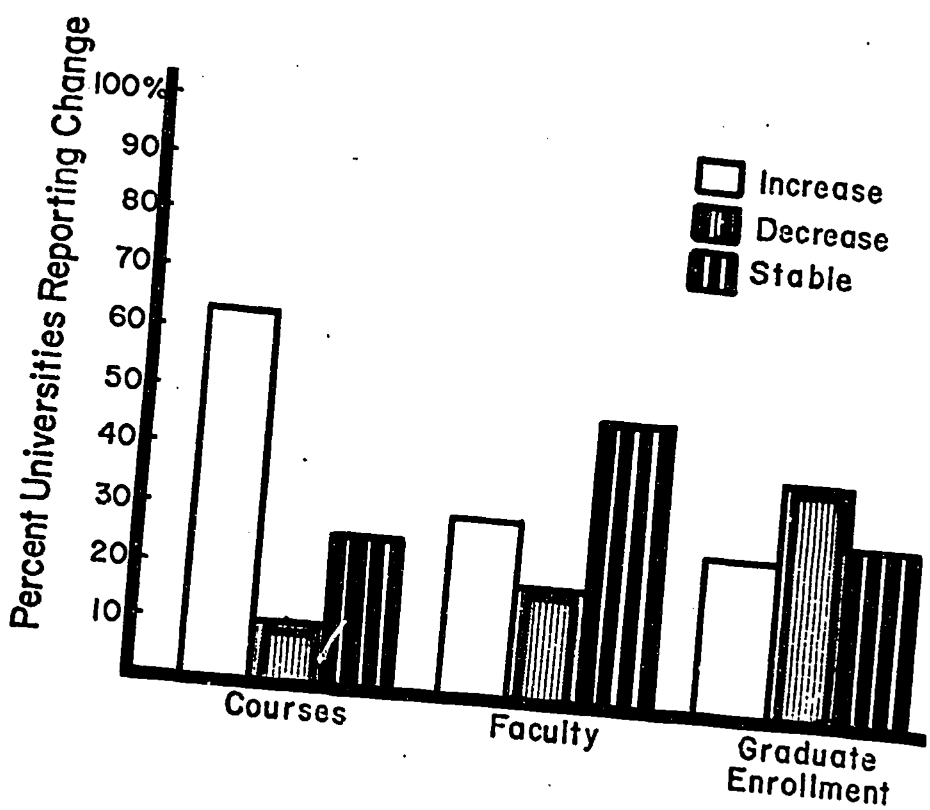
CHANGES IN UNIVERSITY SCIENCE EDUCATION, 1969-79

Table 1.4

Feature	Increase	Decrease	Stable
Courses	64%	10%	26%
Faculty	31%	20%	49%
Graduate Enrollments	27%	42%	31%

(85% changed programs between 1969-1974 to match new curriculum developments)

Graph 1.4

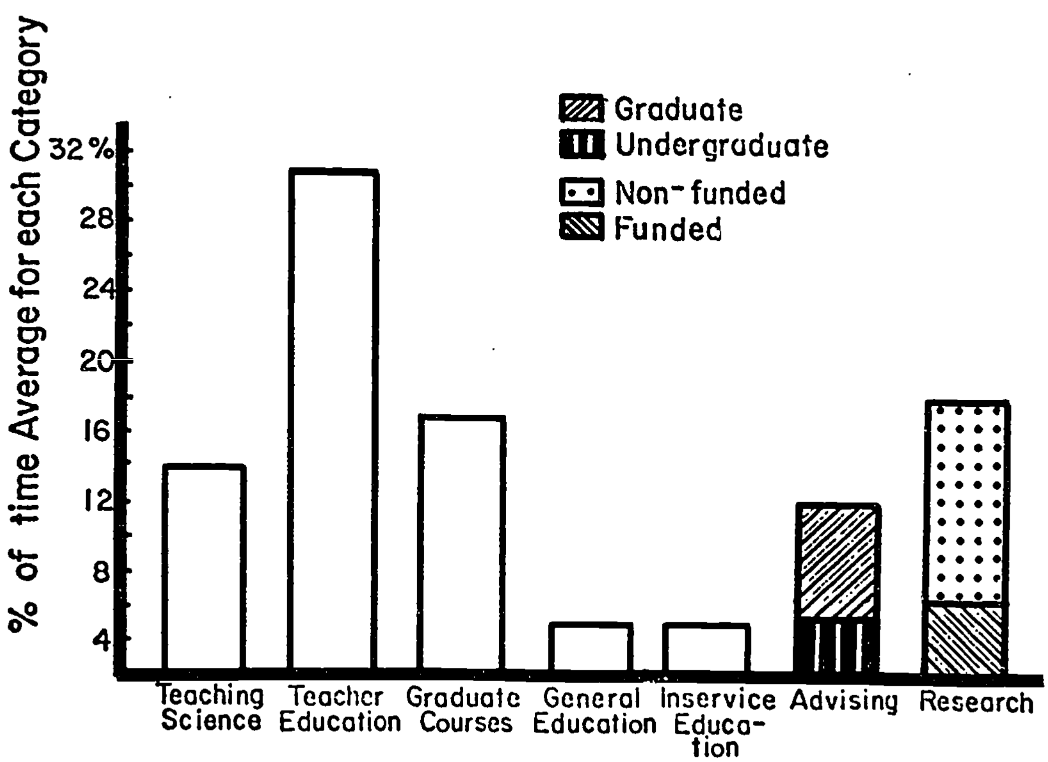


RESPONSIBILITIES OF GRADUATE SCIENCE EDUCATION FACULTY

Table 1.5

Faculty Responsibilities	Time Spent
Teaching Science	14%
Teacher Education	31%
Graduate Science Education	17%
General Education	5%
Advising-Undergraduate	7%
Research-Funded	6%
Research-Non-funded	12%
Other (Service Activities)	8%

Graph 1.5

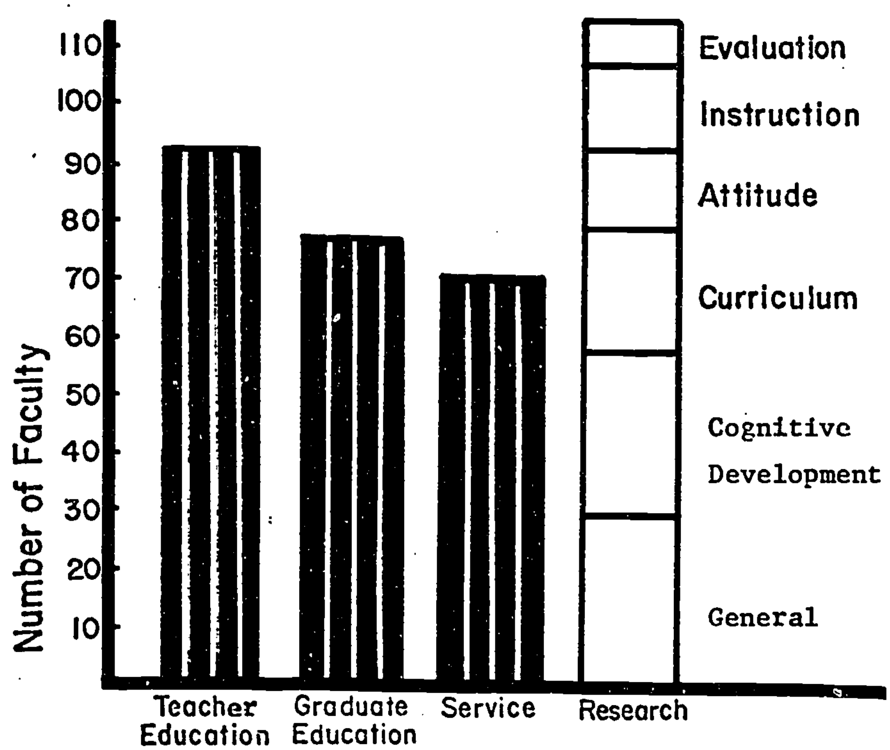


MAJOR INTERESTS OF GRADUATE FACULTY IN SCIENCE EDUCATION

Table 1.6

Interest		Number of Faculty Members
Teacher Education		93
Graduate Education		77
Service		70
Research:		
	General(non-specified)	29
	Cognitive Development	28
	Curriculum	22
	Attitude	14
	Instruction	14
	Evaluation	8

Graph 1.6



III. Report from Contacts at 35 Largest Graduate Programs of Science Education

As a result of the survey of all 365 graduate institutions, the 1974 Butts study (Butts, 1977), and the efforts described in the introduction section of this report, thirty-five institutions were selected as the largest and most productive science education centers, especially in terms of research and production of doctoral graduates. Harvard and Stanford were included in the assessment (though active programs were not in existence at either institution at the beginning of 1980) because of the productivity and size of the programs during the twenty year period, 1960-80. For this phase of the study, five key years were selected for analysis: 1960, 1965, 1970, 1975, and 1980. In each instance, figures were examined for the preceding and the following year to assure that figures for a given year were not anomalies. A copy of the questionnaire used with this facet of the study is included as Appendix E.

Four mailings requesting response to the questionnaire resulted in a ninety percent response by March 1980. The remaining institutions were contacted by telephone; ultimately, information was attained from all 35 institutions. In several instances, additional telephone contacts were made to secure information omitted from the questionnaires. Appendix F lists the institutions and primary institutional contacts involved. In some instances, additional faculty members were involved with locating specific parts of the information. The information for this facet of the study is reported in Tables 2.1 through 2.12 and in corresponding graphs.

Tables 2.1, 2.2, and 2.3 and Graphs 2.1, 2.2, and 2.3 indicate the trends during 1960-80 with respect to degree programs and numbers of graduates at the Bachelor's, Master's, and Doctoral levels at the thirty-five institutions. It is at once apparent that the number of programs increased dramatically at the institutions during the 1960-70 decade. The number of institutions with Bachelor's programs in science education doubled; the number with Master's and Doctoral programs tripled. Essentially, no growth was reported for the 1970-80 decade. Although thirty-five institutions were studied, the suspension of programs at Harvard and Stanford result in only thirty-three with graduate programs at the end of the twenty year period, 1980.

The number of graduates peaked at the Master's and Doctoral levels in 1975 while 1970 was the year for the largest number of graduates at the Bachelor's level.

It is interesting to compare the enrollment figures reported for the thirty-five centers with the total figures reported in the preceding section (Table 1.1 compared with Tables 2.1, 2.2, and 2.3). Two-thirds of the Bachelor's degree recipients in science education came from the thirty-five largest science education centers. However, only about one-half of the Master's graduates matriculated from the thirty-five centers. An interesting trend occurs with the doctoral program. During 1970-75 almost all of the doctoral graduates came from the major universities. (This is similar to the 1974 Butts' report cited earlier). However, the number of doctoral graduates declined between 1975-80, similar to the national declines. The total number of doctorates increased slightly -- almost totally the reflection of more doctorates produced at institutions other than the thirty-five. It is interesting to speculate as to the causes for the production of more doctorates in science education at more institutions at this particular point in time -- a time when there is less need for personnel with the Doctorate.

Tables 2.4 and 2.5 as well as Graph 2.4 and 2.5 provide information concerning the nature of Master's and Doctoral programs at the thirty-five centers. Approximately one-half of the requirements for Master's Degrees consist of more advanced courses in science. This amount has been rather steady through the twenty year period with a slight increase in the total required. The same proportion of science and the same slight increase in the total number of hours required can be observed for the Doctoral programs at the same institutions. The science education course requirements represent about one-fourth of the total program at both the Master's and Doctoral levels. Again, the general trend has been for a slight increase in the total number of hours required over the twenty year period. The other discernible features of the graduate programs at both levels are represented by the history/philosophy/sociology of science category and the general area of curriculum and instruction. Both of these areas can be combined to account for another one-fourth of the total course requirements for the graduate degree programs. Research credit was variously reported to be five to fifteen semester hours of credit at the Doctoral level. In all cases the degree requirements have remained rather constant, with a slight trend toward increased requirements in all categories. Although the newest professional guidelines call for more flexibility and more concern for specific competencies, the formal programs at the major centers have tended to become more structured with an increased number of course requirements.

Table 2.6 and Graph 2.6 provide information regarding the number of science education personnel employed at the thirty-five centers. It is apparent that the number of faculty and assistants increased dramatically during 1960-75. However, the number of faculty members and the number of assistants employed have decreased significantly during the 1975-80 period. The declines in number of personnel parallel similar declines in enrollments in science education at the Bachelor's, Master's, and Doctoral levels.

Tables 2.7, 2.8, and 2.9 as well as Graphs 2.7, 2.8, and 2.9 provide information concerning external funding for enrichment programs for secondary school students, in-service teacher education, and research/ curriculum development in science education at the thirty-five centers. It is apparent that external support for gifted students and for teacher in-service activities peaked in 1970. Currently the total dollar amount is low for the student activities with the average grant size at an all time low for the twenty-year period. A review of teacher in-service programs (Table 2.8) illustrates the drastic drop in support between 1975-80 and the tremendous decrease between the 1960-80 figures. These changes probably reflect changes in the public support for such activities nationally.

Although the figures for research and development indicate some decline during the 1975-80 period, the number of grants has increased and the average size of grant has shown less change during these two decades. It is also interesting to note that the funds for research and development have surpassed the other kinds of external support for the science education centers since 1975.

Table 2.10 and Graph 2.10 illustrate trends at the thirty-five centers with respect to institutional support for science education. It is apparent that levels of internal support have increased over the twenty year period -- except for support for graduate assistants. The salary and general budget increases have been sufficient to mask the decline in total number of faculty during the past few years. Although salaries (faculty and support staff) have increased, the rate has been slower at the end of the twenty year period. The severe cut in funds available for graduate students in science education is striking. The relatively slight increases for equipment and supplies at a time of significant increase in cost because of inflation is another indication of an alarming trend.

Table 2.11 and Graph 2.11 provide information concerning facilities available for science education at the thirty-five centers. The facilities have remained very stable during the two decades with very slight increases in terms of classrooms, laboratories, and offices. Although there have been situations, as revealed by telephone interviews, where decreases in facilities available for science education have been threatened, no such actual decrease in facilities were reported by the respondents from the thirty-five major centers.

Table 2.12 and Graph 2.12 provide information regarding enrollment trends for the doctoral graduates at the thirty-five centers during the 1960-80 period. The number of doctoral students employed as science educators at colleges and universities increased dramatically between 1960 and 1970. The number has decreased dramatically since 1970. The number of graduates who are employed as college science teachers (community colleges, four year colleges, and universities) increased from 1960 through 1970, with greatest increases occurring between 1965 and 1970. Doctoral graduates returning to work in K-12 schools as teachers, supervisors, curriculum directors, or general administrators was rare in 1960, common in 1970, and a major type of employment for graduates in 1975. Current figures suggest that this employment pattern has diminished in importance between 1975 and 1980, probably because of enrollment declines and financial crises in K-12 schools.

The number of doctoral graduates finding employment in industry, health fields, governmental units, public centers (i.e., museums, field stations, nature centers, etc.) is increasing; such employment is now a common occurrence. The 1980 figures do show a slight decline in such fields, however. At the same time employment in these areas did not occur twenty years ago -- at least none was reported by the respondents.

Another factor related to doctoral enrollments and doctoral employment is the large number of non - U.S. citizens enrolled at the major centers. Although this was not a specific question, telephone contacts during this time period revealed that foreign students represent over half of the total doctoral enrollments at some well established centers. With such changes in enrollment, the employment picture is somewhat clouded. Most of the international students return to their homelands as college instructors - both in science and science education. Others are employed in leadership positions in government. It is not known to what degree this change in enrollment and graduation has affected the general employment patterns reflected in Table 2.12.

Although information was sought, there was no significant information collected concerning enrollment, graduates, or employees in science education at the thirty-five centers related to special populations (i.e., women, minorities, and handicapped). There is some evidence that special programs and special activities are being developed at some centers for such special groups. It is known as well that women and minorities are not represented in sufficient numbers in these programs generally. The problem reflects a similar situation in the disciplines of science, probably because people in science education come from the ranks of science majors. The special programs being developed at several institutions are needed as the profession seeks to alleviate this severe national and human concern.

Another aspect of this study of the thirty-five centers was a self-reporting case study. All thirty-five institutions were asked to provide information in specific areas if they were interested in sharing such "in-house" information for a case study of a graduate science education center. The data requested and the organization proposed included the following:

1) General Description of Administrative Characterization of Program
2) Current Staff: Names; Degrees; Professional Experiences; Research Interests
3) Students Enrolled -- Undergraduate and for Each Graduate Program
4) Ph.D.'s (or Ed.D.'s) Awarded since 1974: Name, Date; Topic of Dissertation and Abstract; Current Employment
5) Physical Facilities for Program

6) Support Staff for Program

7) Outline for Each Graduate Degree Offered

8) Graduate Student Support

9) Special Program Features

10) Special Funded Projects Active since 1974

11) Description of Changes at Center During 5 Year Period (1974-79)

12) General and/or Research Interests Characterizing Program

After two notes of invitation, information for "Case Studies of Nine Graduate Science Education Programs" was received from: Purdue University, Georgia State University, University of Georgia, University of Kansas, University of Wisconsin, Teachers College Columbia University, Syracuse University, Temple University, and the University of Iowa. Professors Jane Butler Kahle, Ashley G. Morgan, David P. Butts, William S. LaShier, Fred Finley, Willard J. Jacobson, Ann C. Howe, Donald W. Humphreys, and Robert E. Yager were the institutional representatives, respectively, who assembled the information from their institutions for the case studies. The nine case studies have been published as Technical Report 22 of the University of Iowa Series (Yager, 1980b).

TABLES AND GRAPHS

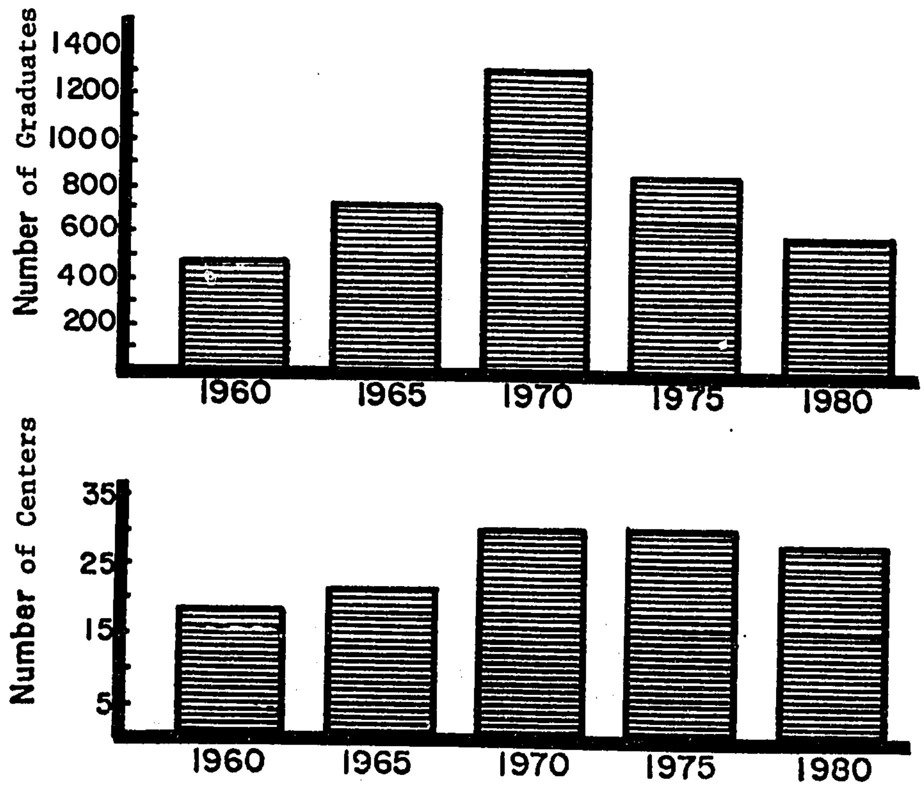
Science Education at the Thirty-Five Centers with the Largest Programs

NUMBER OF CENTERS WITH BACHELOR'S PROGRAMS AND ENROLLMENT TRENDS, 1960-80

Table 2.1

Number of	1960	1965	1970	1975	1980
Graduates	460	715	1318	840	605
Centers	16	21	30	30	29

Graph 2.1

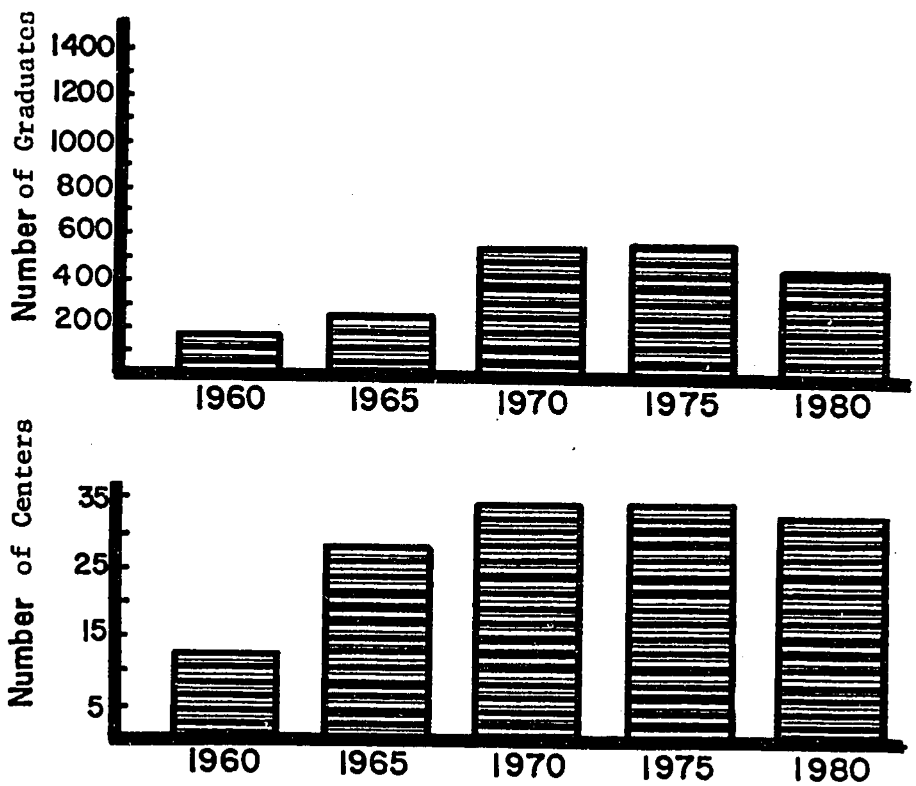


NUMBER OF CENTERS WITH MASTER'S PROGRAMS AND ENROLLMENT TRENDS, 1960-80

Table 2.2

Number of	1960	1965	1970	1975	1980
Graduates	171	240	556	560	486
Centers	12	21	34	34	33

Graph 2.2

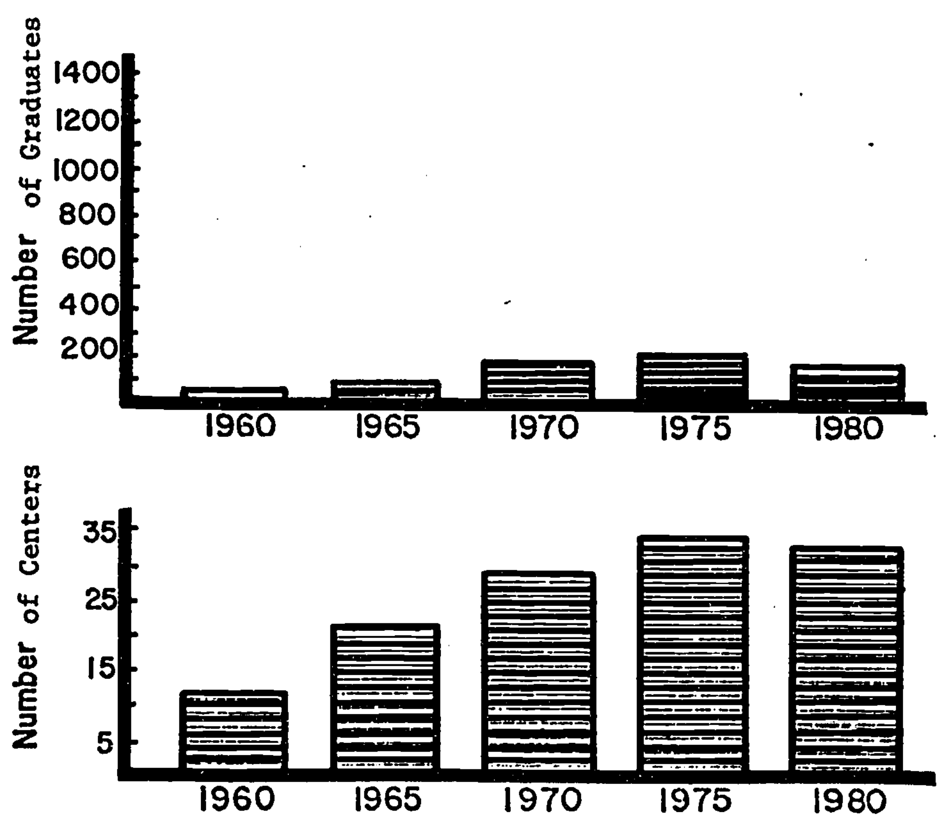


NUMBER OF CENTERS WITH DOCTORAL PROGRAMS AND ENROLLMENT TRENDS, 1960-80

Table 2.3

Number of	1960	1965	1970	1975	1980
Graduates	34	75	179	204	162
Centers	11	21	31	34	33

Graph 2.3

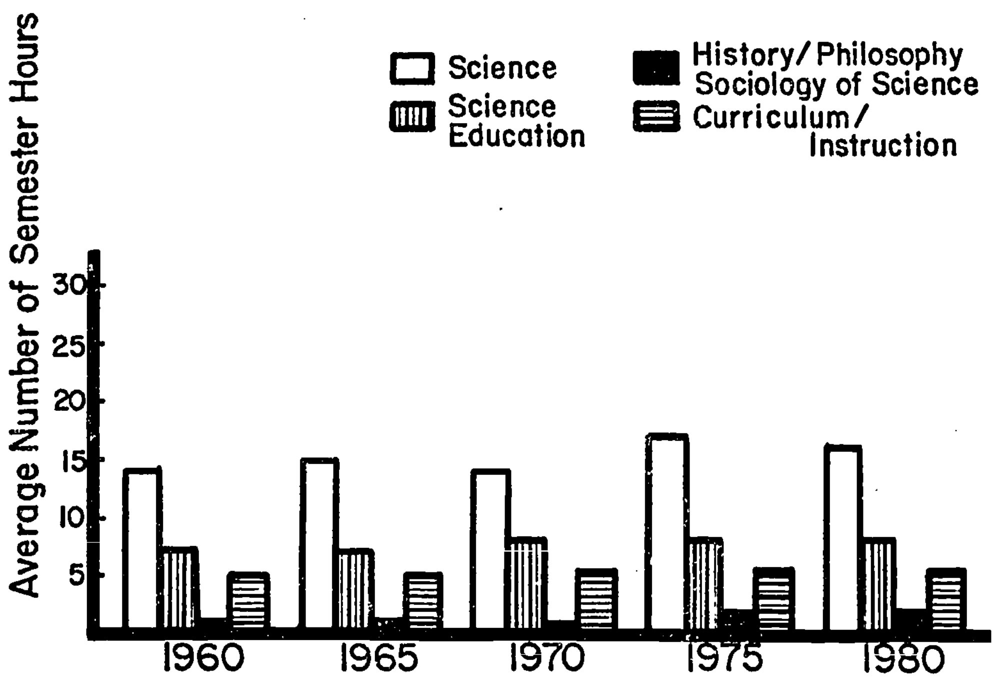


COMPONENTS OF THE AVERAGE MASTERS PROGRAM (SEMESTER HOURS)

Table 2.4

Discipline	1960	1965	1970	1975	1980
Science	14.5	14.9	14.2	16.9	16.3
Science Education	6.8	7.5	7.5	7.3	7.3
History/ Philosophy/ Sociology	1	1	1	2	2
Curriculum/ Instruction	5	5	5.4	5.4	5.4

Graph 2.4

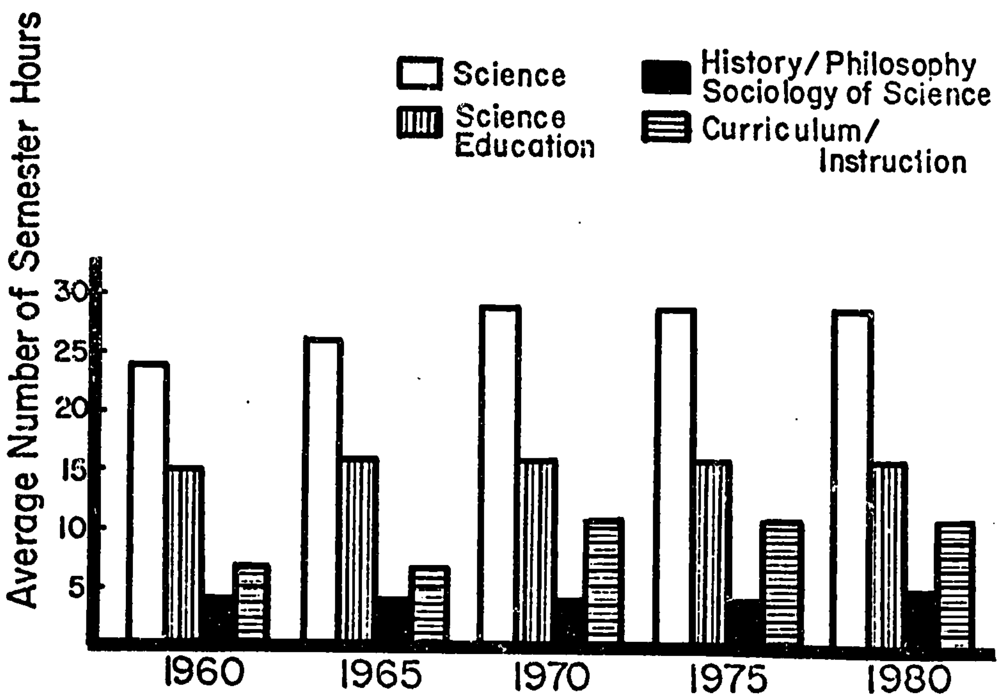


COMPONENTS OF THE AVERAGE DOCTORAL PROGRAM (SEMESTER HOURS)

Table 2.5

Discipline	1960	1965	1970	1975	1980
Science	24	26	29	29	29
Science Education	15	16	16	16	16
History/ Philosophy/ Sociology	4	4	4	4	4.5
Curriculum/ Instruction	7	7	11	11	11

Graph 2.5

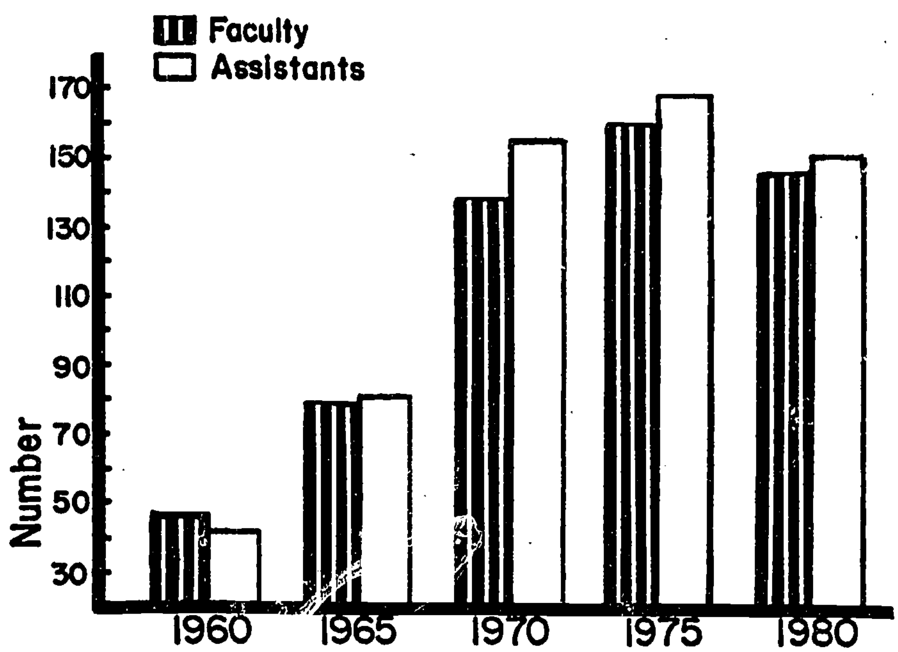


NUMBER OF PERSONNEL IN GRADUATE SCIENCE EDUCATION CENTERS

Table 2.6

Personnel	1960	1965	1970	1975	1980
Faculty	47	80	139	160	146
Assistants	43	82	155	169	150

Graph 2.6

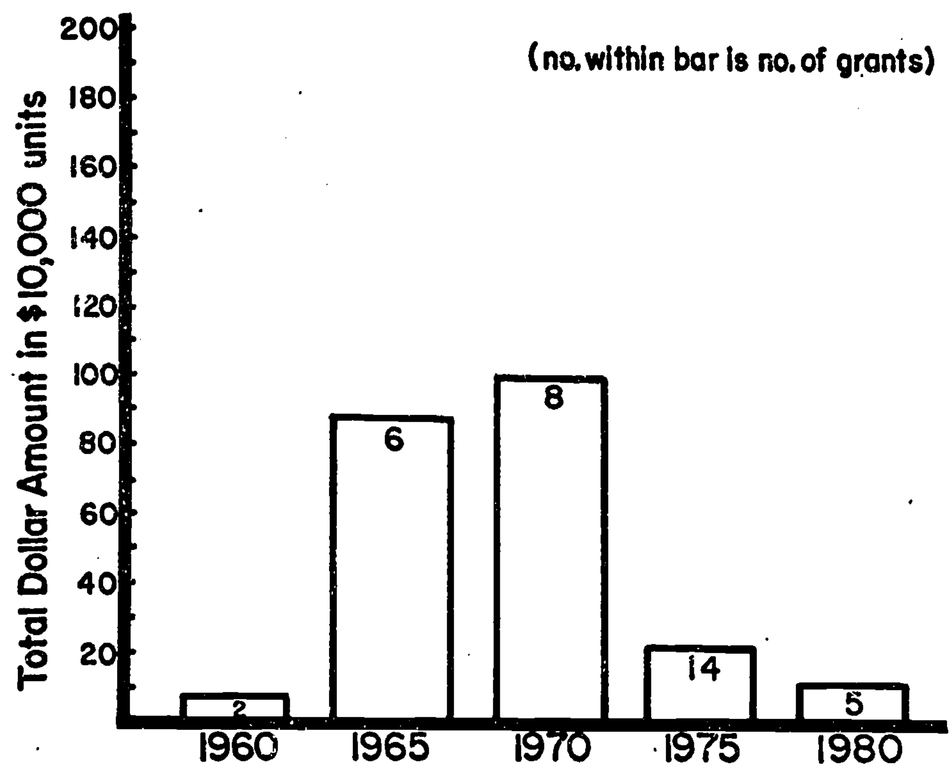


EXTERNAL FUNDING FOR SCIENCE ENRICHMENT FOR SECONDARY SCHOOL STUDENTS

Table 2.7

	1960	1965	1970	1975	1980
Number of Grants	2	6	8	14	5
Total Amounts	$65,000	$880,000	$997,000	$245,000	$102,000
Ave./Grant	$32,500	$146,667	$124,625	$ 17,500	$ 20,400

Graph 2.7

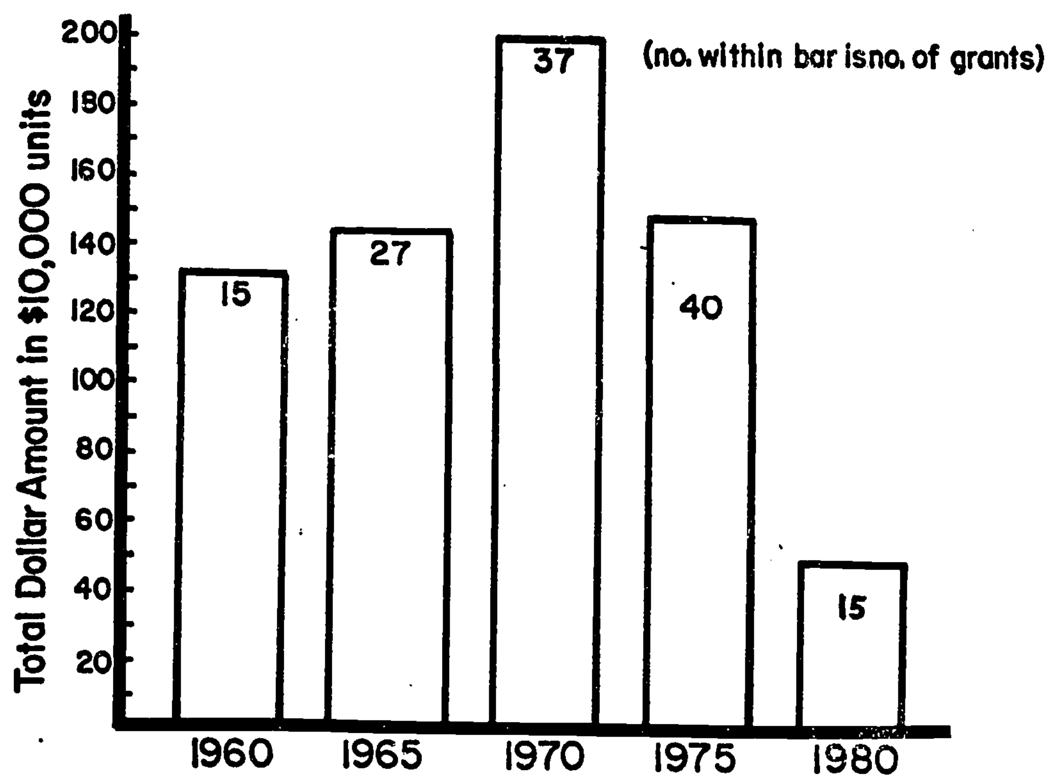


EXTERNAL FUNDING FOR SCIENCE TEACHER IN-SERVICE EDUCATION

Table 2.8

	1960	1965	1970	1975	1980
Number of Grants	15	27	37	40	15
Total Amounts	$1,321,000	$1,456,000	$2,030,100	$1,518,000	$520,000
Ave./Grant	88,067	53,926	54,892	39,950	34,667

Graph 2.8

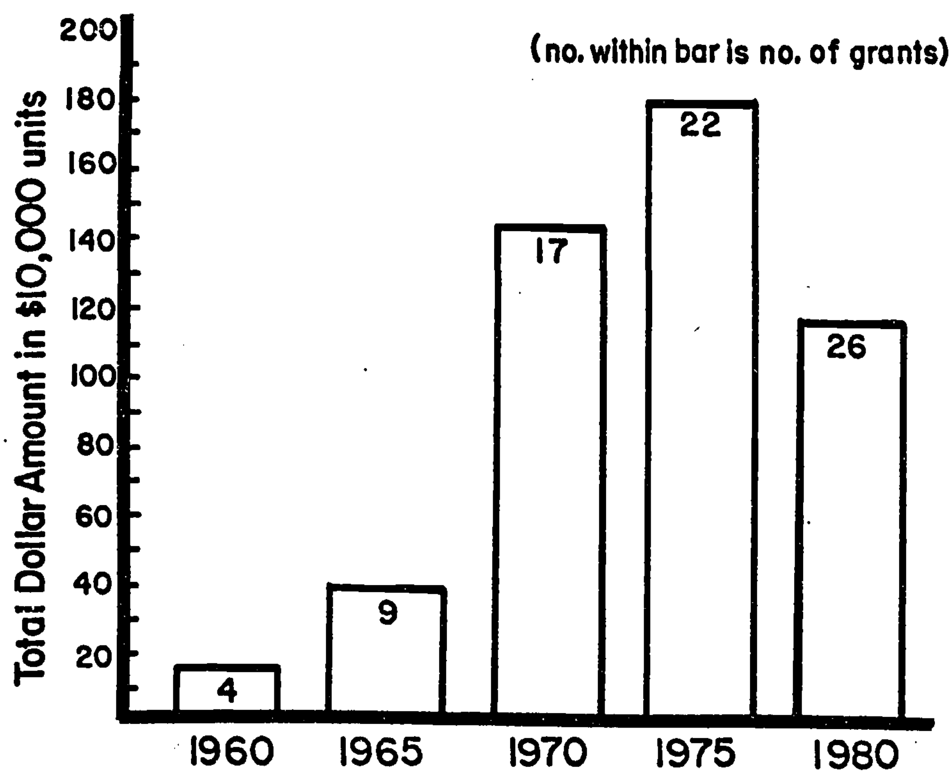


EXTERNAL FUNDING FOR RESEARCH AND CURRICULUM DEVELOPMENT IN SCIENCE EDUCATION

Table 2.9

	1960	1965	1970	1975	1980
Number of Grants	4	9	17	22	26
Total Amounts	$136,000	$400,000	$1,449,000	$1,449,000	$1,192,000
Ave./Grant	34,000	44,445	85,235	82,000	45,846

Graph 2.9

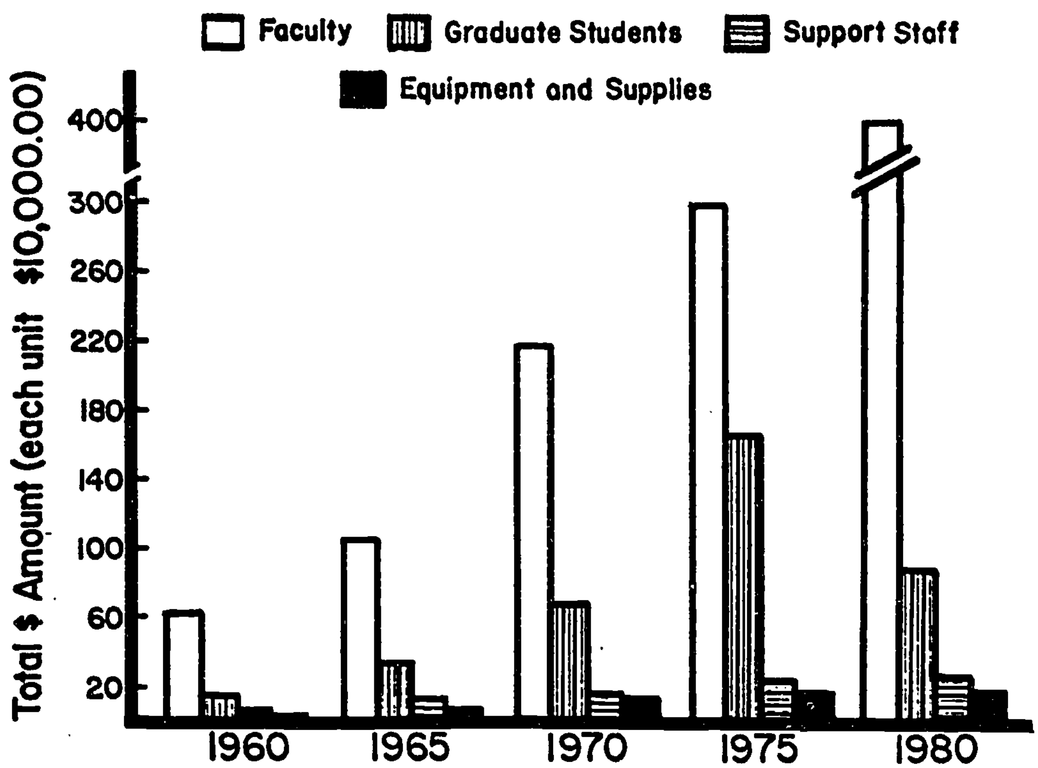


GENERAL UNIVERSITY SUPPORT FOR SCIENCE EDUCATION

Table 2.10

	1960	1965	1970	1975	1980
Faculty	$620,000	$1,051,000	$2,163,000	$2,976,000	$3,991,000
Graduate Students	131,000	314,000	683,000	1,652,000	895,000
Support Staff	34,000	110,000	157,000	214,000	268,000
Equipment/ Supplies	14,000	64,000	1o0,000	139,000	173,000

Graph 2.10

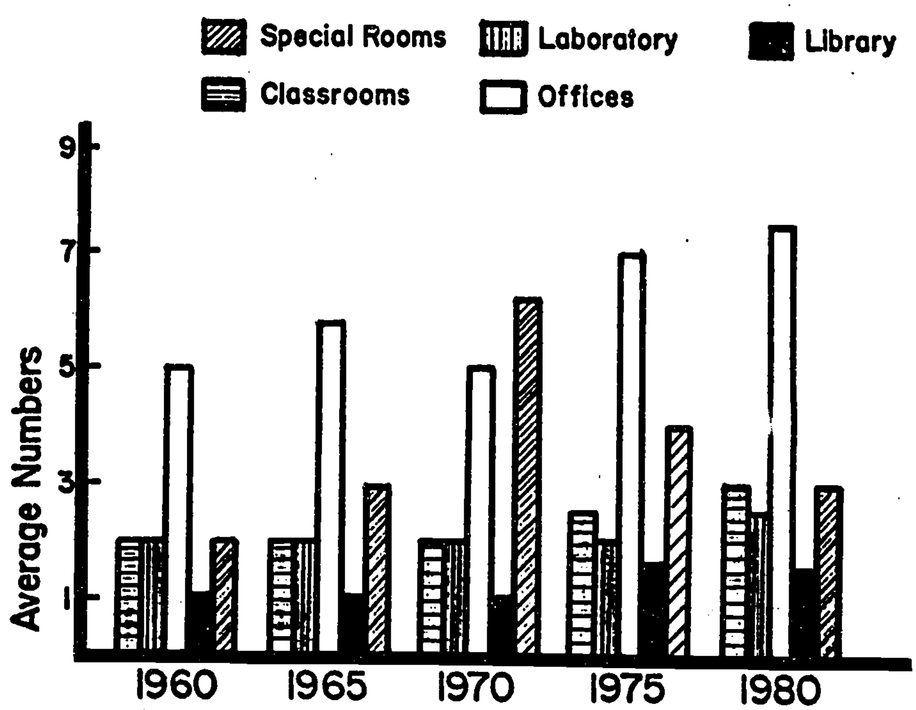


FACILITIES FOR SCIENCE EDUCATION

Table 2.11

Area	1960	1965	1970	1975	1980
Classrooms	2	2	2	2.5	3
Laboratories	2	2	2	2	2.5
Offices	5	6	5	7	7.5
Library	1	1	1	1.5	1.5
Special Rooms	2	3	6	4	3

Graph 2.11



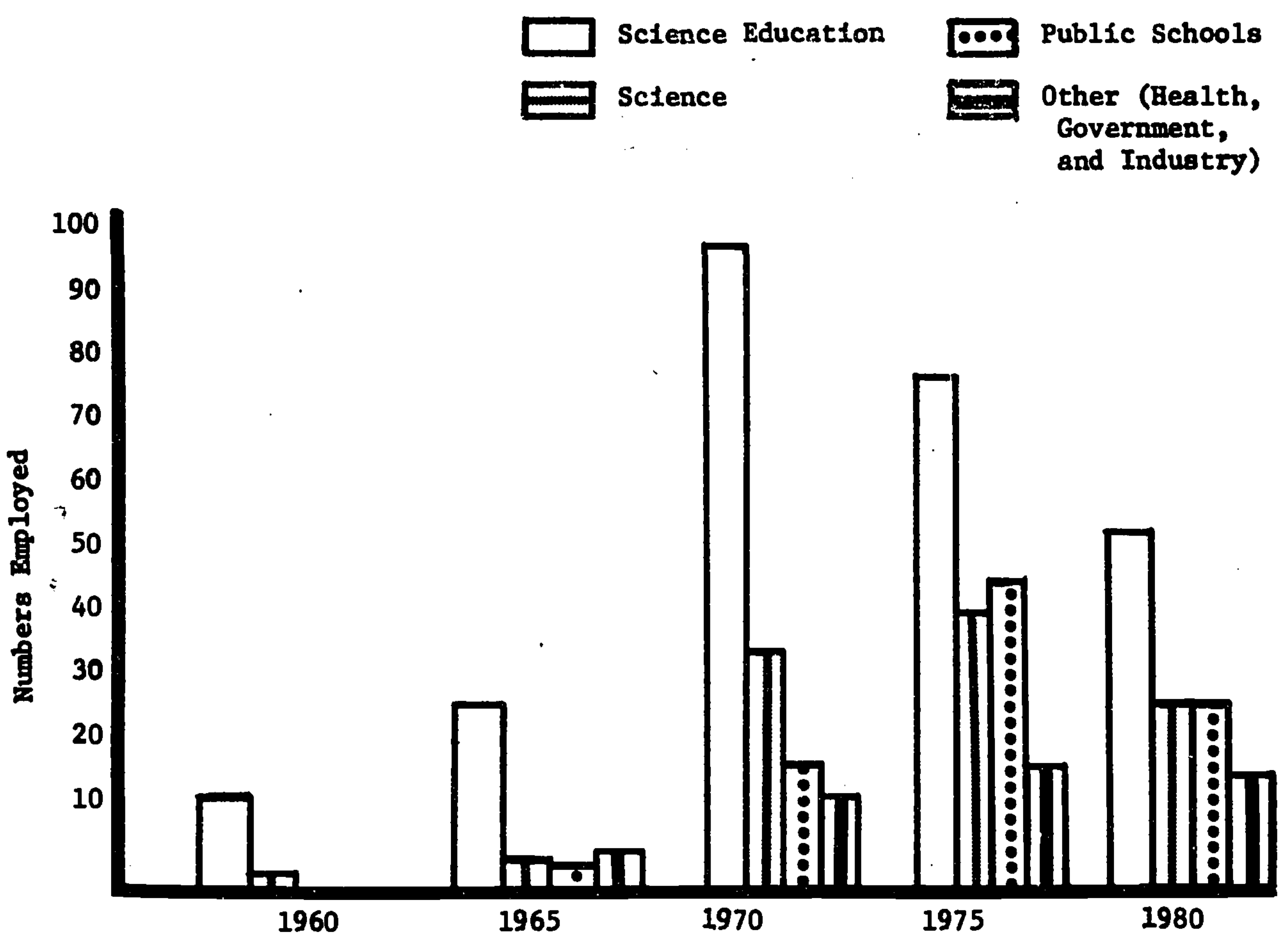
EMPLOYMENT PATTERNS OF DOCTORAL GRADUATES

Table 2.12

	1960	1965	1970	1975	1980*
Science Education	10	26	96	76	51
Science	1	3	32	40	26
Public Schools	0	2	17	45	26
Other (Health, Government, and Industry)	0	4	12	17	15

*The current situation includes significant numbers of foreign students who return to their homelands to employment that may alter the real pattern of employment in the U.S.

Graph 2.12



IV. Characteristics of 168 Faculty Members in Graduate Programs of Science Education

Another aspect of the study of the status of graduate science education is the faculty employed at the major programs. The names and academic qualifications were provided with the information from graduate deans and the contacts at the thirty-five major centers. However, this sketchy information revealed little about the 168 faculty members that comprise the professional workers at the thirty-five major centers. Late in 1979 a decision was reached to extend the study to include vitae from the faculty. Curriculum vitae were first requested from the institution contacts; later, two direct appeals were forwarded by mail to individual faculty members at the thirty-five centers. Another direct appeal was made in person as a part of a general session at the 1980 meeting of the National Association for Research in Science Teaching. Following these requests, there remained thirty vitae from the 168 that were not available. Telephone contacts to centers, to faculty, to colleagues, and directly to individuals who had not responded resulted in needed information for all 168 individuals.

After receiving copies of vitae, additional contacts were often necessary because of the lack of consistency in the vita form. For example, dates for degrees, college majors, complete publication lists, birthdates, and other items that were being tabulated were missing. Biographical outlines were circulated with the information already available indicated and blanks where more information was needed. Ultimately, complete information in all categories was received for all individuals in the 168 person group who had been identified as the faculty at the thirty-five major centers.

Appendix G is a list of the 168 faculty members involved in this study. The faculty members are listed alphabetically as a single list as well as by institutional groups from each of the thirty-five centers. The results from the analysis of these vitae are presented in a series of tables and graphs (3.1 to 3.13).

Table 3.1 and Graph 3.1 provide information regarding the age distribution for the 168 faculty members. Eighty percent of the group fall within the 35 to 54 age group. Only eight faculty members are under 35 years of age while there are 30 who are over 55 years old.

Table 3.2 and Graph 3.2 provide information concerning the number of faculty members at each of the thirty-five institutions. It is interesting that the range of faculty size is one to twelve persons; two of the major centers have a single faculty member while two have a faculty of twelve each. When all thirty-five institutions are considered, the average size of the faculty is 4.8 persons. Although the number of faculty at each center varies considerably, fifty-seven percent of the centers employ two, three, or four faculty members (six centers reporting two faculty, nine have three faculty and five have four faculty).

Tables 3.3 and Graph 3.3 provide information about the relative ages of the faculty members when they were first employed at one of the thirty-five major centers. Although twenty-seven were employed at one of the institutions as a science education faculty member before age 30, nearly eighty percent were first employed at one of the major centers between age 30 and age 44. Only eleven people were employed at a major center after age 45.

Table 3.4 and Graph 3.4 provide information regarding the academic rank of the 168 science educators. Eighty-two percent of the group are associate or full professors. This suggests a stable faculty with most holding tenure positions. Only twenty-five persons hold assistant professorships and four have non-professorial appointments (lecturers or instructors). The fact that the largest number in the total group are full professors is revealing.

Tables 3.5, 3.6, and 3.7 and the corresponding Graphs provide information concerning the training institutions for the Bachelor's, Master's, and Doctoral degrees for the 168 faculty members. It can be seen from Table 3.5 and Graph 3.5 that the faculty members received their Bachelor's degree in sizable numbers from four year (non-graduate) institutions, universities (exclusive of the thirty-five with major science education programs), and one of the thirty-five major centers for science education. The respective percentages are 37.5, 33.9, 28.6.

The information regarding the Master's degree appears in Table 3.6 and Graph 3.6. Interestingly, four faculty members do not have a Master's degree. The number with Master's degrees who report earning theirs from one of the thirty-five major centers (almost half) is about the same as those earning theirs from one of the other universities (about 48%).

Table 3.7 and Graph 3.7 provide information concerning the doctoral preparation. Not too surprisingly, nearly ninety percent of the faculty at the thirty-five major centers received their Doctoral preparation at one of the same thirty-five institutions. Some of the people earning their Doctorates at other institutions actually have their degrees with majors other than science education.

The information in Table 3.8 and Graph 3.8 indicates the nature of the Doctoral program for the faculty members. Predictably the majority have a degree in science education -- almost exactly two-thirds of the group. Unlike many professions, however, is the fact that a third of the group have Doctoral degrees in areas other than the discipline of science education per se. Nearly eighteen percent of the group have a general degree in "education"; another fourteen percent have a degree in one of the science disciplines.

Table 3.9 and Graph 3.9 indicate the dates for the Doctoral degree for the 168 faculty members. Nearly three-fourths of the group received their Doctorates between 1961 and 1975, a fifteen year period. Only 15 received the degree after 1975 while a total of twenty-eight received their degrees prior to 1960. Recalling the stability of the faculty in terms of tenure and rank, it is interesting also to note the uniformity in terms of the date the Doctorate was obtained.

Table 3.10 and Graph 3.10 (a through i) provide information concerning 168 faculty members and their professional experiences prior to their appointment at one of the thirty-five centers. Only sixteen percent of the faculty members has had teaching experience at the elementary school level and one-half of this number has had only one to three years of such experience. Nearly twenty percent has had teaching experience at the middle school level with almost equal numbers having had one to three years to those having four to seven years of such experience.

The largest number (nearly two-thirds) of faculty members in the thirty-five graduate centers has had science teaching experience at the high school level. Although forty-two percent had only one to three years of experience, a large number also has four to seven and eight to fifteen years of experience at the high school level. It is apparent that this significant experience with teaching at the high school level is a factor in terms of dates for earning the Doctorate and the ages of first appointment at the major centers.

Only six percent of the sample has had any experience with teaching science at the community college level and most of this was for a relatively brief period. Nearly twenty percent, however, has had previous experience with teaching at four year colleges. Approximately fourteen percent of the faculty group has had previous experience as a supervisor and/or a consultant of science in state or regional agencies and/or K-12 school systems. A larger number (over seventeen percent) has had a variety of experiences in government, industry, professional science, etc.

Tables 3.10f and 3.10g provide information concerning teaching experience for the 168 faculty members at the University level. The stability of the faculty at the major institutions is apparent from the fact that eighty percent of the group has been employed at such an institution for eight years or more. It is interesting to note that five faculty members are currently experiencing their first year as a faculty member at a major university. Only forty-seven percent (Table 3.10g) of the 168 faculty involved has had previous experience at a University other than the one where currently employed. For those with previous University level experience, nearly fifty-five percent has had only one to three years of such experience. It is rare for a person employed at another University for over seven years to be later employed as a member of the science education faculty at one of the thirty-five largest programs.

The 168 faculty members are professionally active as evidenced by information in Table 3.11 and Graph 3.11. Nearly ninety-five percent is a member of more than four professional societies. Twelve persons report memberships in over twelve different professional societies. Table 3.12 and Graph 3.12 provide additional evidence of an active faculty group in a professional sense. All report at least some national committee assignment, office, or special activity. Three-fourths of this group has been involved with four or more such national activities. As the number of memberships increase, the opportunities for involvement increase. Apparently, science educators at the thirty-five major programs avail themselves of such opportunities.

Table 3.13 and Graph 3.13 provide information about publications by the 168 science educators. Forty-two percent of the sample has authored textbooks -- either for K-12 school use or use in college settings. Nearly seventy percent has prepared published booklets and general instructional materials for use in school or college settings.

Most of the publication activity has been in the area of position papers and/or philosophical papers. These include articles in professional publications for teachers, other educators, and the general public. Over ninety-six percent of the group has published such articles. The number of these articles varies considerably but uniformly across the sample. Fifteen persons have published over thirty such manuscripts.

The faculty group has also been active in the preparation of research reports -- those with data reported and analyzed. Nearly ninety percent of the sample has published at least one article; nearly seventy percent has published four or more such reports. Thirteen members of the group have published over twenty such reports of experimental research. The nature of this research and that of graduates from the thirty-five centers is discussed in the next section of this report.

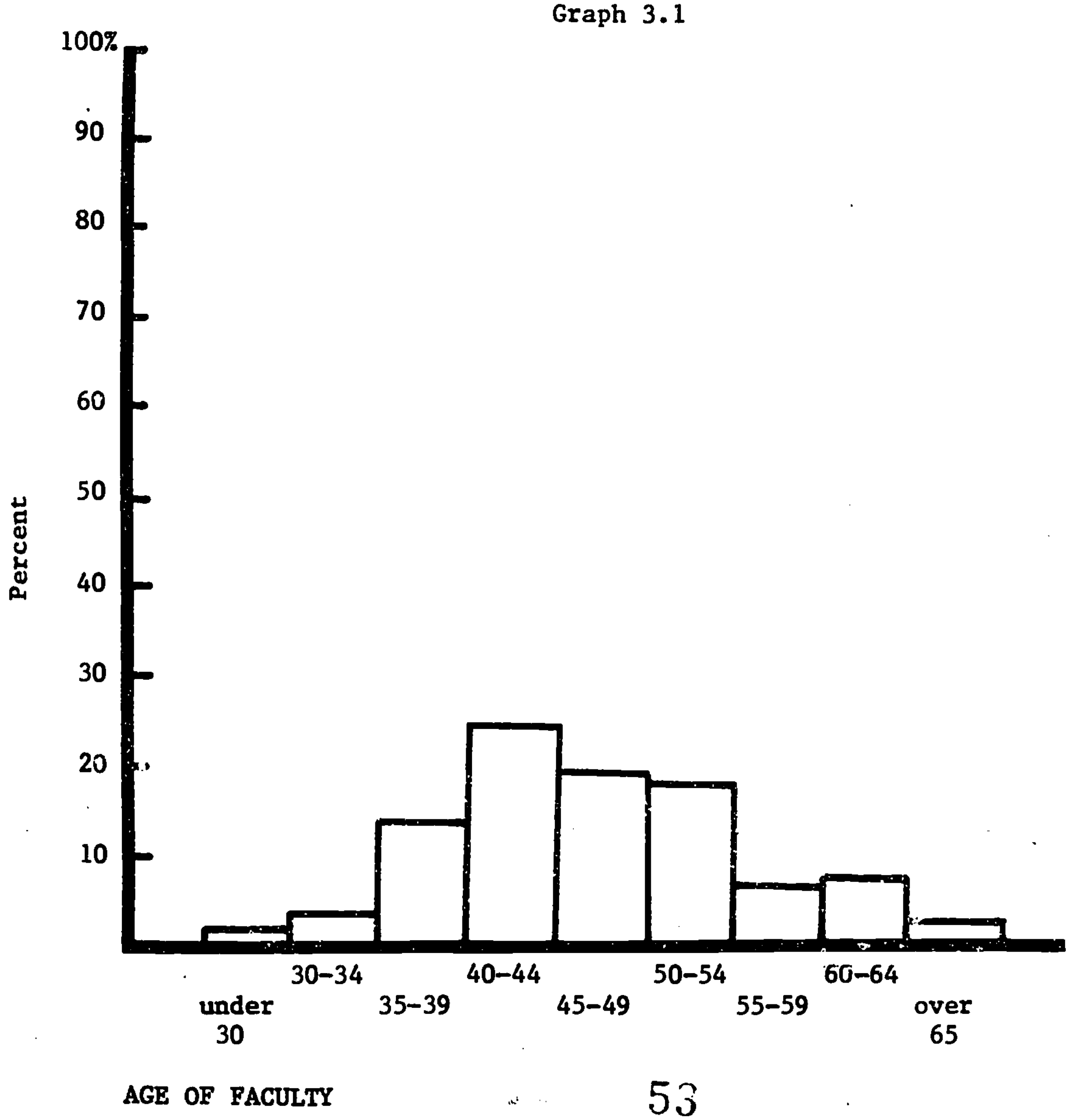
Of the 168 faculty members at the thirty-five centers, only 20 are women (12%). No information was requested nor provided regarding minority representation among the faculty. Similarly, no specific information was sought nor available about handicapped persons or representation of any other special population in the sample.

AGE OF FACULTY IN LARGEST SCIENCE EDUCATION CENTERS

Table 3.1

Age	Number of Faculty	Percent of Faculty	Year of Birth
under 30	2	1.2	1950 or later
30-34	6	3.6	1946-50
35-39	24	14.3	1941-45
40-44	42	25.0	1936-40
45-49	33	19.6	1931-35
50-54	31	18.5	1926-30
55-59	12	7.1	1921-25
60-64	13	7.7	1916-20
over 65	5	3.0	1900-15
	168		

Graph 3.1

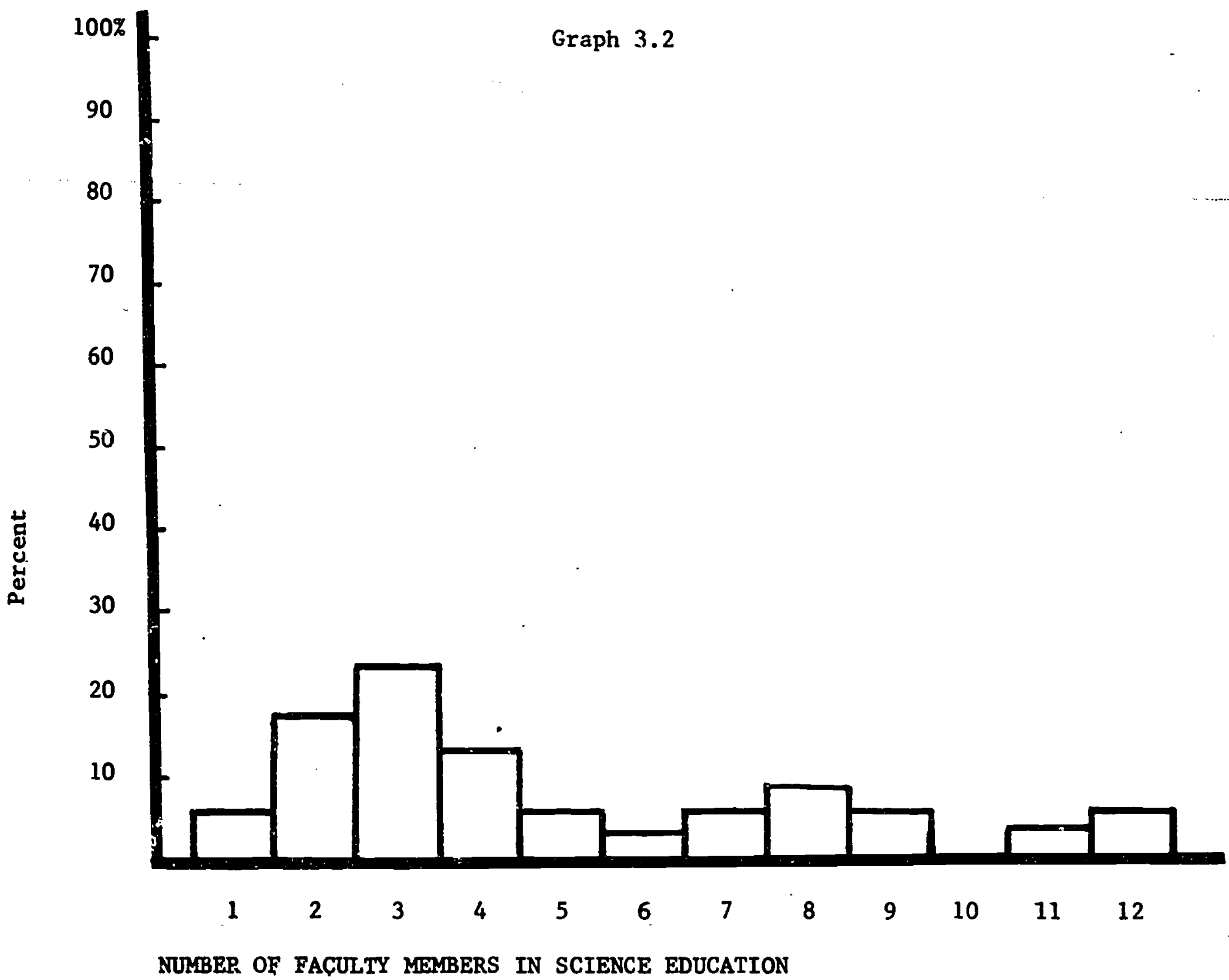


STAFF IN SCIENCE EDUCATION

Table 3.2

Number of Faculty Members	Number of Institutions	Percent
1	2	5.7
2	6	17.1
3	9	25.7
4	5	14.3
5	2	5.7
6	1	2.9
7	2	5.7
8	3	8.6
9	2	5.7
10	0	0.0
11	1	2.9
12	2	5.7
	35	

Graph 3.2

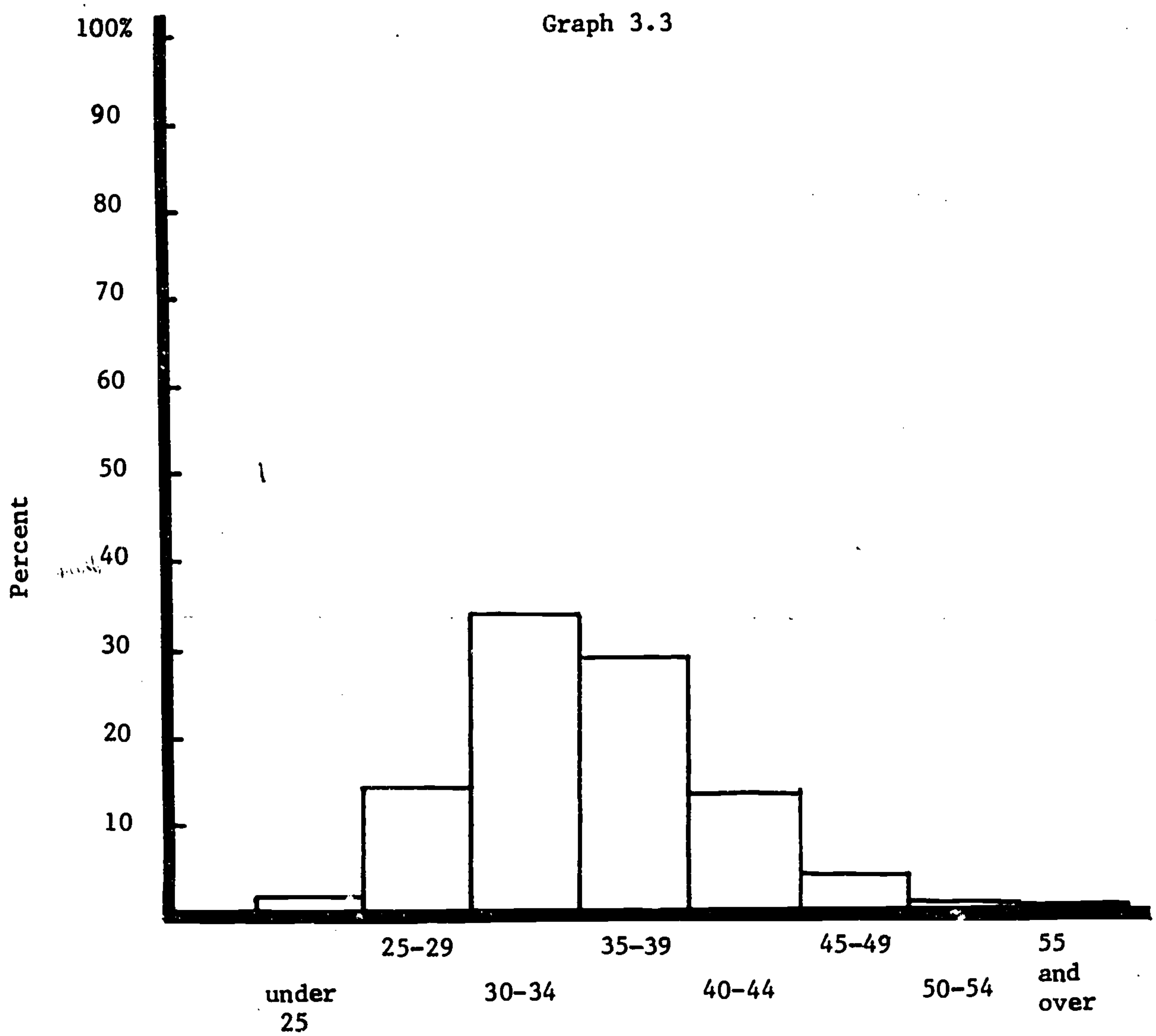


AGE AT FIRST APPOINMENT

Table 3.3

Age of Individual	Number of Individuals	Percent
Under 25	3	1.8
25–29	24	14.3
30–34	57	33.9
35–39	50	29.8
40–44	23	13.7
45–49	8	4.8
50–54	2	1.2
55 and over	1	0.6
	168	

Graph 3.3



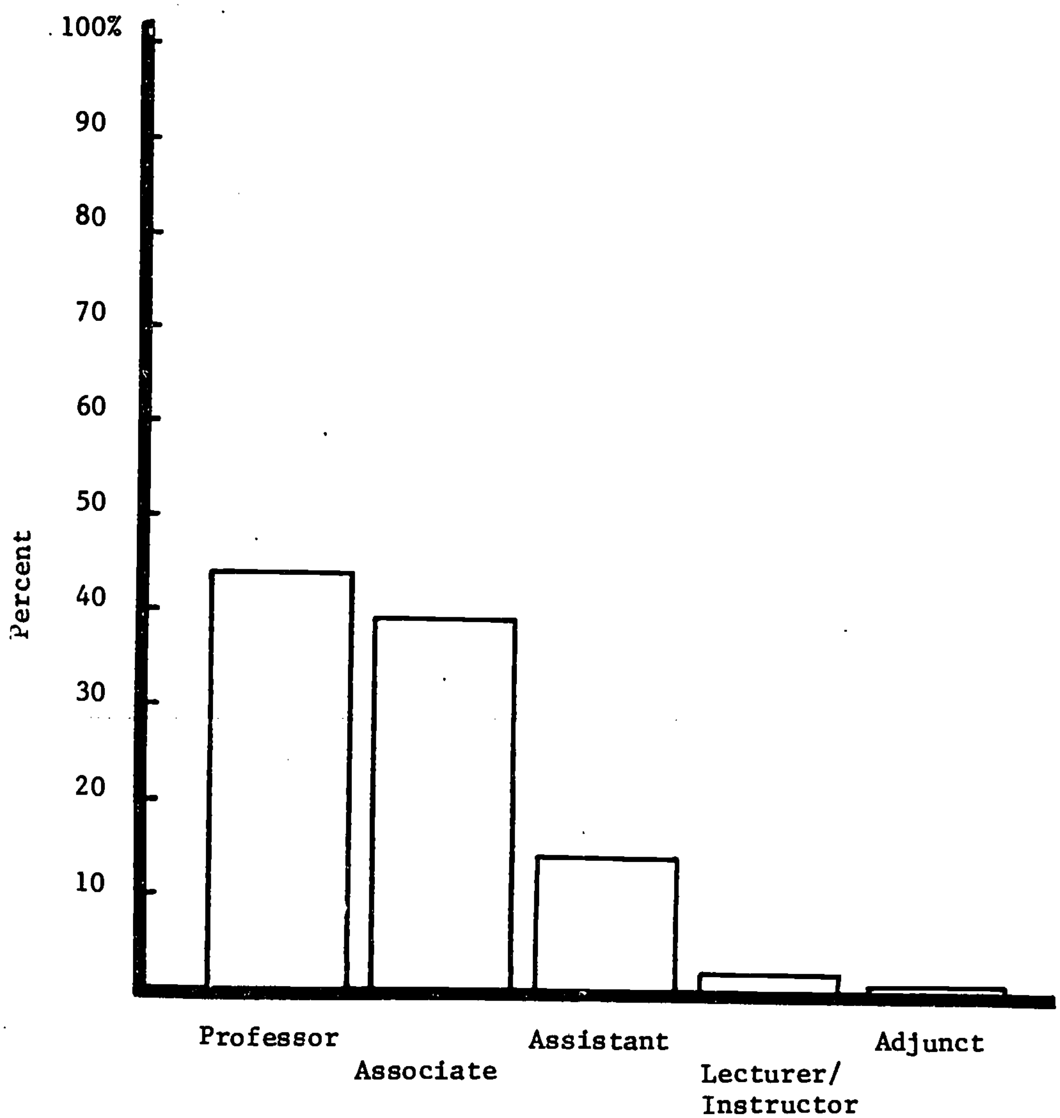
AGE AT FIRST APPOINTMENT

ACADEMIC RANKS OF FACULTY MEMBERS

Table 3.4

Rank	Number of Individuals	Percent
Professor	73	43.5
Associate	65	38.7
Assistant	24	14.3
Lecturer/Instructor	4	2.4
Adjunct	2	1.2
	168	

Graph 3.4



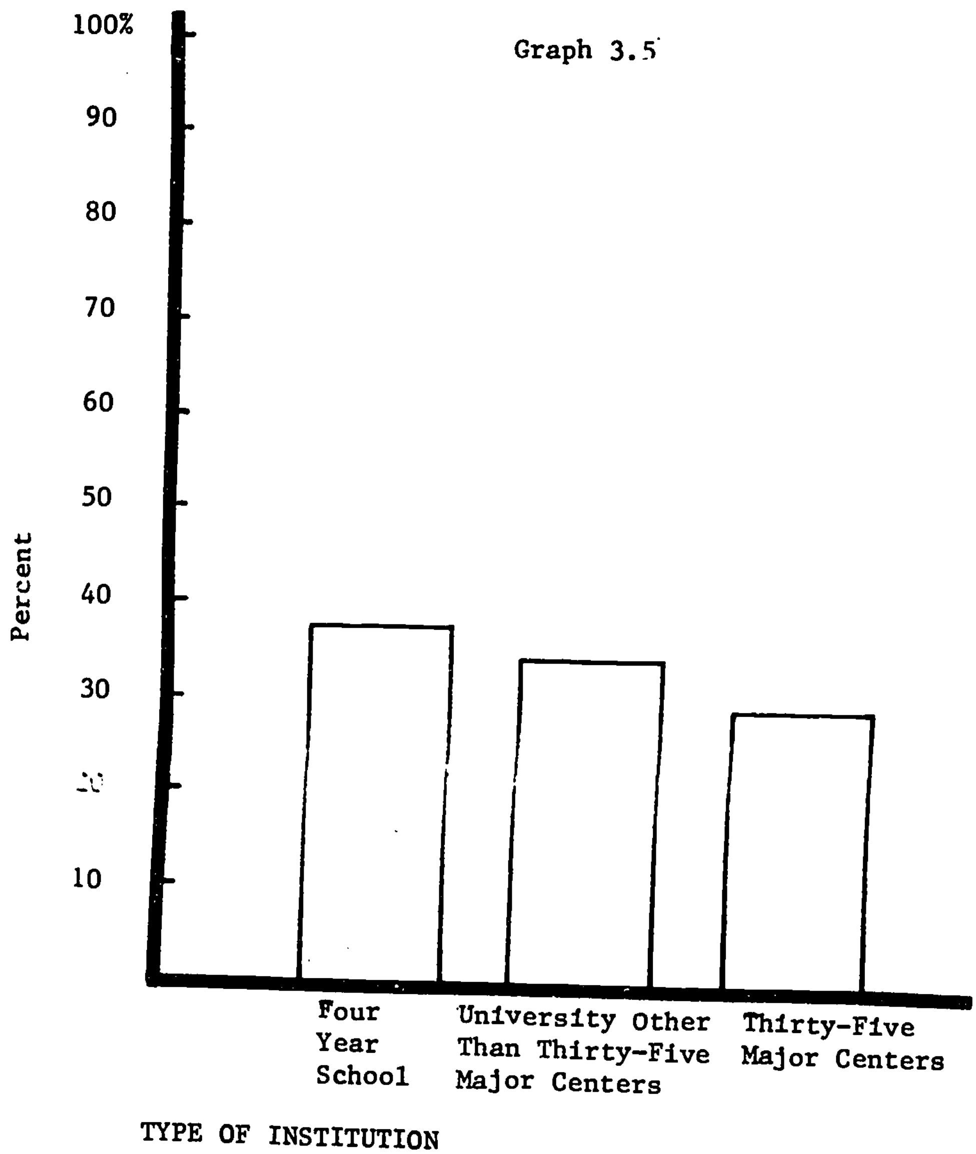
ACADEMIC RANK

SOURCE OF BACHELOR'S DEGREES FOR FACULTY MEMBERS

Table 3.5

Type of Institution	Number of Individuals	Percent
Four Year School	63	37.5
University Other than Thirty-five Major Centers	57	33.9
Thirty-five Major Centers	48	28.6
	168	

Graph 3.5

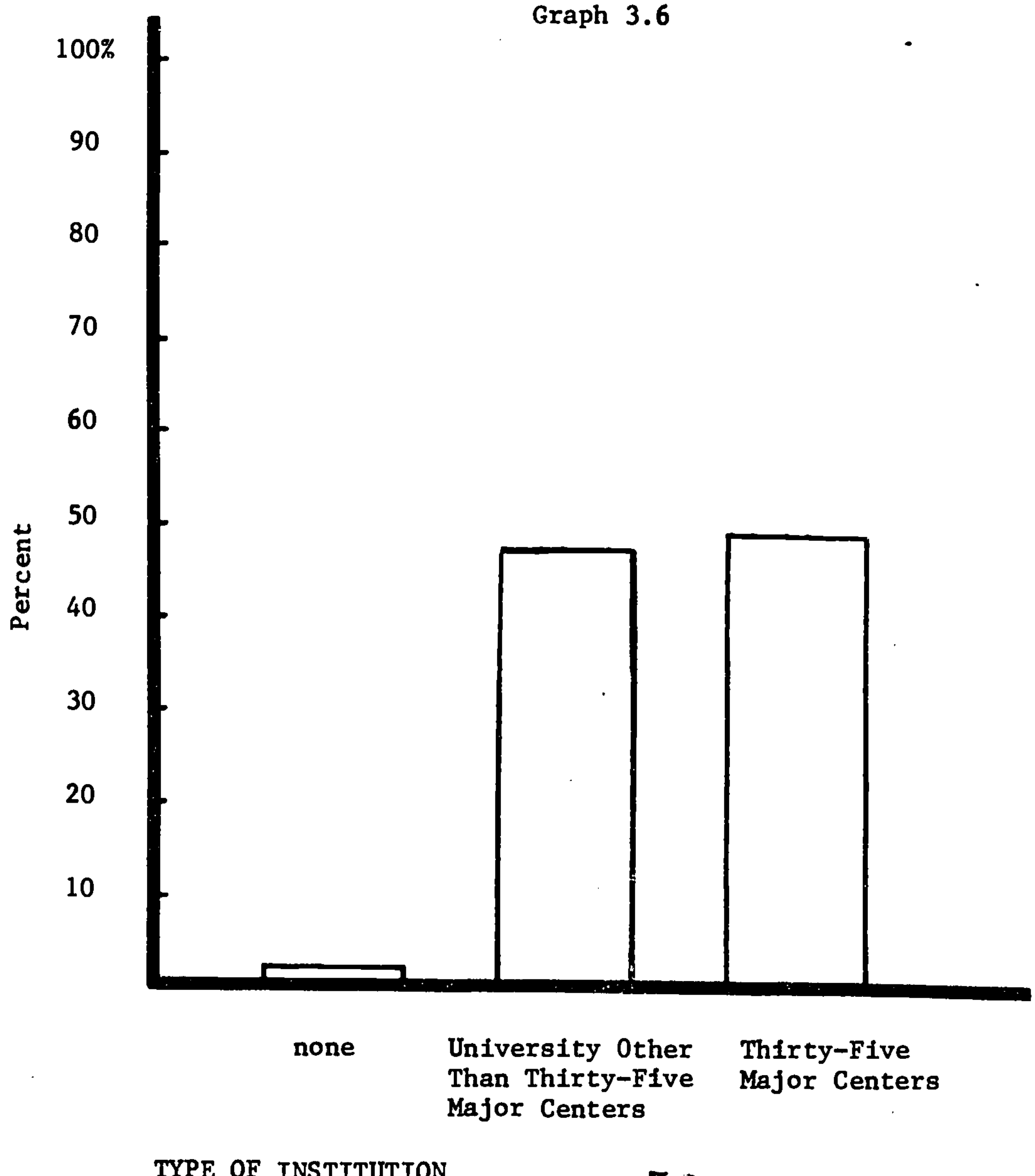


SOURCE OF MASTER'S DEGREES FOR FACULTY MEMBERS

Table 3.6

Type of Institution	Number of Individuals	Percent
None	4	2.4
University Other Than Thirty-five Major Centers	81	48.2
Thirty-five Major Centers	83	49.4

Graph 3.6

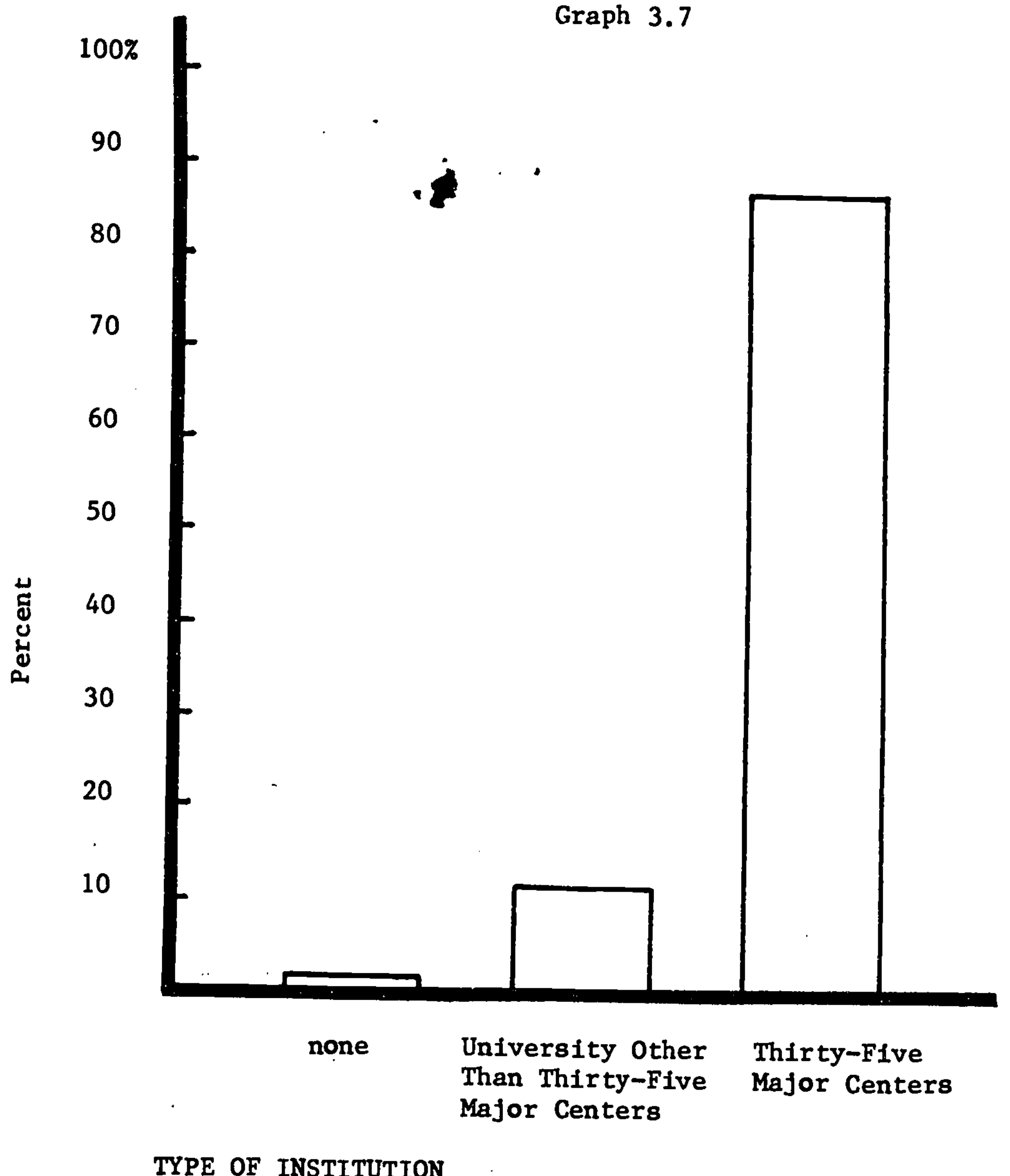


SOURCE OF DOCTORAL DEGREES FOR FACULTY MEMBERS

Table 3.7

Type of Institution	Number of Individuals	Percent
None	3	1.8
University Other than Thirty-five Major Centers	19	11.3
Thirty-five Major Centers	146	86.9

Graph 3.7

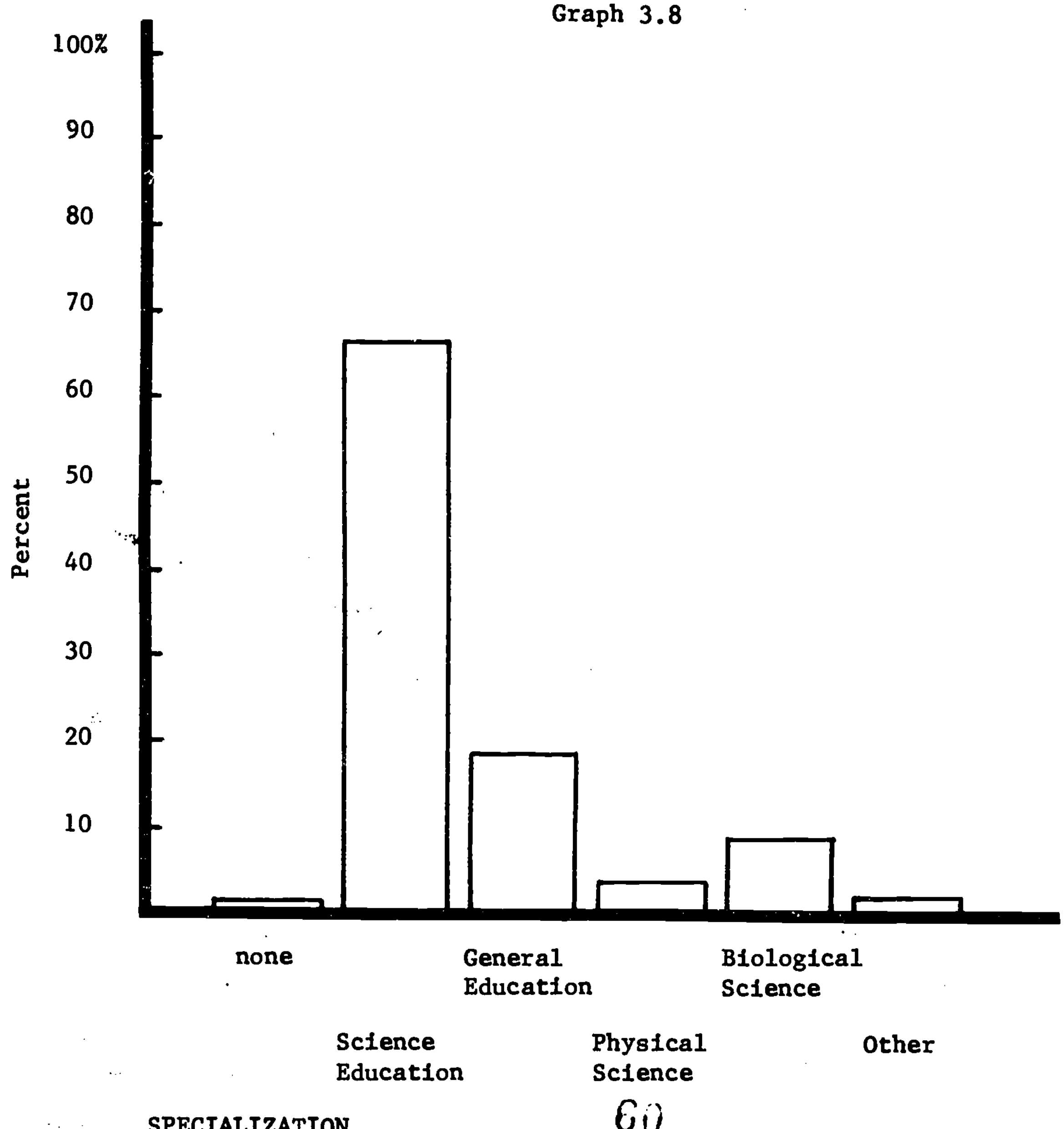


TYPE OF DOCTORAL DEGREE AWARDED TO SCIENCE EDUCATION FACULTY

Table 3.8

Area of Specialization	Number of Individuals	Percent
None	3	1.8
Science Education	112	66.6
General Education	30	17.9
Physical Science	5	3.0
Biological Science	14	8.3
Other	4	2.4
	168	

Graph 3.8

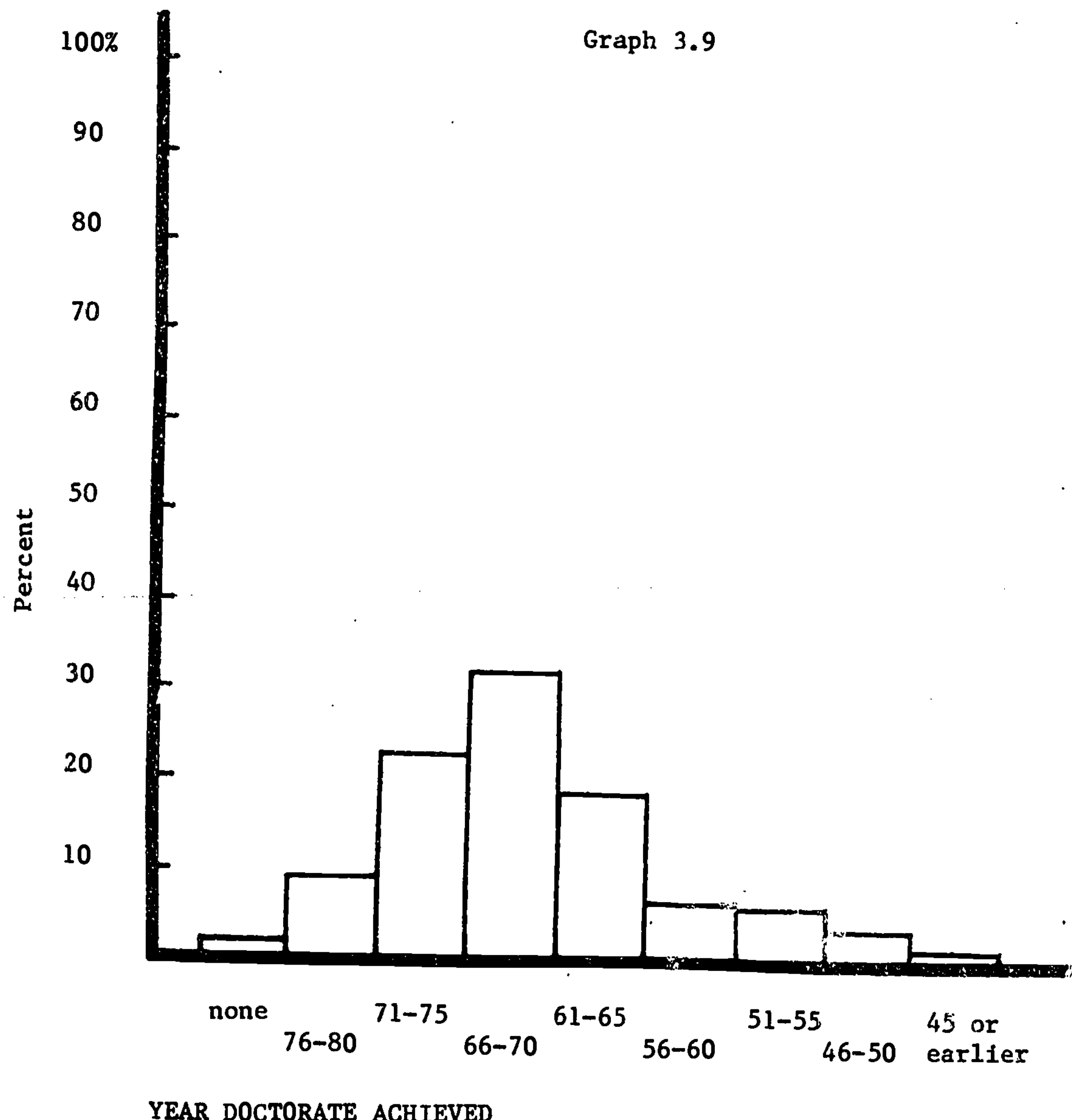


YEAR DOCTORATE ACHIEVED BY FACULTY MEMBER

Table 3.9

Year	Number of Individuals	Percent
none	3	1.8
1976-1980	15	8.9
1971-1975	38	22.6
1966-1970	54	32.0
1961-1965	30	17.9
1956-1960	11	6.6
1951-1955	10	6.0
1946-1950	5	3.0
1945 or earlier	2	1.2
	168	

Graph 3.9

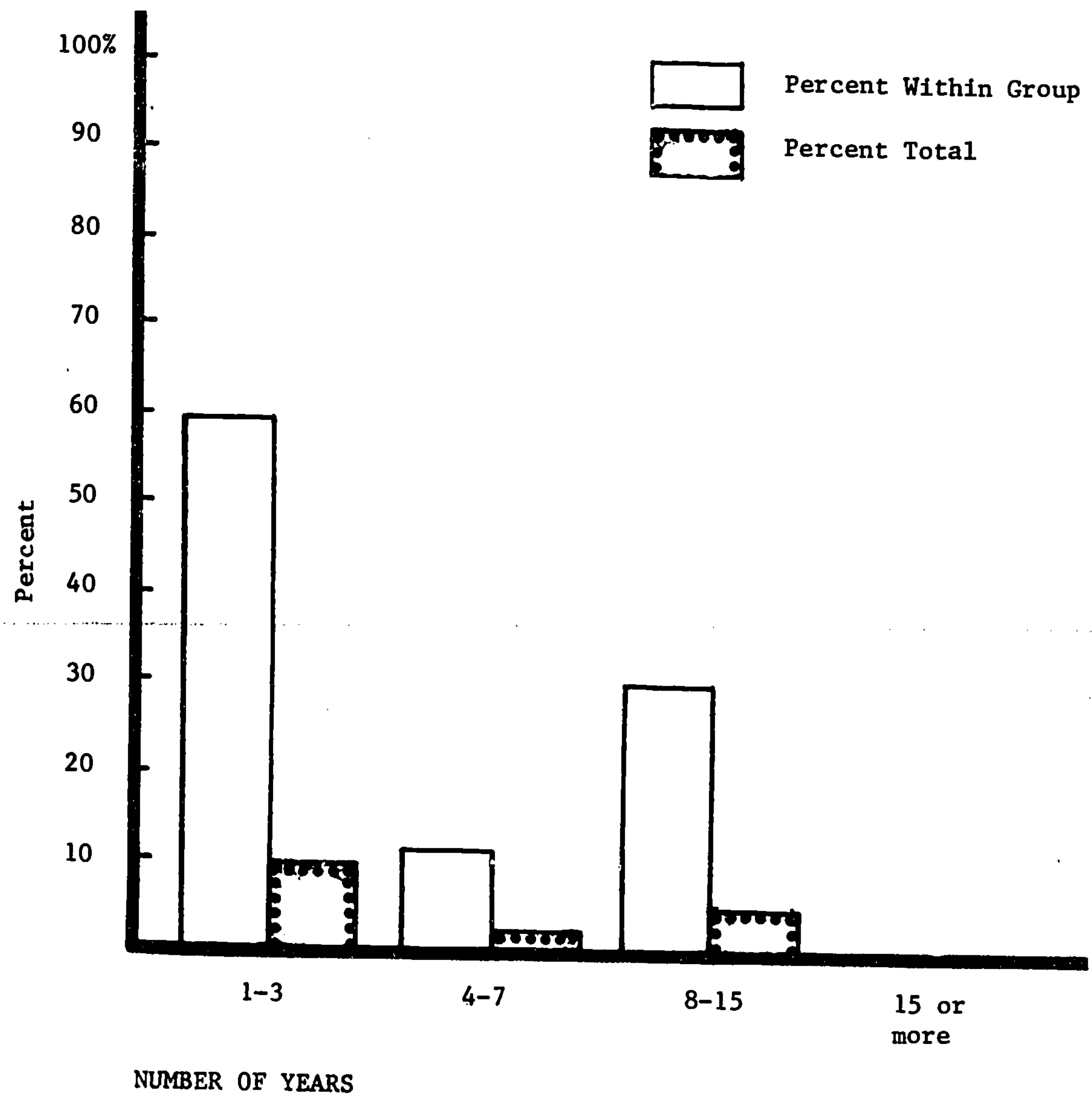


TEACHING EXPERIENCE AT ELEMENTARY SCHOOL LEVEL

Table 3.10 a

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	16	59.2	9.5
4-7	3	11.1	1.8
8-15	8	29.8	4.8
15 or more	0	0.0	0.0
	27		16.1

Graph 3.10 a

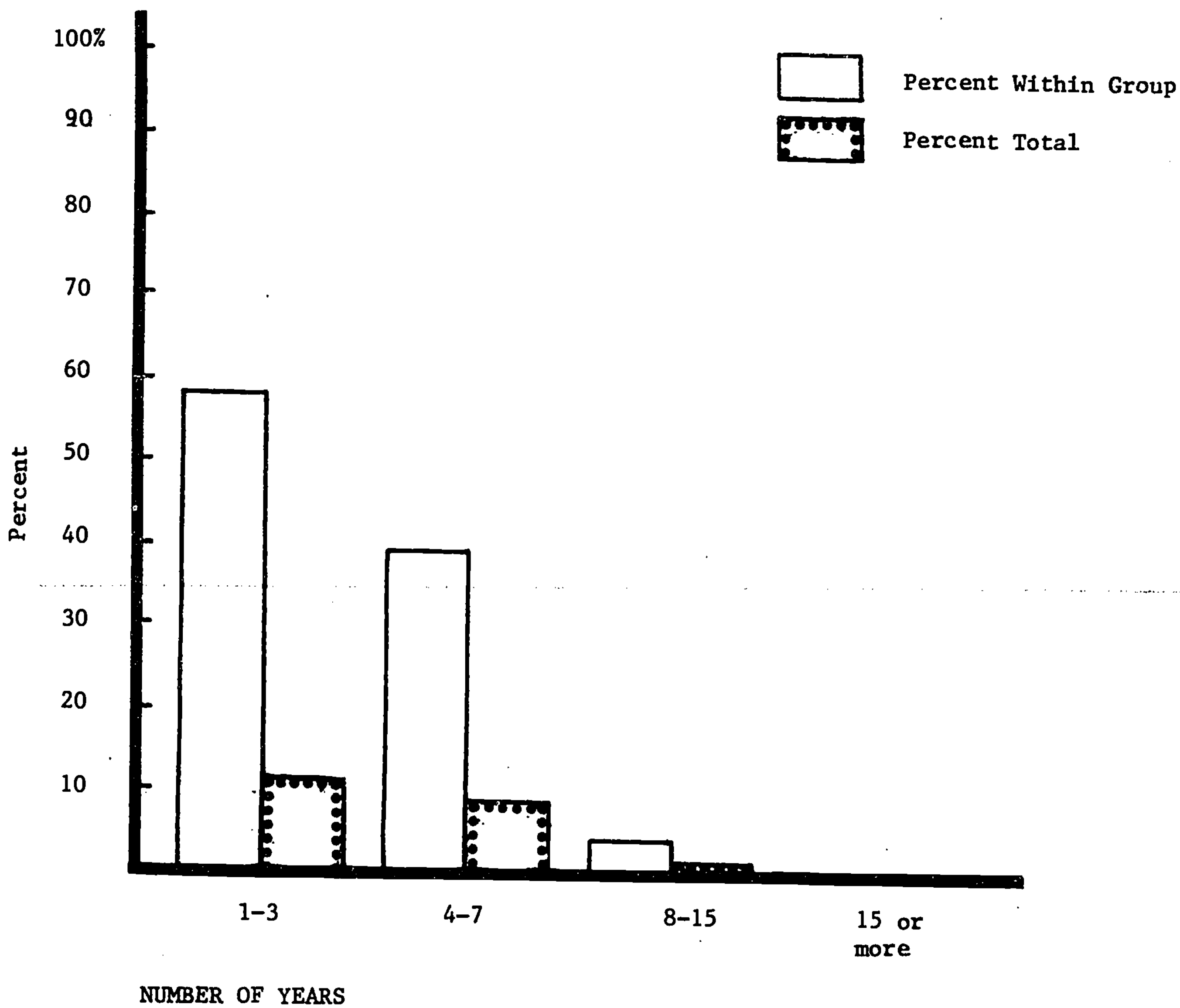


TEACHING EXPERIENCE AT MIDDLE SCHOOL LEVEL

Table 3.10 b

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	19	57.6	11.3
4-7	13	39.4	7.7
8-15	1	3.0	0.6
15 or more	0	0.0	0.0
	33		19.6

Graph 3.10 b

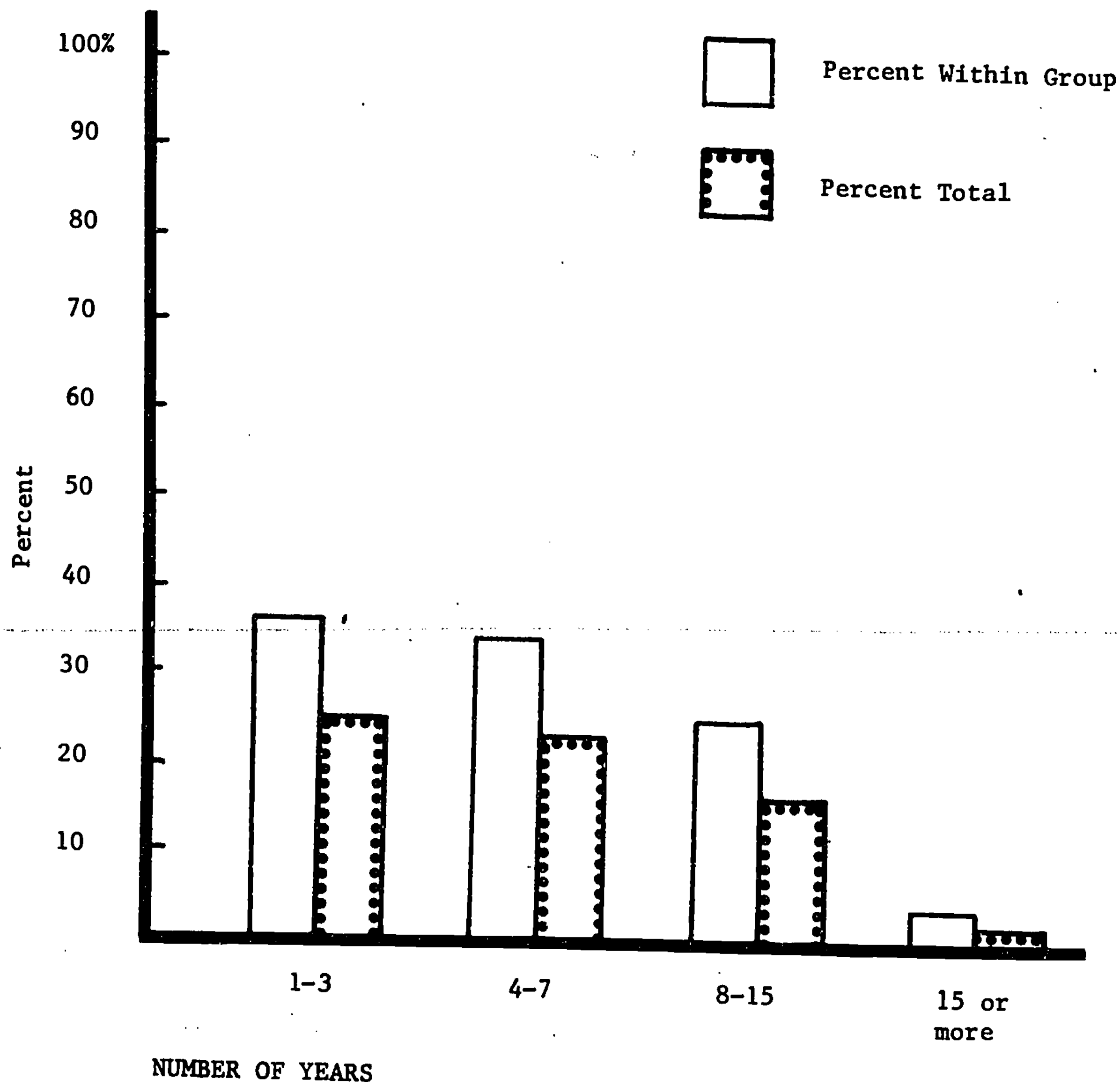


TEACHING EXPERIENCE AT HIGH SCHOOL LEVEL

Table 3.10 c

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	42	37.5	25.0
4-7	38	33.9	22.6
8-15	28	25.0	16.7
15 or more	4	3.6	2.4
	112		66.7

Graph 3.10 c

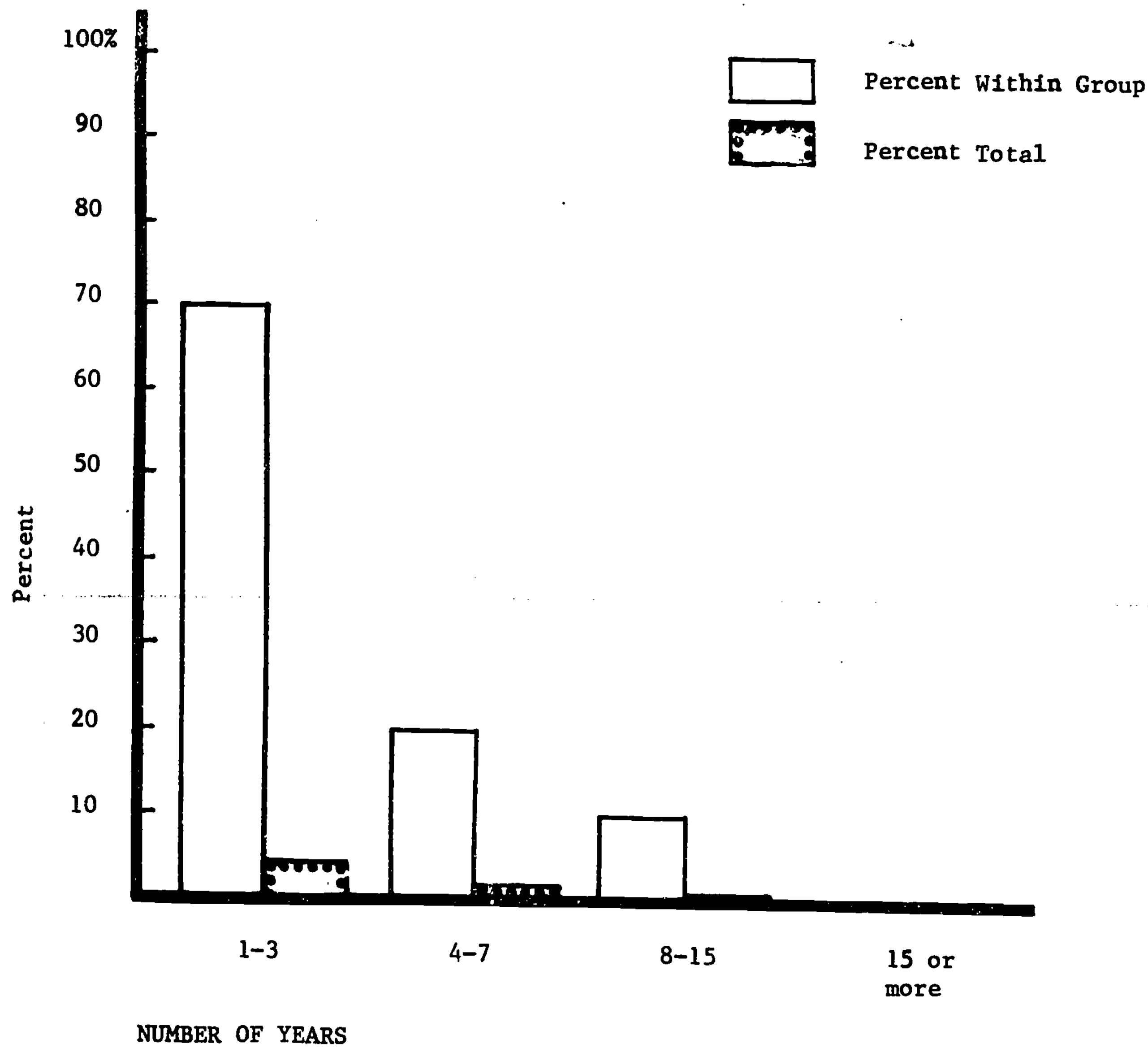


TEACHING EXPERIENCE AT COMMUNITY COLLEGE LEVEL

Table 3.10 d

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	7	70.0	4.2
4-7	2	20.0	1.2
8-15	1	10.0	0.6
15 or more	0	0.0	0.0
	10		6.0

Graph 3.10 d

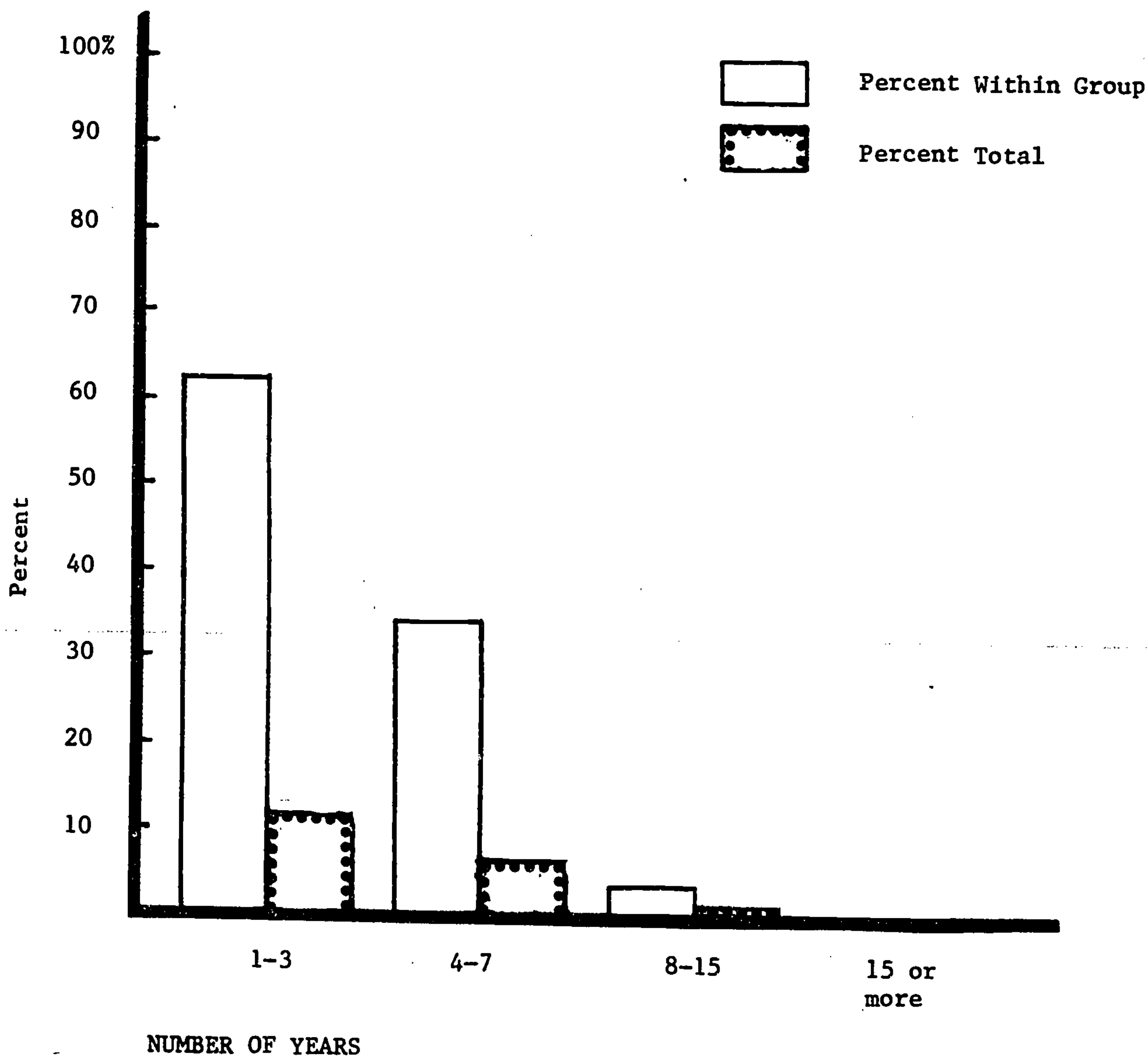


TEACHING EXPERIENCE AT FOUR YEAR COLLEGES

Table 3.10 e

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	20	62.5	11.9
4-7	11	34.4	6.6
8-15	1	3.1	0.6
15 or more	0	0.0	0.0
	32		19.0

Graph 3.10 e



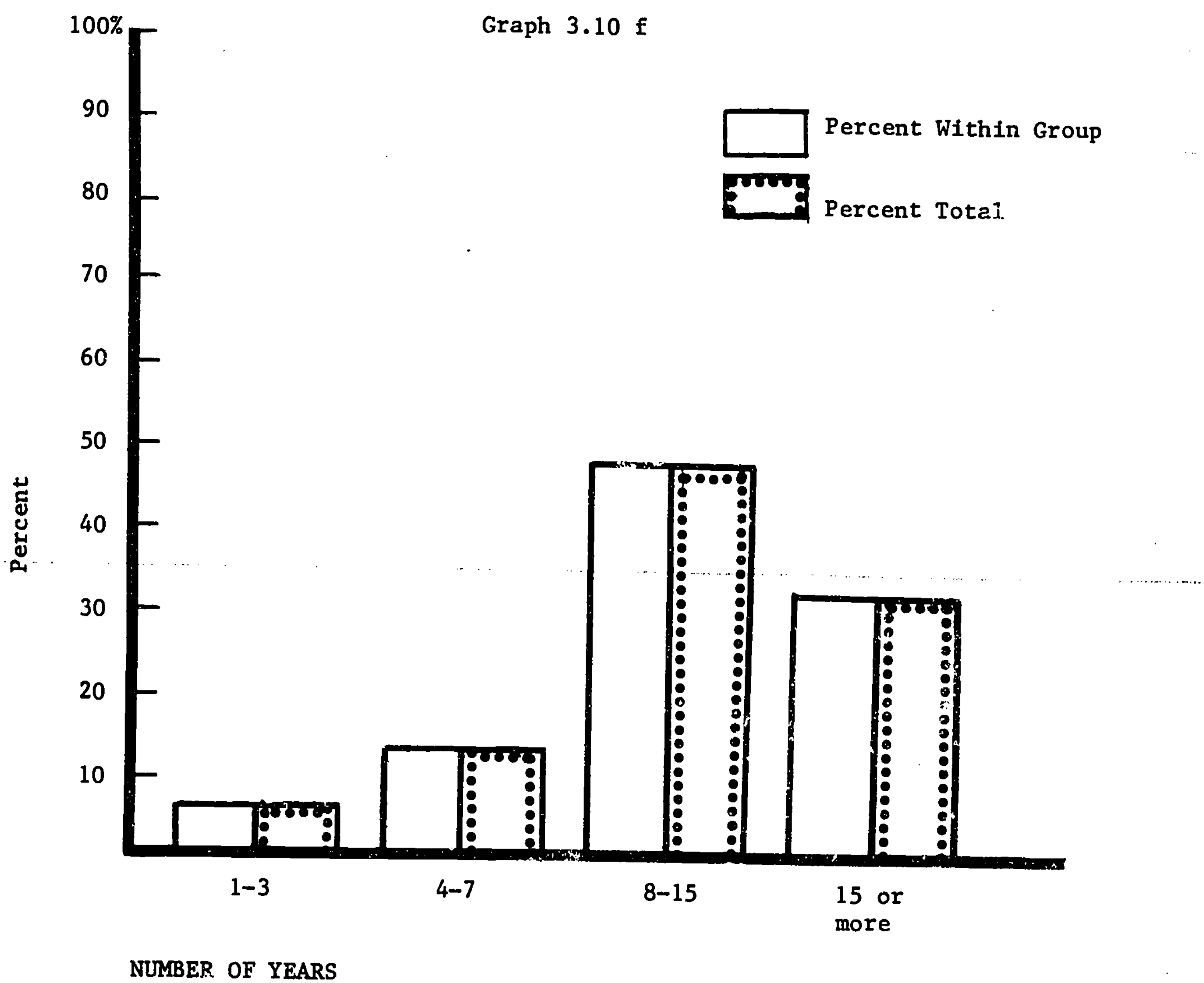
TEACHING EXPERIENCE AT UNIVERSITY LEVEL*

Table 3.10 f

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	11	6.5	6.5
4-7	23	13.7	13.7
8-15	81	48.2	48.2
15 or more	53	31.6	31.6
	168	100.0	100.0

*Figures include experience at the institution currently employed

Graph 3.10 f



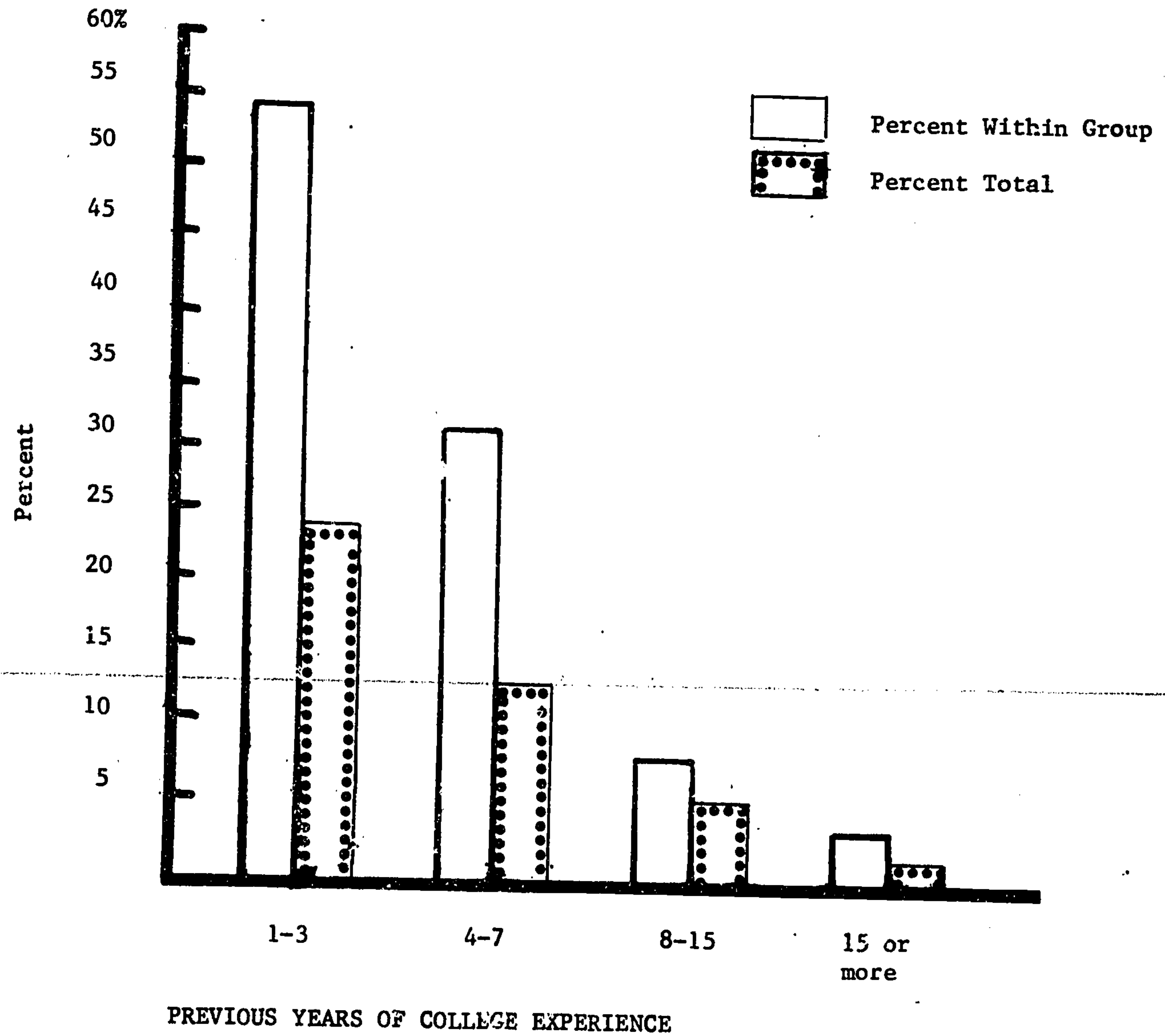
PRIOR TEACHING EXPERIENCE AT UNIVERSITY LEVEL

EXCLUDING CURRENT POSITION

Table 3.10 g

Number of Years	Number of Institutions	Percent Within Group	Percent Total
1-3	41	54.6	24.4
4-7	24	32.0	14.3
8-15	7	9.3	6.5
15 or more	3	4.0	1.8
	75		47.0

Graph 3.10 g

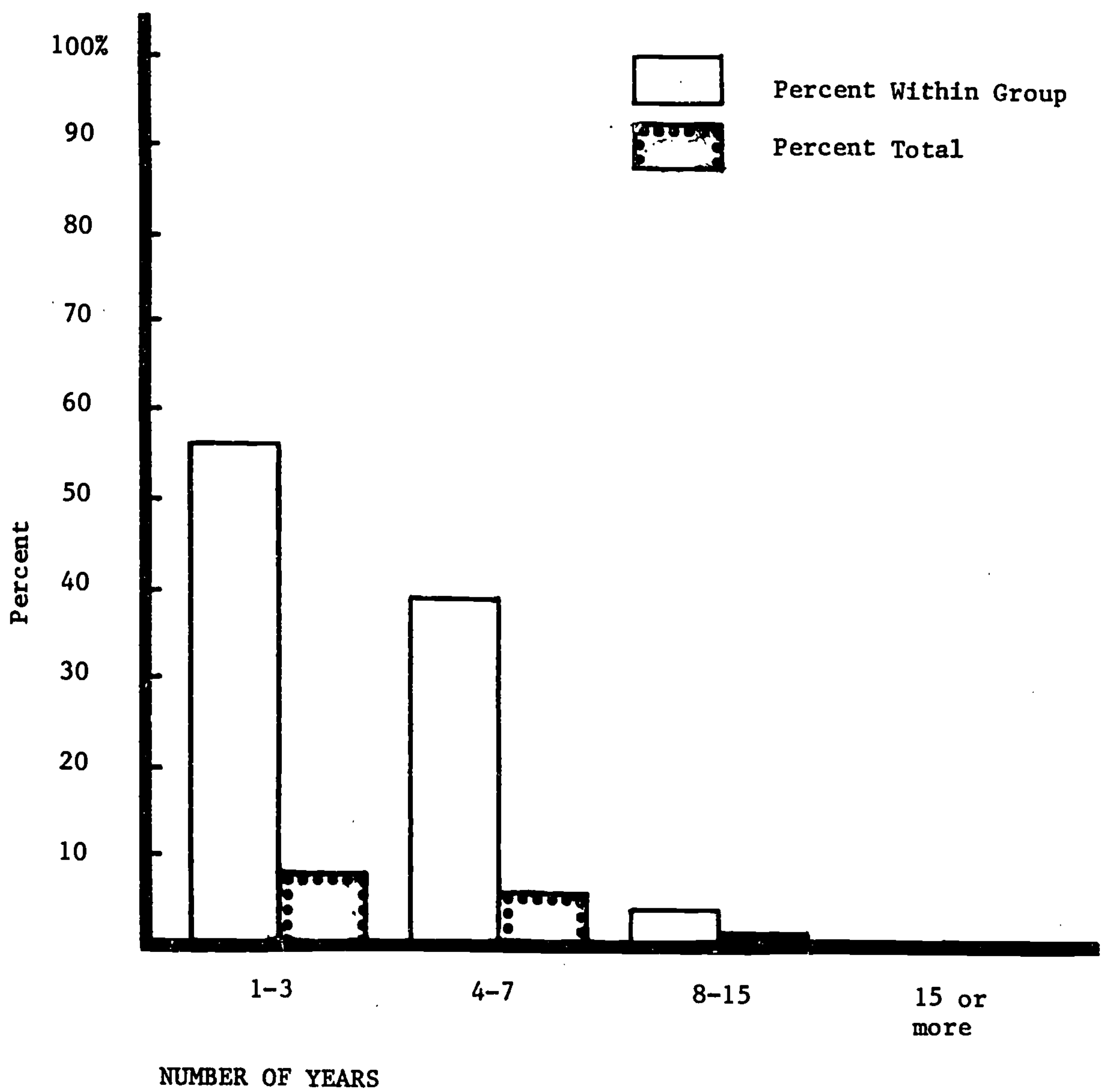


PREVIOUS EXPERIENCE AS SUPERVISOR OR CONSULTANT

Table 3.10 h

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	13	56.5	7.7
4-7	9	39.1	5.4
8-15	1	4.3	0.6
15 or more	0	0.0	0.0
	23		13.7

Graph 3.10 h

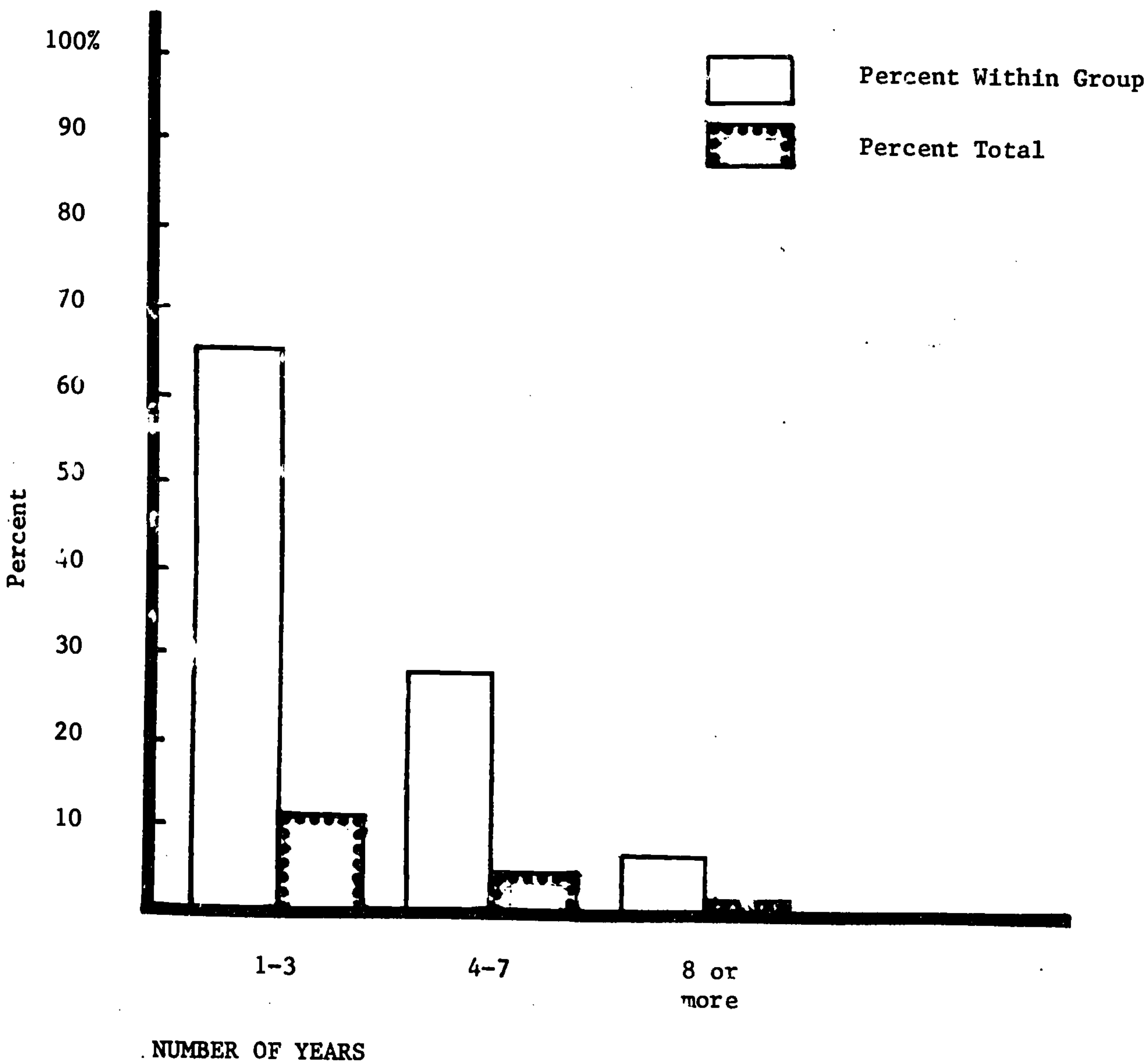


OTHER EXPERIENCE IN HEALTH, GOVERNMENT, AND INDUSTRY

Table 3.10 i

Number of Years	Number of Individuals	Percent Within Group	Percent Total
1-3	19	65.5	11.3
4-7	8	27.6	4.8
8 or more	2	6.9	1.2
	29		17.3

Graph 3.10 i

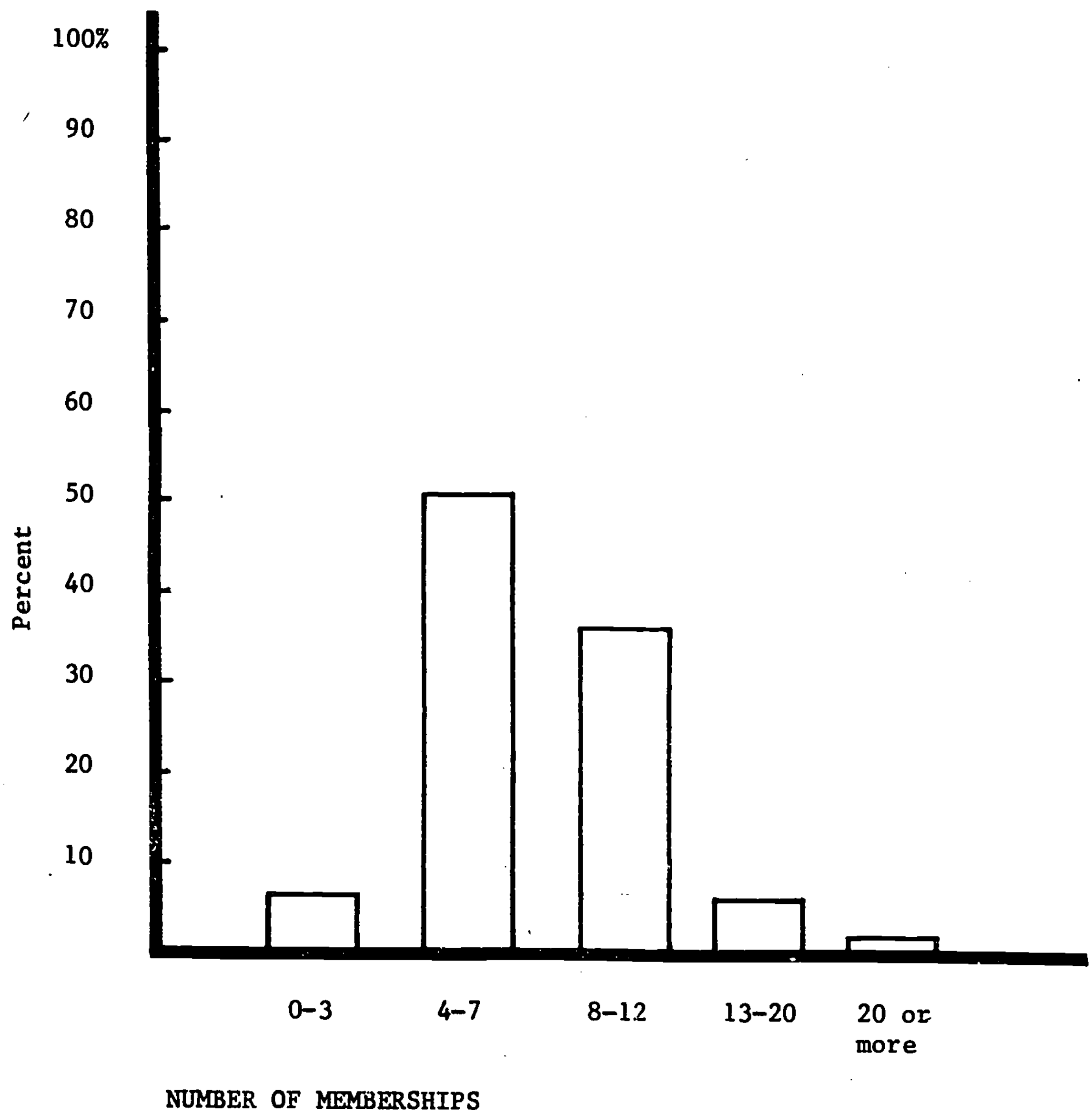


NUMBER OF PROFESSIONAL MEMBERSHIPS

Table 3.11

Number of Memberships	Number of Individuals	Percent
0–3	11	6.5
4–7	85	50.6
8–12	60	35.7
13–20	10	6.0
20 or more	2	1.2
	168	100.0

Graph 3.11

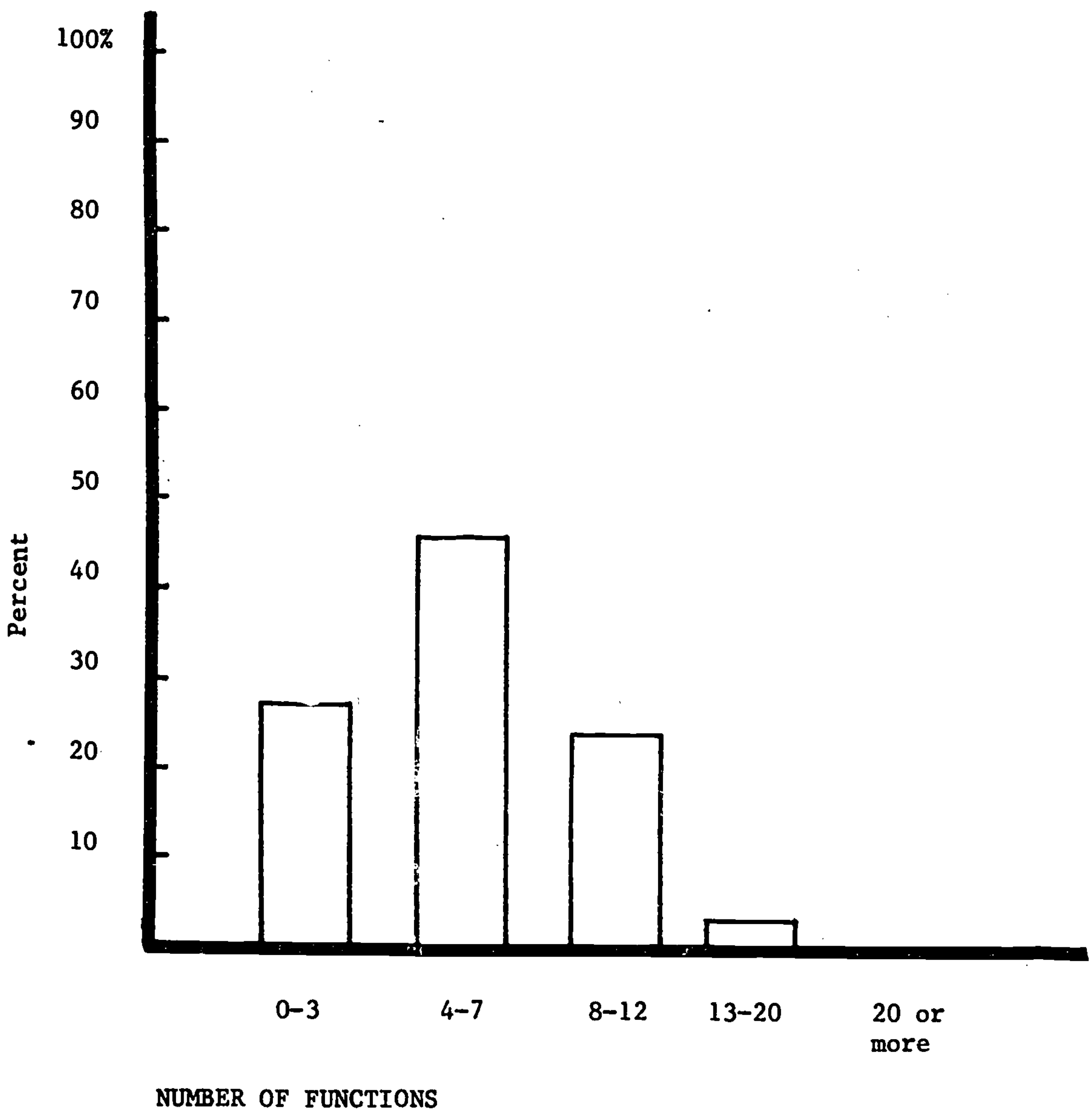


LEADERSHIP IN PROFESSIONAL ORGANIZATIONS

Table 3.12

Number of Functions	Number of Individuals	Percent
0-3	46	27.4
4-7	77	45.8
8-12	40	23.8
13-20	5	3.0
20 or more	0	0.0
	168	100.0

Graph 3.12

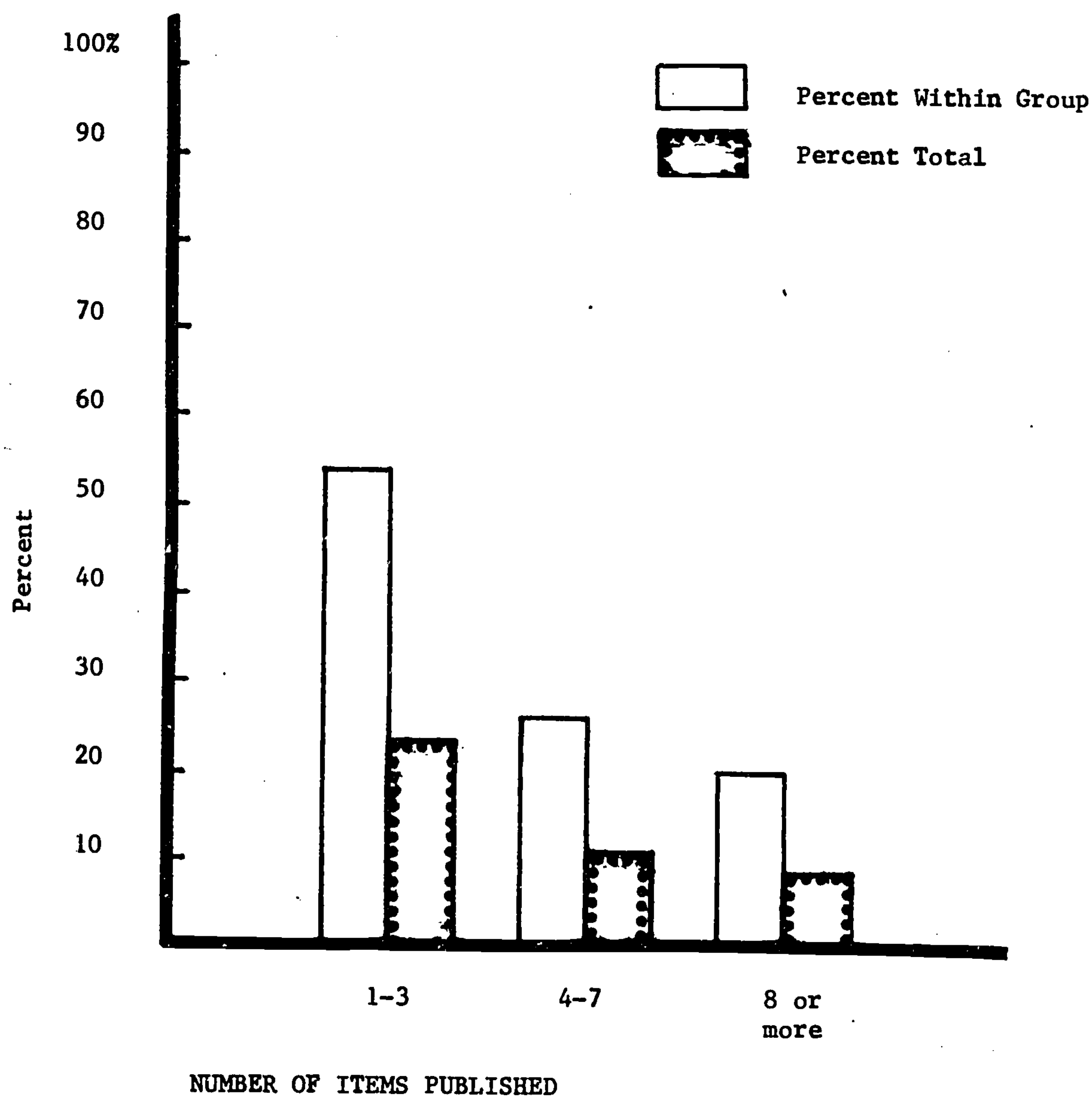


TEXTBOOKS PUBLISHED BY FACULTY GROUP

Table 3.13 a

Number of Items Published	Number of Individuals	Percent Within Group	Percent Total
1-3	38	54.3	22.6
4-7	18	25.7	10.7
8 or more	14	20.0	8.3
	70		41.6

Graph 3.13 a

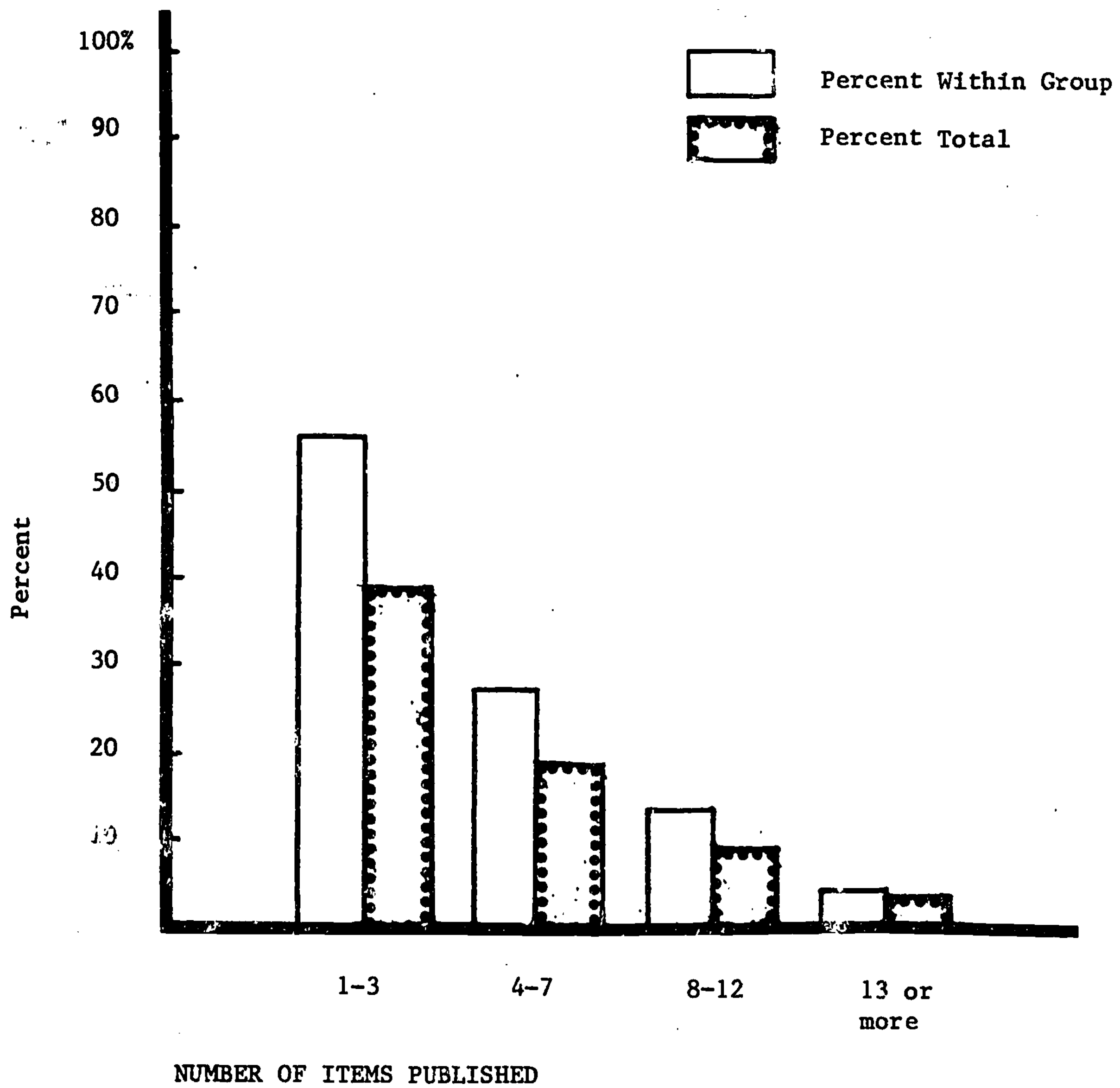


BOOKLETS AND INSTRUCTIONAL MATERIALS PUBLISHED BY FACULTY GROUP

Table 3.13 b

Number of Items Published	Number of Individuals	Percent Within Group	Percent Total
1-3	65	55.7	38.7
4-7	31	27.0	18.5
8-12	5	13.0	8.9
13 or more	5	4.3	3.0
	106		69.1

Graph 3.13 b

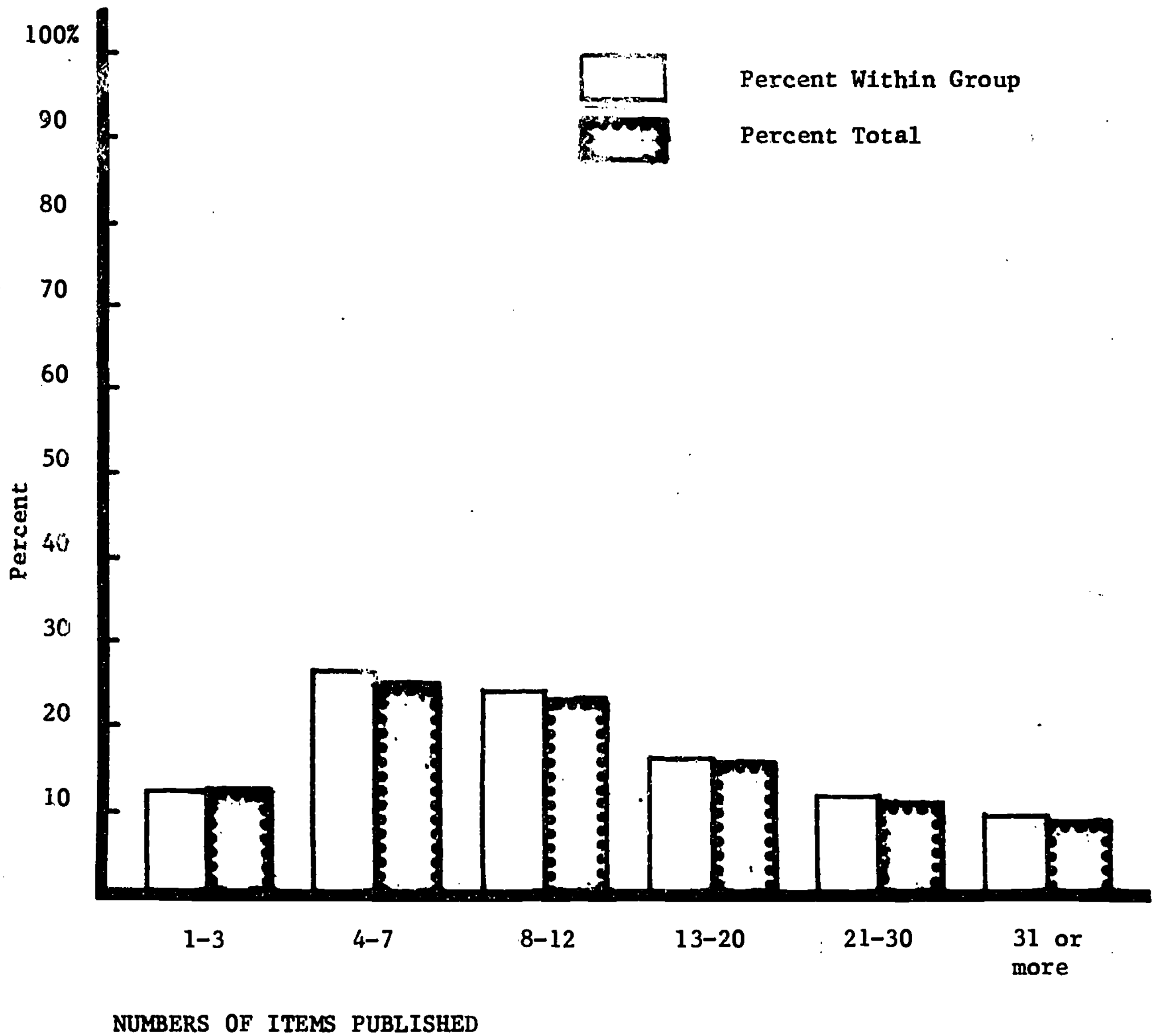


POSITION PAPERS AND PHILOSOPHICAL PAPERS PUBLISHED BY FACULTY GROUP

Table 3.13 c

Number of Items Published	Number of Individuals	Percent Within Group	Percent Total
1-3	21	12.4	12.5
4-7	42	26.1	25.0
8-12	39	24.2	23.2
13-20	26	16.1	15.5
21-30	19	11.8	11.3
31 or more	15	9.3	8.9
	162		96.4

Graph 3.13 c

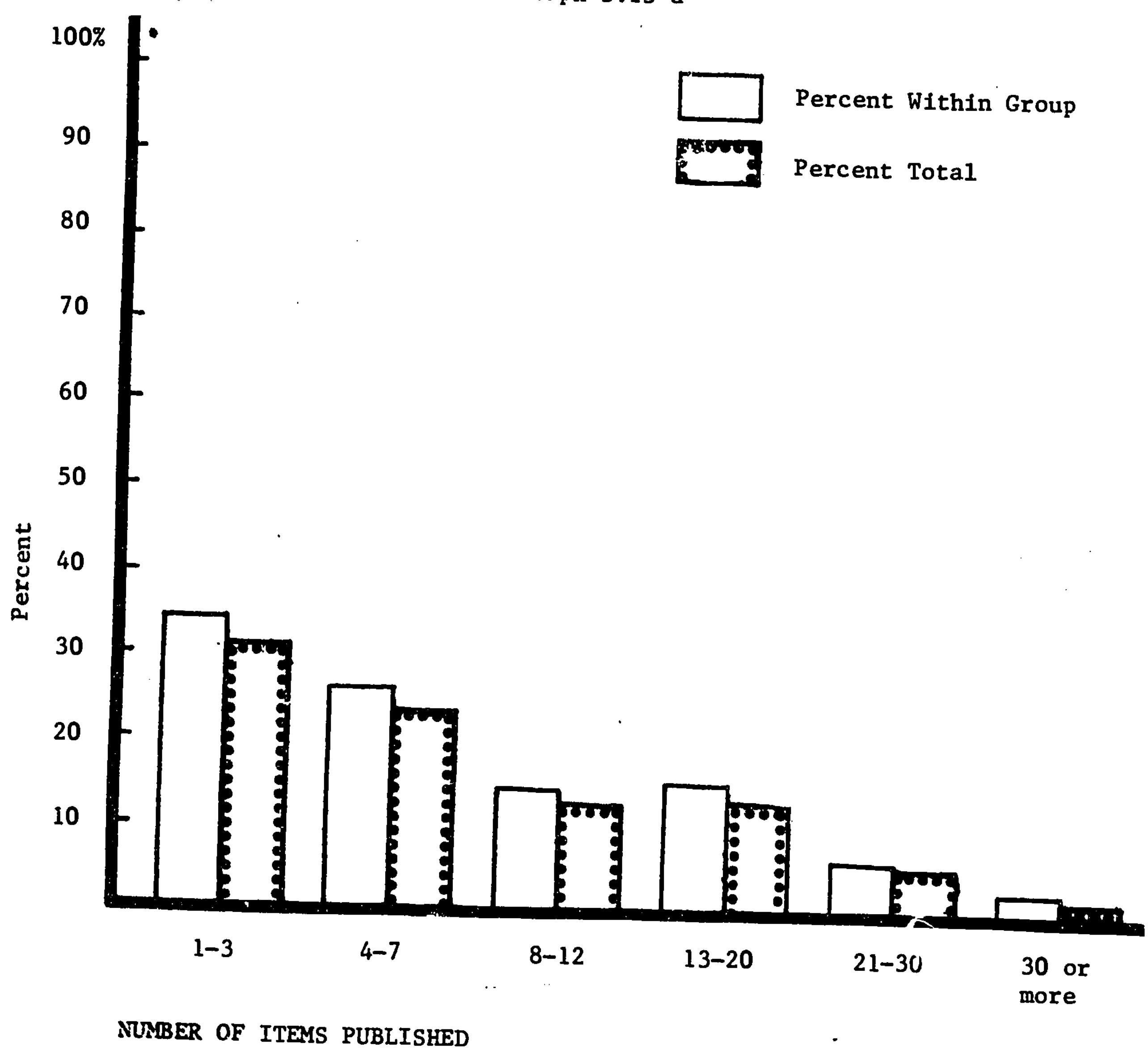


RESEARCH REPORTS PUBLISHED BY FACULTY GROUP

Table 3.13 d

Number of Items Published	Number of Individuals	Percent Within Group	Percent Total
1-3	52	34.4	30.9
4-7	40	26.5	23.8
8-12	22	14.6	13.1
13-20	24	15.9	14.3
21-30	9	6.0	5.4
30 or more	4	2.6	2.4
	151		89.9

Graph 3.13 d



V. Review of Science Education Research Reports

A fourth facet of the study of the status of science education at graduate centers in the United States is concerned with research productivity and focus. Several classification schemes have been proposed for reviewing the research in science education. The Educational Resources Information Center/Science, Mathematics, and Environmental Education Information Analysis Center (ERIC/SMEAC) uses a system as has the National Association for Research in Science Teaching for its annual meetings and its yearly research reviews. Unfortunately, these systems did not prove exclusive and/or meaningful in terms of reviewing the discipline in an informative way. The various systems seemed useful only for the purpose of categorization.

The system proposed by the National Institute for Education/ National Association for Research in Science Teaching (NIE/NARST) Special Committee for Determining Research Priorities (Yager, 1978) was ultimately adopted for this analysis of research in science education for 1960-80. This system provides a holistic view of the discipline since the major purpose of the scheme was that of defining the domain for science education. The scheme recognizes the terminology and view of systems analysts in that the inputs, throughputs, and the outputs of science education represent the major categories of the classification. The complete system used (with the same numbered and lettered categories used throughout with the tables, graphs, and discussion) is as follows:

1. Antecedents (entry conditions)
   a. Student Characteristics (i.e., interest, previous experiences, attitudes, cognitive development)
   b. Teacher Characteristics (i.e., philosophy, preparation, perceptions, personal traits)
   c. Science (i.e., content, processes, course and curriculum structure)
   d. School Climate (i.e., bureaucracy, policies, physical appearance, community influences)
   e. Societal Imperatives (i.e., environmental quality, societal views of science and/or technology, health and well being)
   f. Home Environments (i.e., vocation, family structure and function, physical features, philosophy)
   g. Science Facilities (i.e., classroom/laboratory, materials, budget)
   h. Goals (i.e., philosophy statements, school board and other outside groups, departmental)

2. Transactions (interactions)
   a. Pedagogy (i.e., procedures followed to promote instruction)
   b. Teaching Style (i.e., behavior traits of teachers)
   c. Social Climate (i.e., ways teachers and learners interact as a group)
   d. Curriculum Implementation (i.e., how content is organized and used with learners)
   e. System for Change (i.e., school policies, teacher and/or student intimation)

3. Outcomes (results of instruction)
   a. Student Achievement (i.e., test scores, other measures)
   b. Student Attitudes (i.e., student feelings about science and science learning)
   c. Student Behavior Change
   d. Teacher Behavior Change
   e. Scientific Literacy (i.e., more knowledgeable concerning meanings, limitations and value of science)
   f. Preparation for Practicing Scientific Vocations
   g. Institutional Effects
   h. Unanticipated (or unwanted and unplanned)

After reviewing many possible approaches to the analysis of research, it was decided to concentrate upon four sources of data, namely articles in the Journal of Research in Science Teaching, articles published in Science Education, dissertations listed in University microfilms, and the dissertation titles reported by the contacts at the thirty-five major centers for science education (Appendix H). These titles are also presented as a means of describing the actual categorization of research reports in all categories. Some work was accomplished with the yearly programs of the National Association for Research in Science Teaching, the annual research reviews prepared by the National Association for Research in Science Teaching, and the research publications listed by the 168 faculty members at the thirty-five major centers. For varying reasons, the analyses of the research reports in these three categories were not completed.

As in previous sections, the years 1960, 1965, 1970, 1975, and 1980 were chosen as key ones for reporting the situation during the twenty year period. In the case of the Science Education reports and the University Microfilm listing, 1975 was the last year for information.

Tables 4.1, 4.2, and 4.3 and Graphs 4.1, 4.2, and 4.3 provide information concerning the classification of research reported in the Journal of Research in Science Teaching, Science Education, Dissertations on University Microfilm, and the Dissertation reports by contacts at the thirty-five major centers in the area of entry conditions, interactions, and the results of instruction. It is at once apparent that the most popular kind of research has been concerned with entry conditions (category 1). There has been at least twice the activity with respect to entry conditions as that concerned with interactions and results of instruction (category 2 and category 3).

Table 4.4 and Graph 4.4 provide information regarding the general classification of science education research for all four sources for the years 1965, 1970, and 1975 -- the three years where there is corresponding information from all sources. The popularity of research dealing with entry conditions is again apparent as is the greater popularity of studying interactions over the results of instruction.

Table 4.5 and Graph 4.5 provide a breakdown of the dissertations that were analyzed 1960-80. Of the years reported, 1970 was the peak year for number of dissertations reported. As anticipated, the number coincides with the enrollment figures for Doctoral students from the thirty-five centers. It also parallels the dissertations entered in the University Microfilm listing. Stanley L. Helgeson (ERIC/SMEAC) provided a tabulation of all science education dissertations from all institutions recorded in Dissertation Abstracts as follows:

1955	1960	1965	1970	1975
26	51	211	231	209

These numbers represent averages for the two years on either side of the year listed. With the data for each specific year it was possible to identify 1973 as the peak year for number of dissertations produced in science education nationally. The trends with respect to categorization of dissertation research reflect the situation observed for the other sources of research reports that were studied.

Table 4.6 and Graph 4.6 provide information concerning the review of research as it pertains to the eight priorities identified by the NIE/NARST Committee report (Yager, 1978). Specifically, the eight priorities for research for the 1980's were:

Antecedents	Transactions	Outcomes
1. Teacher Characteristics	4. Pedagogy	7. Student Attitudes
2. Student Characteristics	5. Classroom Climate	8. Scientific Literacy
3. Social Imperatives	6. Implementation Activities	

As indicated from the preceding analyses, activity (as judged from reported research) has been most prominent in the area of entry conditions (715 of 1191 = 60%). Of special interest is the fact that of the three priority areas, social imperatives showed little activity (5 of 715 reports in Category I). However, nearly one-half of the reports (43%) are concerned with science -- its content and process. Reports concerning important areas of school climate, home environment, and science facilities are small in number (a total of 87 of 715 reports in Category I).

The second category, concerned with transactions, shows the greatest activity in pedagogy (203 of 274 = 74%) and some interest/activity/concern in the areas of social climate (12 of 274 = 4%) and implementation activities (46 of 274 = 17%). It is important to note that this category contains 274 of 1191 reports (or 23% of the total activity).

Numbers of reports concerning outcomes of instruction indicate the least activity of the three categories (202 of 1191 reports = 17% of activity). The priorities of student attitudes (20 reports) and scientific literacy (0 reports) represent only 10% of the activity within this category. Interestingly, these two priorities along with the six listed above were judged to be the ones where exciting breakthroughs were likely to be imminent.

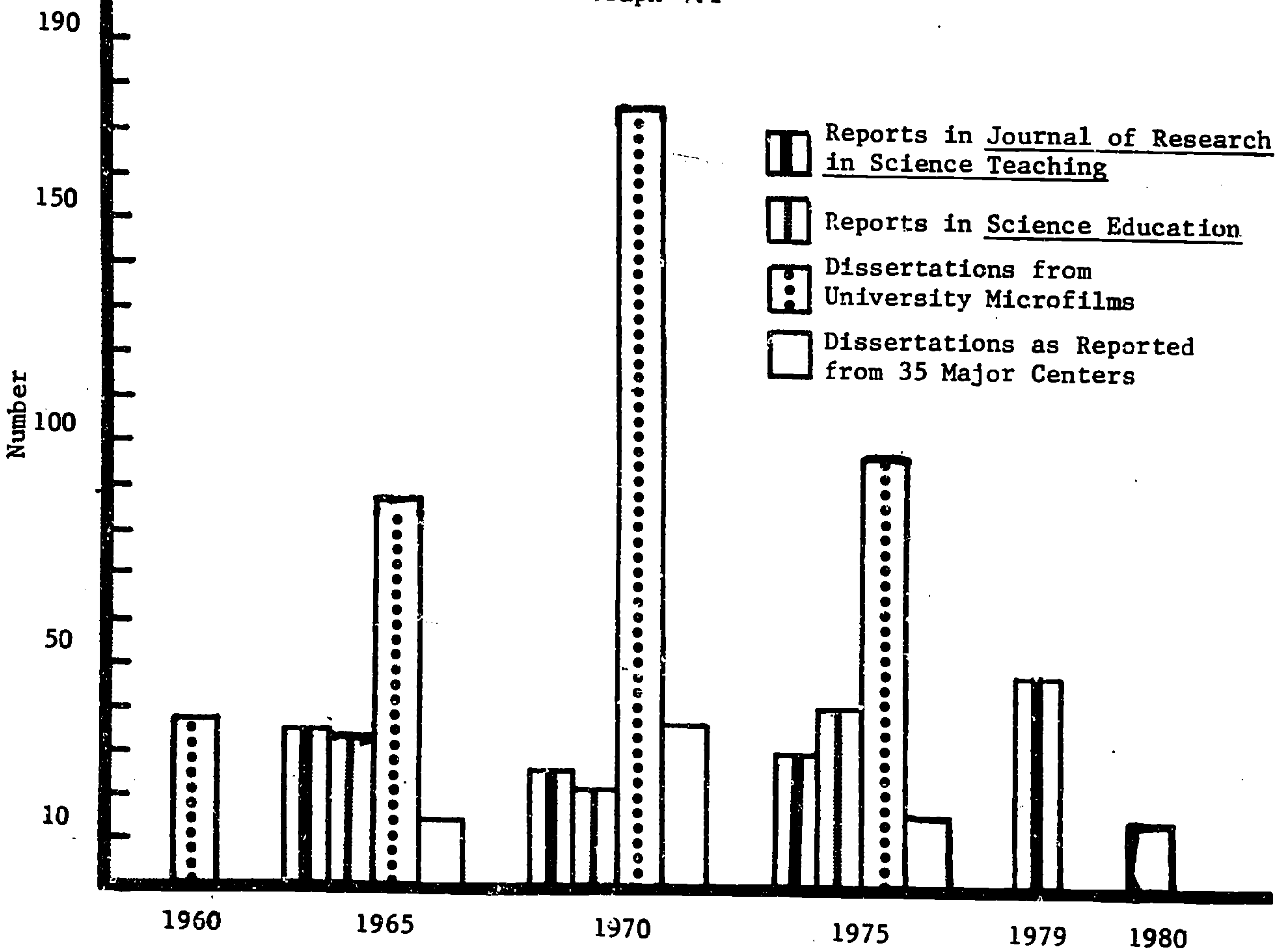
This part of the status study has not been concerned with a synthesis of research findings. Instead, it has been concerned with the number of reports and the categories which describe their location in the overall domain of science education. Special attention has been placed upon Doctoral research and that reported at the thirty-five major centers. Another interesting activity would be such a synthesis.

RESEARCH CLASSIFICATION CONCERNING ENTRY CONDITIONS*

Table 4.1

	Dissertations 35 Major Centers '65	'70	'75	'80	Journal of Research in Science Teaching '65	'70	'75	'79	Science Education '65	'70	'75	Dissertations (University Microfilms) '60	'65	'70	'75
1a	5	8	7	8	5	9	9	16	3	3	8	5	19	35	28
1b	2	6	4	2	5	4	8	7	3	6	4	10	18	46	17
1c	7	15	5	3	5	9	9	14	22	12	28	16	45	81	47
1d	1	-	-	-	1	-	-	-	3	1	-	1	-	5	-
1e	-	1	-	1	-	-	-	-	1	-	-	-	2	-	-
1f	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
1g	-	-	-	-	-	-	-	1	-	-	-	3	1	2	1
1h	-	1	-	1	18	-	-	-	-	-	-	1	2	2	3
1i	-	5	-	-	1	4	4	9	-	-	-	-	2	6	2
	15	36	16	15	35	.26	30	47	32	22	40	36	89	178	98

Graph 4.1



PUBLICATIONS PER YEAR

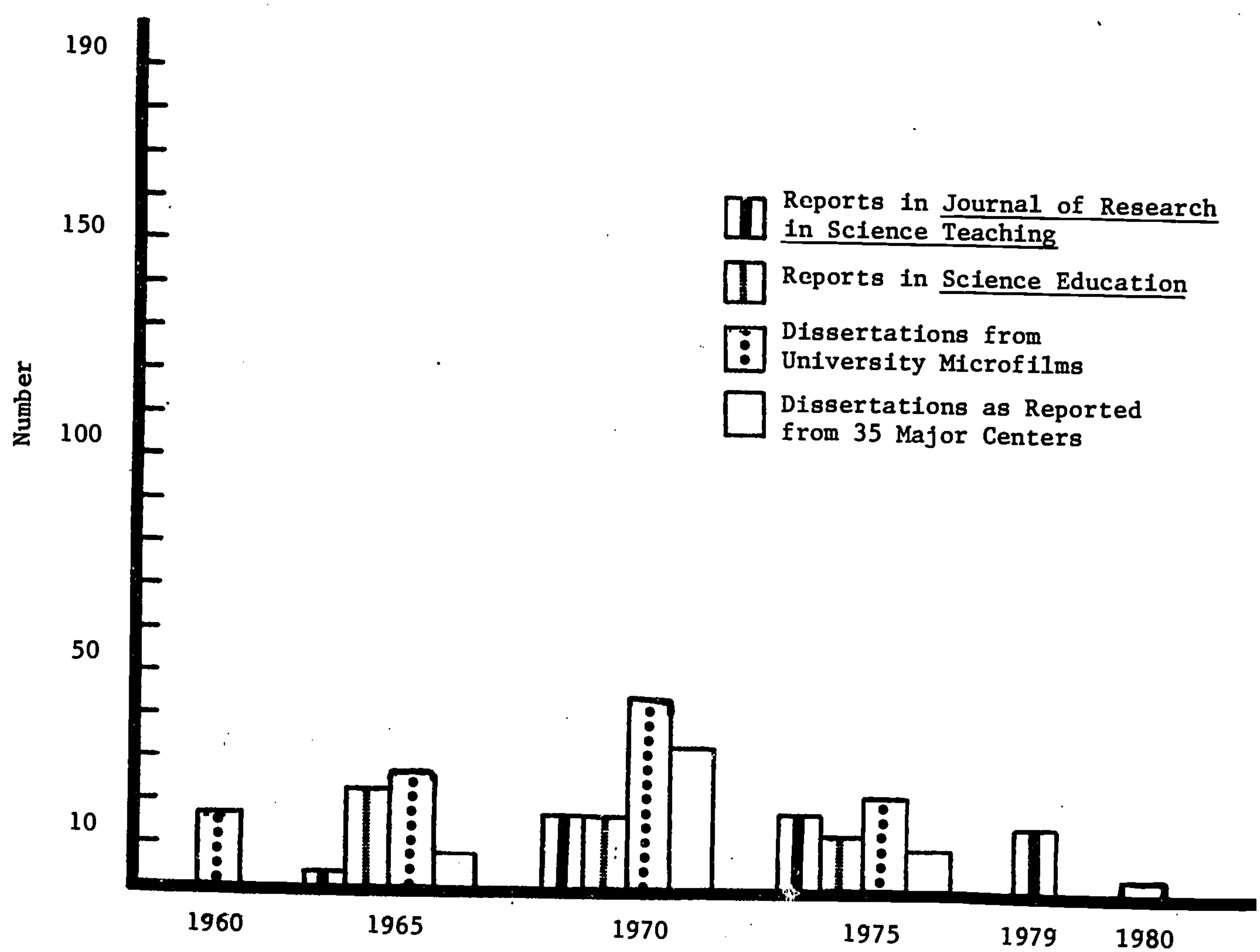
*Raw numbers for sample years from four information sources

RESEARCH CLASSIFICATION CONCERNING INTERACTIONS*

Table 4.2

	Dissertations 35 Major Centers				Journal of Research in Science Teaching				Science Education			Dissertations (University Microfilms)			
	'65	'70	'75	'80	'65	'70	'75	'79	'65	'70	'75	'60	'65	'70	'75
2a	5	27	8	2	2	5	16	11	22	17	11	9	17	36	15
2b	–	1	–	–	1	3	2	2	1	–	1	–	–	1	–
2c	1	1	1	–	–	2	–	2	–	–	–	1	1	3	1
2d	1	4	1	1	–	7	–	2	–	–	2	6	9	[illegible]	6
2e	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	7	33	10	3	3	17	18	17	23	17	14	16	27	47	22

Graph 4.2



PUBLICATIONS PER YEAR

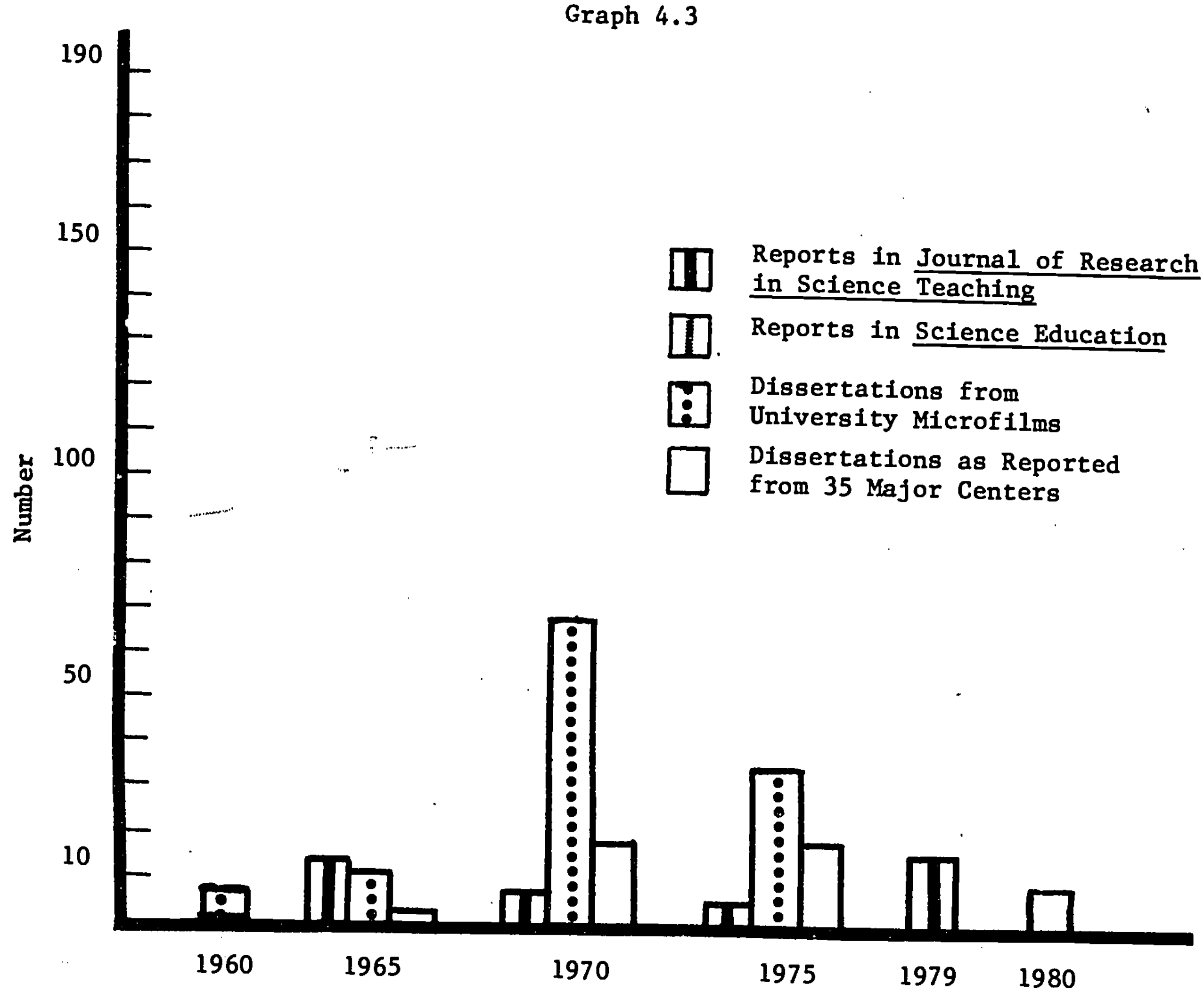
*Raw numbers for sample years from four information sources

RESEARCH CLASSIFICATION CONCERNING RESULTS OF INSTRUCTION*

Table 4.3

	Dissertations 35 Major Centers				Journal of Research in Science Teaching				Science Education			Dissertations (University Microfilms)			
	'65	'70	'75	'80	'65	'70	'75	'79	'65	'70	'75	'60	'65	'70	'75
3a	-	4	8	5	11	5	4	6	-	-	-	8	7	48	25
3b	-	1	3	-	-	1	-	-	-	-	-	-	-	6	9
3c	-	1	1	-	-	-	-	-	-	-	-	-	4	11	3
3d	-	7	4	2	1	-	-	9	-	-	-	-	-	5	1
3f	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-
3g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3h	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	0	14	16	7	12	7	4	15	0	0	0	8	11	70	38

Graph 4.3



PUBLICATIONS PER YEAR

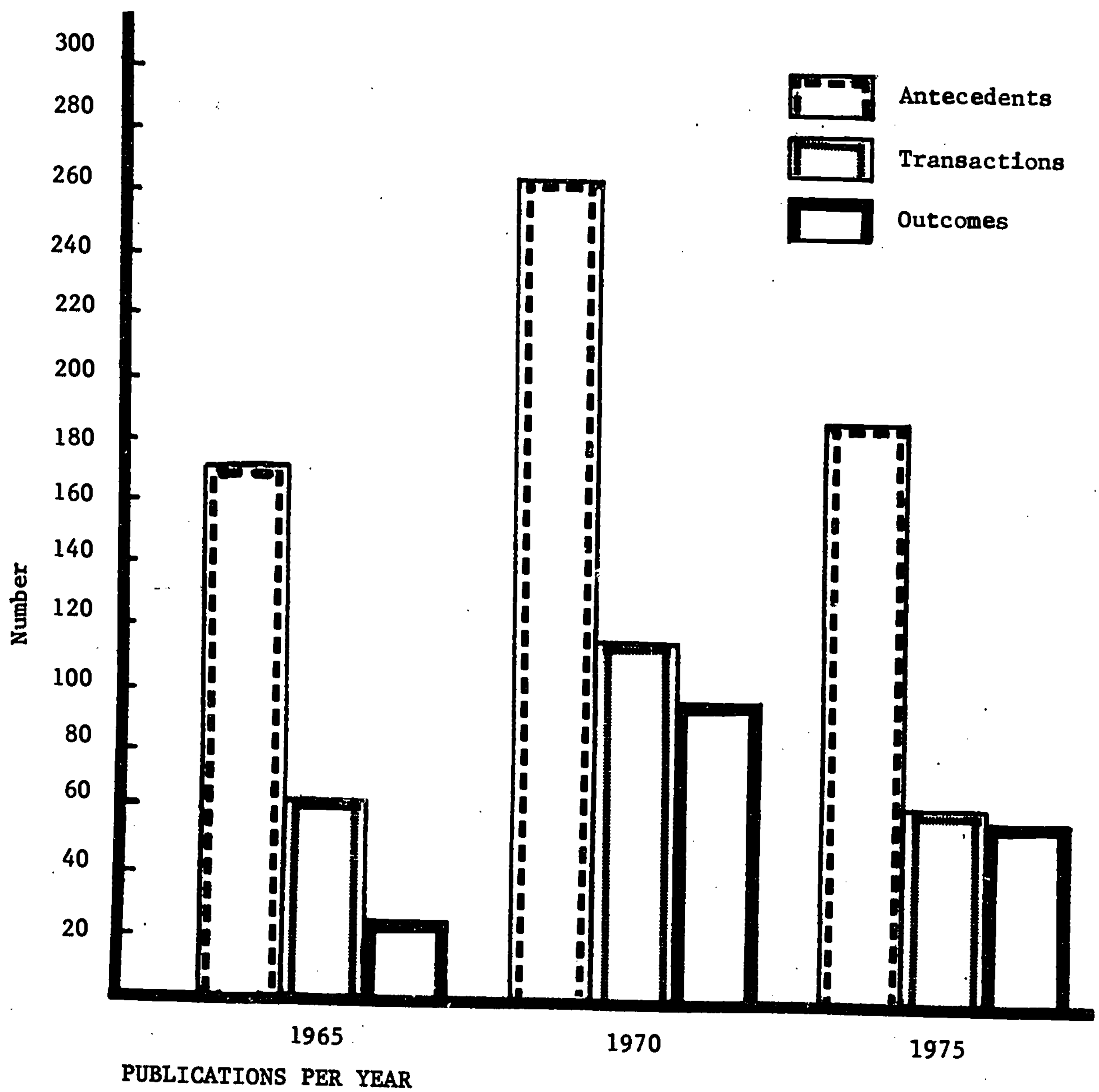
*Raw numbers for sample years from four information sources

COMBINED TOTALS FOR RESEARCH ARTICLES APPEARING IN THE JOURNAL OF RESEARCH IN SCIENCE TEACHING, SCIENCE EDUCATION, SCIENCE EDUCATION ENTRIES IN DISSERTATION ABSTRACTS, AND DISSERTATIONS REPORTED AT 35 MAJOR INSTITUTIONS

Table 4.4

Category	1965	1970	1975
Antecedents	171	262	184
Transactions	60	114	64
Outcomes	23	91	58
	254	467	306

Graph 4.4



BREAKDOWN OF DISSERTATION RESEARCH BY CATEGORY, 1960-1980

Table 4.5

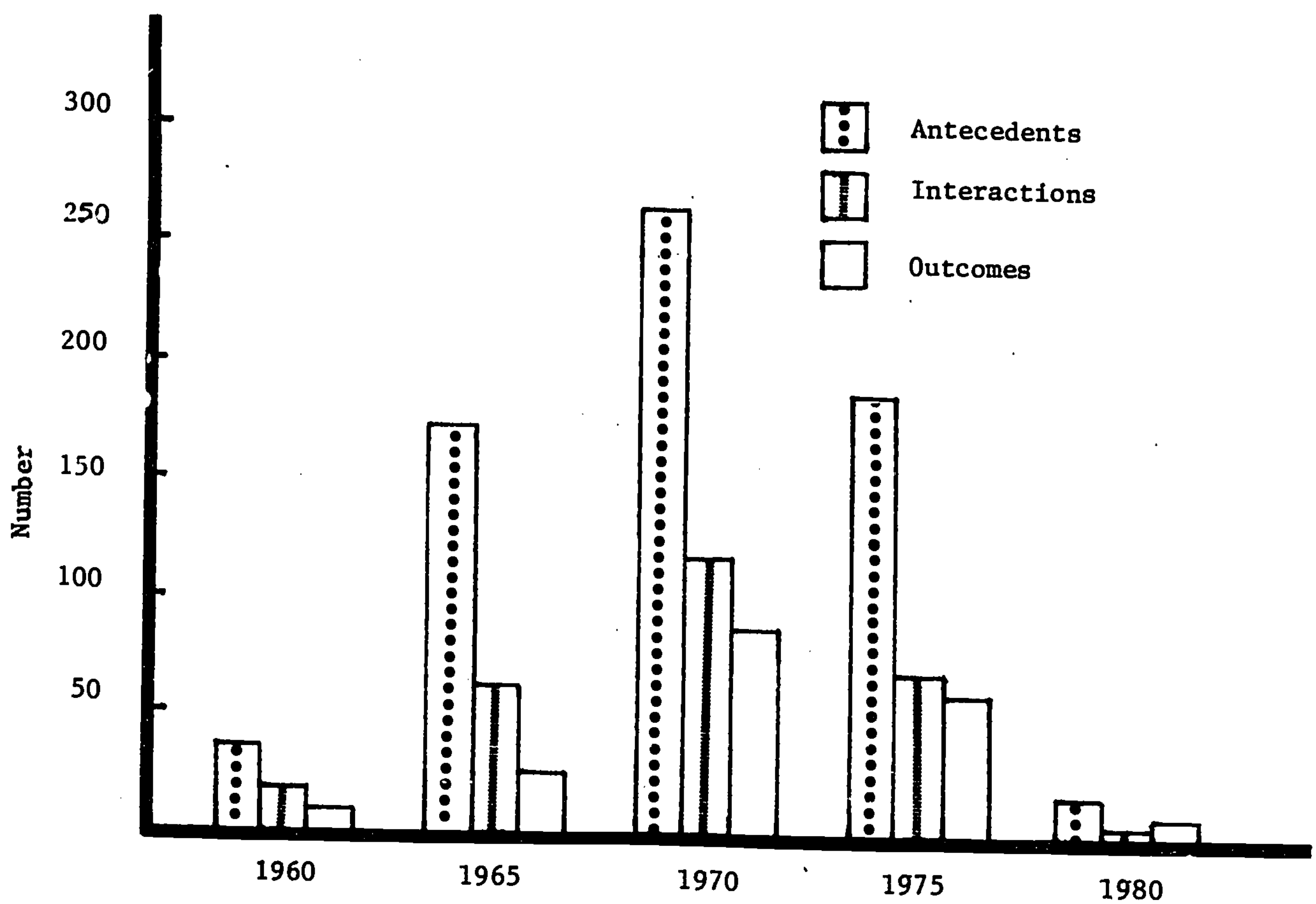
Category	1960	1965	1970	1975	1980
Antecedents	36	171	262	184	15
Interactions	16	60	114	64	3
Outcomes	8	23	91	58	7
	60	254	467	306	25

TOTAL NUMBER OF DISSERTATIONS CATEGORIZED*

1960	1965	1970	1975	1980
60	149	378	200	25

*Column 1 and 4 of Tables 4.1, 4.2, and 4.3

Graph 4.5



DISSERTATIONS PER YEAR

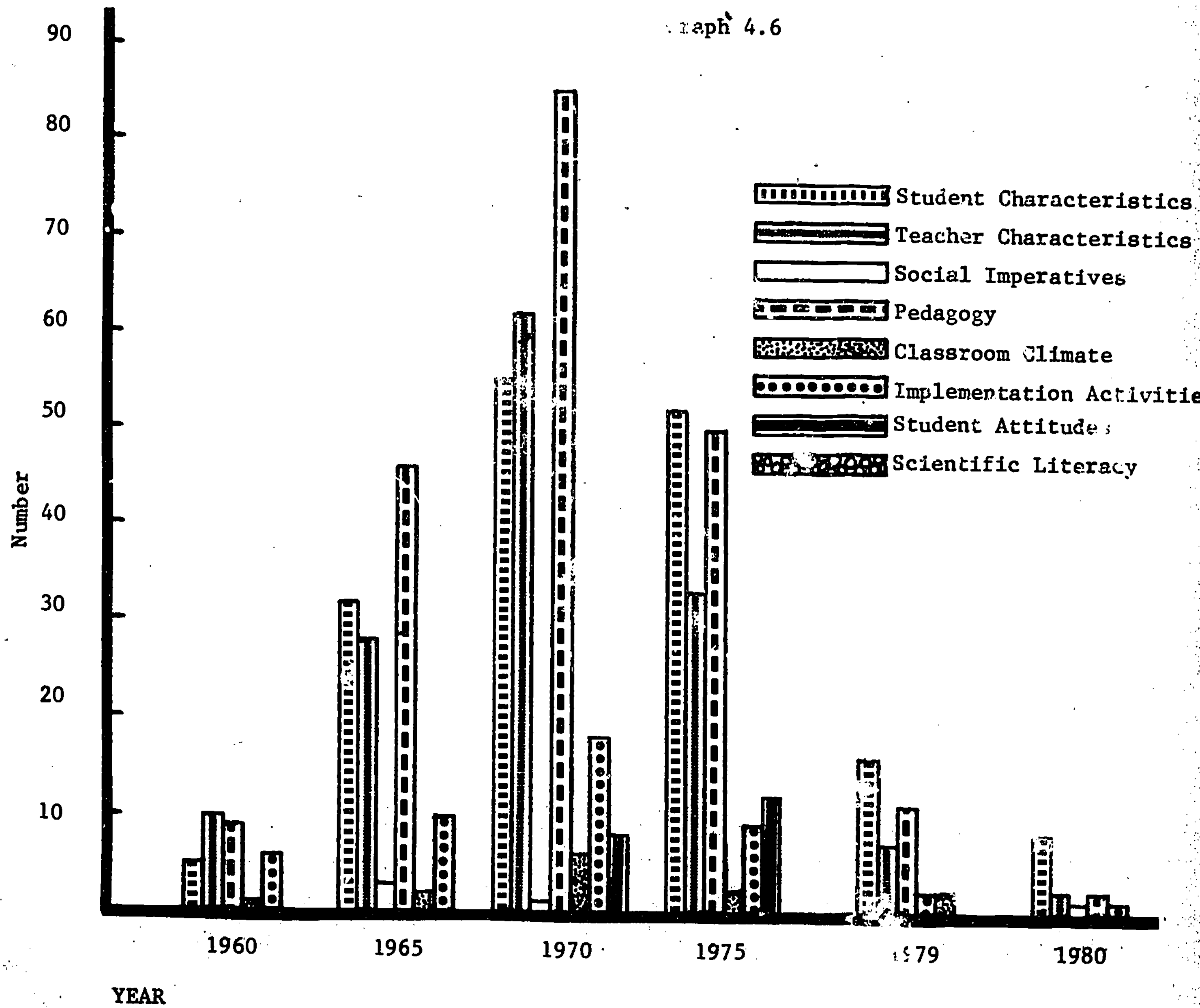
RELATIVE PRODUCTIVITY IN EIGHT AREAS

RESEARCH PRIORITY

Table 4.6

Category	1960	1965	1970	1975	1979	1980
Student Characteristics (1a)	5	32	55	52	16	8
Teacher Characteristics (1b)	10	28	62	33	7	2
Social Imperatives (1e)	0	3	1	0	0	1
Pedagogy (2a)	9	46	85	[illegible]	11	2
Classroom Climate (2c)	1	2	6	2	2	0
Implementation Activities (2d)	6	10	18	[illegible]	2	1
Student Attitudes (3b)	0	0	8	[illegible]	[illegible]	0
Scientific Literacy (3e)	0	[illegible]	0	[illegible]	0	0

Graph 4.6



VI. Summary and Recommendations

This study of the current status of science education at graduate institutions in the United States grew from a series of contacts and exchanges from representatives of major institutions who shared expressions of major problems, ideas for solving such problems, and analyses of the current professional crisis in the discipline. A steering committee prepared a paper which outlined features of the crisis (Yager, 1980a). Ideas for this paper were later shared with the membership of the National Association for Research in Science Teaching at the 1980 annual meeting in Boston in a general session (Yager, Bybee, Gallagher, and Renner, 1980).

It was soon apparent that more precise information would be helpful regarding science education institutions, programs, enrollments, faculty, and research as a first step in approaching discipline problems. This status study of graduate science education in the United States, 1960-80, was conceived as a four part study. It consisted of a survey of all graduate institutions concerning the existence of graduate programs in science education, an identification of major centers and a closer look at these, a review of the faculty at the major institutions with programs in graduate science education, and a review of the nature of research reports in science education for the twenty year period.

After some time, response from questionnaires sent to the 365 graduate institutions was received from 328 institutions for a response rate of over ninety percent. Of the responding institutions, only 132 reported having a graduate program in science education. Of these, fewer than 70 had formal Doctoral programs in science education. When all 132 programs are considered, enrollment trends indicate a very significant decline in Bachelor's degree recipients, with the peak number of graduates occurring in 1974. For Master's degree programs, the peak year of production was 1974 with a slight decline noted currently. In the case of Doctoral programs, the number continues to increase during the current year although there has been a definite decrease in the rate of growth.

Nearly half of all graduate programs in science education exist as units within Curriculum and Instruction departments in Colleges of Education. When changes have occurred, the direction of change is for less autonomy for science education as a discipline. The number of courses offered in science education _per se_ has increased as faculty size has stabilized and enrollments declined.

The major responsiblity for science educators at the 132 institutions with graduate programs is teacher education. Graduate teaching, research, and teaching science courses are also important responsibilities for the faculty in science education. Correspondingly, the major interest of the faculty members is also teacher education. Teacher education is a major activity, interest, and research area for members of science education faculties.

The second part of the study was a close look at the thirty-five centers with the largest programs, especially in terms of the Doctorate. Well over ninety percent of Doctoral graduates were from one of the thirty-five institutions during the 1960-75 period. During the last five years, more Doctoral students are graduating from institutions other than the thirty-five largest centers.

Enrollment at the Bachelor's, Master's and Doctoral levels at these thirty-five centers increased dramatically during 1960-70. The Bachelor's enrollment peaked at 1970 with continuing declines to 1980. The Master's and Doctoral enrollments peaked at 1975 with declines at both levels reported for 1980.

Graduate programs at the thirty-five institutions (both Master's and Doctoral levels) have tended to become more rigid during the twenty year period with more courses required in all categories. The degree programs include advanced preparation in science (approximately one-half of the program), experiences in science education (about one-fourth of the total program), experience with history/philosophy/sociology of science, general preparation in curriculum and instruction, and research credit.

The number of faculty members, support staff, and graduate assistants has decreased during the past five years. In a similar fashion, the level of outside support for student programs, for in-service teacher education, and for curriculum development and research has decreased dramatically. In contrast, the level of internal support has increased for faculty salaries, support staff, and supplies. The increase for materials and supplies has not increased in proportion to inflation. The internal support for graduate students has declined during the past five years. The physical facilities for science education have remained rather stable over the twenty year period.

There have been striking changes in employment patterns for Doctoral graduates. Most Doctoral students were employed by universities during 1960-70; the number has decreased since 1970. The number of science education graduates employed as college science teachers increased during 1960 to 1975 with the greatest increases occurring between 1965 and 1970. Graduates returning to schools, usually leadership positions, became common in 1970 and increased through 1975. It appears that fewer have been employed by school districts between 1975 and 1980. The number of Doctoral graduates employed in health fields, in government, in industry and similar non-traditional areas became common in 1970. Employment in such areas seems to have declined in the recent past, including the current year. The significant number of international students enrolled at the largest centers was noted as a current situation.

The third facet of the study was concerned with the 168 faculty members at the thirty-five centers. Most were found to be 35 to 50 years of age. Most had Doctoral training at one of the thirty-five major centers. Although the experience records varied as to teaching, by far the majority of the faculty members had significant teaching experience at the high school level (4-15 years). The faculty members were extremely active professionally with most holding memberships in many organizations. The group has been very active in terms of publications. The average number of textbooks written is 2.3; the average number of professional/ instructional materials is 2.8; the average number of position/philosophical articles is 14; the average number of research reports is 8.

The number of faculty at the thirty-five major centers is stable. A total of eighty-two percent is tenured; most were appointed at the center between ages 30 and 44. The average number of faculty at each center is 4.8 with the range being one at one center to twelve at two centers. About two-thirds of the faculty members earned their degrees in science education per se; nearly ninety percent from one of the thirty-five centers involved in the study. Nearly three-fourths of the group received their

Doctorates between 1961 and 1975. Women comprise only 12 percent of the group.

The fourth part of the study was concerned with an analysis of research for the twenty year period. The years 1960, 1965, 1970, 1975, and 1980 were selected for analysis of research appearing in the Journal of Research in Science Teaching, Science Education, Dissertation Microfilm, and the dissertation reports for the same years produced at the thirty-five major centers. The classification scheme proposed by the NIE/NARST Steering Committee (Yager, 1978) was used to categorize research reports from each of the four sources.

The most common kind of research has occurred in the area of entry conditions. When only the NIE/NARST eight priorities were considered, proportionately more activitiy in the area of interaction studies was noted for the three priority areas in this category. Little research is occurring in the results of instruction area even though two of the eight priority areas are in this category. This probably reflects lack of agreement regarding a rationale for the profession and for a theory base for research efforts in science education.

The dissertation research peaked in terms of quantity during 1970. This reflects the peak number of graduates at the thirty-five major centers and the number of science education entries in the University microfilm listings of dissertations nationally.

The status study revealed many areas indicative of problem/crisis for the discipline of science education, 1980. These include:

1) the decrease in number of active graduate science education programs;

2) the move to less autonomy for science education on campuses;

3) disagreement as to the nature of and priorities for the discipline of science education;

4) decrease in faculty numbers and hence areas of specialization in the field;

5) homogeneous faculty set as to age, background, experience, and aspirations;

6) a relatively high degree of professional isolation both within the discipline and with respect to other related disciplines;

7) little evidence of cooperative research and adequate communication among centers;

8) decline in external support, especially for training programs;

9) too little involvement in externally funded research and curriculum development;

10) too much 'one-shot' research;

11) decrease in support for graduate students in science education and for operating programs;

12) significant changes in employment patterns for graduates in science education.

The study of the status of graduate science education results in several recommendations for next step actions. Some of these include the following:

1) There is a need for attention to a better definition for the discipline of science education. Criteria need to be formalized for determining such a definition, a framework, and a rationale for science education.

2) Attention must be given to solving the fractionalization within the field. This pertains to areas of research, levels of teaching, and institutions (both with respect to other institutions of higher learning and with public schools).

3) New research procedures are needed that will coincide with a new definition for science education and new goals at every level. Important questions should be agreed upon and the best minds and resources used for their resolution.

4) Major research centers must be more concerned with the future of the discipline than upon preparatory functions and instructional programs per se. Too many science educators are too involved with training -- at all academic levels; too few have an opportunity for creative and futuristic thinking.

5) More attention is needed for synthesizing the research within science education. Such synthesis should also be coordinated with similar efforts in related disciplines.

6) Major curricular innovation is needed -- more so than in the early 1960's; however, the efforts must be responsive to the needs of all facets of society. Mere attention to updating the disciplines of science for science teaching as it has been known in the past will not be adequate.

7) Science education and science educators must be concerned with more than teaching science in schools. The whole population is largely illiterate with respect to science -- an indication of major failures of past efforts with school science.

8) Research in science education should be expanded to include the ecology of science teaching. Such research should be concerned with the present understanding and needs of science teachers and how they interface with related social problems. Cooperative research programs among individuals and research centers are needed; such efforts should be concerned with synthesizing and interpreting research for practitioners and the general public as well as for other researchers.

9) There is need for more attention to science for special populations and/or all segments of our current population. Such efforts will alter the concentration upon science as mastery of specialized information for professional preparatory functions only.

10) Linkages are needed among the faculties of large science education centers, other colleges and universities, other educational agencies and units, and the K-12 schools. Networks for cooperative efforts (including research, development, and evaluation) are needed to maximize the potential for resolving problems in the discipline of science education.

REFERENCES

Butts, David P. "Doctoral Program for Science Educators." 1977 AETS Yearbook, Science Teacher Education: Vantage Point 1976. Columbus, Ohio, ERIC/SMEAC, 1977.

Butts, David P. and Robert E. Yager. "A Comparison of Twenty-Two Doctoral Programs Over a Fourteen Year Period." Science Education, in press.

Butts, David P. and Robert E. Yager. "Science Educators' Perceptions of the Graduate Preparation Programs of Science Teachers in 1979." Journal of Research in Science Teaching, in press.

Bybee, Rodger and Robert E. Yager. "Science Education Needs a New Direction." Science Education, submitted for publication.

Gallagher, James J. and Robert E. Yager. "Perceived Problems of Science Educators for Their Discipline." Science Education, in press.

Gallagher, James J. and Robert E. Yager. "Science Educators' Perceptions of Problems Facing Science Education: A Report of Five Surveys." Journal of Research in Science Teaching, in press.

Gerlovich, Jack and Robert E. Yager. "Comparison of Perceptions of Major Problems in Science Education." Iowa Science Teachers Journal, in press.

Helegson, Stanley L., Patricia E. Blosser, and Robert W. Howe. "Science Education Volume 1." The Status of Pre-College Science, Mathematics, and Social Science Education: 1955-75, Washington, D.C., U.S. Government Printing Office.

Hurd, Paul D. "Transformation of Science Education: Challenges and Criteria." Science Education, submitted for publication.

Kahle, Jane B. and Robert E. Yager. "Current Indicators for the Discipline of Science Education." Science Education, in press.

Renner, John W. and Robert E. Yager. "Proposed Solutions for Perceived Problems in Science Education - 1979." Science Education, in press.

Stake, Robert E. and Jack Easley, Jr. "The Case Reports, Volume 1; Design, Overview and General Findings, Volume 2." Case Studies in Science Education, Washington, D.C., U.S. Government Printing Office, 1978.

Weiss, Iris R. Report of the 1977 National Survey of Science, Mathematics and Social Studies Education. Washington, D.C., U.S. Government Printing Office, 1978.

Yager, Robert E. "Case Studies of Nine Graduate Programs in Science Education." Technical Report #22, Science Education Center, University of Iowa, 1980b.

Yager, Robert E. "Confronting Problems with Solutions in Science Teacher Education." The Science Teacher, in press.

Yager, Robert E. "Crisis in Science Education." Technical Report #21, Science Education Center, University of Iowa, 1980a.

Yager, Robert E. "Priorities for Research in Science Education." Journal of Research in Science Teaching, March 1978, 15 pp. 97-107.

Yager, Robert E. "A Survey of Perceptions of Major Professional Problems and Recommendations for Their Solution by Science Educators Representing Major Centers in the United States." Technical Report #18, Science Education Center, University of Iowa, 1979.

Yager, Robert E., Rodger Bybee, James J. Gallagher, and John W. Renner. "An Analysis of the Current Crisis in the Discipline of Science Education." Journal of Research in Science Teaching, in press.

Yager, Robert E. and Jane B. Kahle. "Priorities for Needed Policies and Research in Science Education." Journal of Research in Science Teaching, submitted for publication.

APPENDICES

APPENDIX A

TWENTY-EIGHT INSTITUTIONS AND TWENTY-EIGHT CONTACT PERSONS*

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*These persons agreed to serve as contacts for their respective institutions for the professional exchanges which occurred late in 1978 and throughout 1979 among science educators. Some utilized their faculty colleagues at each institution more than others as the dialogue about current professional problems transpired. The original group for the effort consisted of Marjorie H. Gardner, Fletcher Watson, and Robert E. Yager.

APPENDIX B

Following is a listing and a brief summary of manuscripts which resulted from the two year effort that produced this Status Study. The first in the series represents the thinking of the concerned science educators who first agreed that the current crisis in science education demanded attention. Several represent reports of some information of interest to the profession as a precursor and a supplement to the actual status of the profession *per se*. Some represent reports to professional groups which were a part of the original NSF contract. The last manuscript is the paper presented as a general session at the 1980 national meeting of the National Association for Research in Science Teaching.

Other reports will be published. Sections IV and V include important information that should be analyzed and reported as a series of publications. The information in these sections was secured after some of the earlier data were studied. Information gaps and follow-up questionnaires promise additional reports and publications arising from this national effort in the future.

1. A Survey of Perceptions of Major Professional Problems and Recommendations for Their Solution by Science Educators Representing Major Centers in the United States.

Robert E. Yager, The University of Iowa

Technical Report Series #18, Science Education Center, The University of Iowa, 1979.

During the early part of 1978, a series of informal discussions among science educators at professional meetings were held involving persons across the U.S. It became obvious that there was much concern, turmoil, and lack of agreement about the future of science education as a discipline. At an international meeting in Israel in July of 1978, the U.S. participants agreed to contact persons at all major centers for science education to learn of interest in formal communication, person-to-person meetings, and some action regarding the apparent professional crisis.

Late in 1978, all representatives of the twenty-eight institutions were asked to prepare a statement (approximately one page in length) which would identify their perceptions of major problems which are affecting science education currently. All twenty-eight science educators knew that these statements would become a part of a set of statements for further analysis, discussion, and action.

Early in 1979, the twenty-eight institutional representatives were asked to read the problem statements and to consider the set and/or their own problem statements further before offering some proposed solutions to the current professional problems in science education.

The problems and solutions stated were tabulated and analyzed; they were discussed in open forum. This is a report of the original statements, the analyses, and the discussions regarding them.

The concerns of the science education profession are great. There is a universal agreement that we are in a time of crisis. The information provided in this report and the initial analyses of the problem and solution statements have provided a rich data base for preparing a major paper as a first step in recognizing the crisis and establishing directions for action.

2. Perceived Problems of Science Educators for Their Discipline.

James Joseph Gallagher, Michigan State University; and Robert E. Yager, The University of Iowa

Science Education, in press.

A mail survey directed to twenty-eight science educators at the twenty-eight universities in the United States responsible for nearly all graduates research, was conducted. Each science educator was asked to prepare a short description of his/her perception of the current problems in science education in the United States either as an individual or after consultation with colleagues at the particular institution.

The participants presented their statements of problems in an open-ended narrative format. The results of the survey on perceived problems follow:

Problems	Frequency
I. Societal Attitudes towards Science	
A. General anti-science tenor of society.	11
II. Rationale for Science Education	
A. Uncertainty about goals and objectives of science education.	15
B. Lack of leadership of science education.	8
C. Lack of theoretical base to guide theory and practice.	6
III. Teacher Education in Science	
A. Poor quality science education programs.	5
B. Lack of interactions between researchers and	4
C. Lack of valid inservice programs	4
D. Failure to help teachers understand the nature of science.	3
E. Limited contact between university and precollege faculty.	3
IV. School Programs in Science	
A. Declining enrollments in science courses	12
B. Poor teaching and counseling in science and mathematics.	5
C. Lack of science programs for all students.	4
D. Programs and movements that exclude science education.	4
E. Changes in number, average age and quality of staff.	4
F. Lack of achievements in science.	3
G. Unionism and governmental control.	2

Problems	Frequency
V. Budgets for Science Education	
A. Diminishing budgetary reserves	9
B. Job shortages university science educators	5
C. Limited support for doctoral students	2
D. Program cutback	2
E. Federal budgeting schedule	1

3. Proposed Solutions for Perceived Problems in Science Education - 1979.

John W. Renner, The University of Oklahoma; and Robert E. Yager, The University of Iowa

Science Education, in press.

Early in 1979 representatives of twenty-eight major science education centers were asked to reflect upon proposed problem statements, local discussions, other readings and professional contacts. They were then asked to prepare brief and succinct statements that represented proposed solutions to these current problems in science education today.

The suggested solutions for the current problems in science education as proposed by twenty-eight science educators from the major research centers in the field are as follows:

ADMINISTRATION

1. Increase funding - at all levels; provide grants to assist with inservice, research, graduate work and post-doctoral studies.
2. Attempt to move science education into a formal science education center or move science education out of education.
3. Restore the status of science coordinators in schools and regional centers.
4. Encourage legislation which mandates continuing education to maintain licensing; develop appropriate college courses for science education personnel.
5. Seek a market for degree holders in other areas.
6. Make science educators responsible for the education in science for the general public.
7. Establish a "doctoral practioner degree".
8. Increase communication among science educators.

RESEARCH

1. Develop cooperative research programs among research centers.

2. Establish research paradigms and recommend that all research arise from them.

3. Insure that research has integrity and is not "available for purchase".

4. Initiate research to guide curriculum and instruction.

5. Promote research which articulates the contribution of science experiences to intellectual growth.

6. Emphasize research which analyzes and synthesizes what is known.

7. Identify specific traits, skills and attitudes of a scientifically literate person.

8. Relate research to teaching practice.

SCIENCE CONTENT

1. Identify the basic body of content, the processes, the attitudes, and the other dimensions of science which students at the various grade levels should experience and learn.

2. Develop and offer courses to teachers in the science disciplines which are applicable to the responsibilities of a science teacher.

3. Concentrate science courses upon educating today's students to consider problems which are facing society today.

4. Educate teachers and those educating the teachers to be aware of the function and limits of scientific knowledge in a democratic society.

5. Document that achievement of science objectives enhances performance in areas of the other basic skills.

THEORY AND LEARNING

1. Establish a theory base for science education to guide science teaching at all levels as well as the teaching of science education and research in science education.

2. Establish a clear, succinct set of goals for science education.

3. Make evidence known that achievement of the goals of science enhances performance in other basic skills.

THEORY AND LEARNING continued -

4. Be sure theory base reflects the nature of science and the nature of the human as a synergistic whole.

5. Emphasize the philosophic foundation of science and less "the so-called psychological foundation of learning".

TEACHER EDUCATION

1. Increase the number, kinds, and availability of in-service education programs.

2. Examine existing teacher education programs and attempt to identify theoretical orientations which have relevance for classroom practice.

3. Devise means which will enable science teachers to integrate graduate work in science education and continued work in the classroom.

4. Ensure that the education of science teachers considers not only the fundamentals of science but the fundamentals of education and the many dimensions of science as it interfaces with society.

5. Prepare persons for helping non-school learners with the world of science.

4. Current Indicators for the Discipline of Science Education.

Jane Butler Kahle, Purdue University; and Robert E. Yager, The University of Iowa

Science Education, in press.

This report is a synthesis of the proposed indicators for science education as a discipline. The data base for the study includes the correspondence that occurred prior to and following a face to face meeting of contacts from the twenty-eight major research centers, an analysis of the open dialogue, and a review of reports circulated prior and following the open forum.

Following are the indicators of desired directions and future foci, perceived by active and concerned science educators, for science education as a discipline in 1980. Although the list is not presented in any order of importance, it does represent the frequency with which an idea was mentioned.

1. Science teachers will be the key to improved science education.
2. The teaching of science will focus on current scientific/ technological/societal problems.
3. Efforts to redefine and to improve science education will involve persons from all dimensions of the field.
4. A new rationale for science education as a discipline will reflect the nature of science, the nature of society/culture, the expectations of education, and the needs of human beings.
5. Major research efforts in science education will seek to establish criteria and mechanisms for improving science teaching.
6. Science education will include more than teaching science in schools.
7. Science education will be concerned to a greater degree in the role and importance of science for special populations.

8. Values and ethics will be considered integral parts of science education as they are related to scientific/technological/societal problems.

5. Science Educators' Perceptions of the Graduate Preparation Programs of Science Teachers in 1979.

David P. Butts, The University of Georgia; and Robert E. Yager
The University of Iowa

Journal of Research in Science Teaching, in press.

The ecology of science teacher development relates students, their teachers, their teacher's instructors and the instructor's graduate professors together in an interacting web. The purpose of this study is to describe the context and commitments of the graduate programs as perceived by the graduate professor of science education as one important component of science teaching leadership development.

The following questions were asked; the responses tabulated and analyzed:

a) What are the institutional commitments to its task of preparing science education leadership and now have these changed in recent years?

b) What are the student commitments to the task of science education leadership and how have these changed in recent years?

c) What are the program emphases related to the task of science education leadership and how have these changed in recent years?

The science educators were also asked to reflect upon professional needs of the future. They identified the following:

a) A new broad and more flexible focus for the graduate degree program are needed.

e.g., -- New majors for community college teaching, environmental education.

-- New emphasis on practitioner rather than research orientation.

-- Increased depth and breadth.

-- Make degree holders more attractive in the market place.

b) Assume leadership in developing a public understanding of science.

e.g., -- Educate the public on the need and function of science education - both related to general goals of schooling.

-- Make graduates greater advocates of science as an applied field.

-- Assume substantative leadership within respective states, regions, and nation.

c) Initiate fresh recruiting for keen minds in science education.

e.g., -- Initiate MAT-type programs for the non-teaching science major.

-- Focus on new science education related courses.

-- Encourage greater foreign student involvement.

-- Increase the attractiveness of science teaching as a career.

d) A clear focus is needed in the applied nature of science education programs.

e.g., -- Increase the interface between university and public schools, add skills in computer applications, and initiate off-campus degrees and inservice programs.

e) Secure stronger budget support both to maintain pace with inflation and to provide support for on-campus residence.

6. Transformation of Science Education: Challenges and Criteria

Paul DeHart Hurd, Stanford University

Science Education, submitted for publication.

The development of a conceptual framework and associated goals for science teaching should be a product of primary data and conceptual analysis; it is a lengthy process of research, not an event. Unless a statement can be backed by empirically determined information demonstrated as a function of science or society its status is little more than that of wishful thinking or an unanalyzed generalization. The criteria for an acceptable conceptual framework, beyond that of appropriate scholarship, are found in the following frames of reference:

- the current condition of the scientific enterprise and the mode of scholarship of the contributing science disciplines;
- the impact of science on the social process and the interactions characterizing the science/technology/society/values paradigm;
- the persistent science/society problems and issues that characterize our culture;
- the conditions of knowing and the cognitive and affective attributes essential for rational behavior in a science/technological based society;
- the flow of existing intellectual currents for ideas, empirical generalizations, perspectives and human priorities that are pertinent to a science conceptual framework.

The synthesis processes for developing the conceptual enlightenment we seek are available. Once a conceptual framework is developed, refinement and changes are brought about through research, testing in a real-life situation, and constant re-aligning with shifts in science and society. Whatever disputes may evolve regarding the framework are to be settled by recourse to evidence.

7. Crisis in Science Education.

Robert E. Yager, The University of Iowa

Technical Report Series #21, Science Education Center, The University of Iowa, 1980.

The report begins with an assessment of the current status of science education based on three separate surveys seeking to:

1) provide current information about the nature and activities of the science education programs at twenty-eight major universities;

2) identify perceptions of problems facing science education by some of its practitioners; and

3) collect suggestions from a sample of science educators for solving some of the current professional problems.

In addition, an open forum with representatives from the twenty-eight science education programs was held, recorded, and analyzed. Further, all major reports, studies, and analyses concerning science education as a profession published in the last four years were studied and synthesized.

The third phase of this report is an analysis of the current crisis from a philosophical perspective. It arises from a prospective synthesis of current literature in science education and related disciplines, the analyses reported in Part Two, and the open forum. Such a perspective provides a context and a framework for analysis and reflection for ameliorating the crisis.

The fourth part of the report deals with future steps. It focuses on new directions and needed actions in both policy and research. The recommendations are proposed as a result of other recent attempts to change. The recommendations can be viewed as present day indicators for science education as a discipline.

8. Confronting Problems with Solutions in Science Teacher Education.

Robert E. Yager, The University of Iowa

The Science Teacher, in press.

Two studies were conducted to assess the perceptions of problems in the discipline of science education in 1980. A summary of the results are listed below.

Problems as Perceived by 150 Faculty Members at 30 Large Graduate Centers for Science Education in the U.S. are as follows:

1)	Uncertainty about goals and objectives of science education	75%
2)	Declining enrollments in science and science education	60%
3)	General anti-science tenor of society	55%
4)	Diminishing financial support for science education	45%
5)	Lack of leadership in science education	40%
6)	Lack of theoretical base to guide research and practice	30%
7)	Poor quality of teacher education programs	25%
8)	Inappropriate programs (curricula) for all persons	25%

Problems as Perceived by 150 Teachers, In-Service Supervisors, Workshop Supervisors/Department Chairs, Graduate Students, and College Science Educators (30 each) are as follows:

1)	Confusion and uncertainty concerning goals and objectives	71%
2)	Lack of vision and leadership in schools and universities	43%
3)	Public and parental apathy towards misunderstanding of science and science education	39%
4)	Limited budgets and facilities	36%
5)	Poor quality and low standards of teacher education programs	30%
6)	Limited scholarly dialogue between researchers and practitioners	28%
7)	Declining enrollments generally	26%
8)	Lack of a theoretical base for science education	25%

9. Comparison of Perceptions of Major Problems in Science Education.

Jack A. Gerlovich, Iowa State Department of Public Instruction; and Robert E. Yager, The University of Iowa

Iowa Science Teachers Journal, in press.

The top eight professional problems in science education are identified as perceived by 1) Iowa science supervisors, 2) graduate faculty from university centers, and 3) a cross-level sampling of the profession, including teachers, supervisors, curriculum directors, graduate students, and college faculty. Surveys of these three groups were accomplished during 1979.

One of the striking results of the studies is the unanimity of the most important problem -- that of defining better the goals and objectives for the discipline. At this time of crisis in science education as we have known it, it is apparent that the profession is clamoring for new directions, a new rationale, a new definition of the discipline, a new framework.

It is also interesting to note the kinds of problems cited. Most deal with major issues -- philosophical ones. These problem areas include the need for new goals, the need for a theory base, the need for better leadership, the problems with respect to understanding the interaction of science and society. A second kind of problem exists with respect to administrative/programmatic matters. These problems deal with teaching assignments, teacher education programs, and the existence of model materials and approaches. A third kind of problem is those which are actually symptoms of the current crisis. These problems are concern for declines in enrollment and financial support for science instruction. Many see these problems as evidence of crisis and reason for change. Few suggest that the problems will be solved by more money and more students required to enroll in current courses.

10. Science Educators' Perceptions of Problems Facing Science Education: A Report of Five Surveys.

James Joseph Gallagher, Michigan State University; and Robert E. Yager, The University of Iowa

Journal of Research in Science Teaching, in press.

Science education, like many professions, is currently facing an array of problems. This is a report of a survey of professional opinions regarding the identification of problems facing science education currently. The groups asked to respond to the question included science educators from graduate centers, in-service teachers in Michigan, Iowa graduate students, in-service science supervisors from Iowa, and supervisors enrolled in leadership conferences. An analysis of an open-ended survey of the five groups of science educators resulted in identification of six major problem areas -- conceptual, organizational, teacher-related, student-related, university-centered, and societal. Conceptual problems were most frequently mentioned by the respondents followed by university-centered problems and organizational problems. Specific problems receiving greatest attention included:

-- confusion and uncertainty in goals and objectives.

-- lack of vision and leadership in schools and universities.

-- absence of a theoretical base for science education.

-- poor quality teacher education programs.

-- inappropriate avenues for continuing education of teachers.

-- limited dialogue between researchers and practitioners.

-- declining enrollments.

-- poor quality teaching and counseling.

-- insufficient programs in science for the wide spectrum of students.

-- public and parental apathy towards science.

Areas where actions are necessary have been identified. Action plans need to be developed at the local, regional, state and national levels. Some are in the formative stages; others are yet to be proposed and developed. Among the most pressing actions needed are those which will clarify purposes and objectives of science education. Unless this occurs, science educators will be in growing disarray. There is strong evidence that the profession can and is responding to the current crisis. The decade of the 80's may indeed be another golden age as science education becomes widely recognized as an important, vital, and active discipline.

11. Science Education Needs a New Direction.

Rodger W. Bybee, Carleton College; and Robert E. Yager,
The University of Iowa

Science Education, submitted for publication.

Several reports have provided information concerning perceptions of professional problems, proposed solutions to current problems, and recommendations for improving science education as a discipline. This paper is a synthesis of the findings from five such studies. The groups included several analyses associated with the 1979-80 studies of graduate centers of science education and the 1978-79 studies of science education in small colleges. The study is an attempt at establishing validity for the separate reports of problems, solutions, and new directions in science education. More importantly, the accumulated evidence supports the claim that science education is in a period of significant transition and change. The need to identify a new direction is the next step of the transition. Presently, science educators do not have a common purpose that would provide a new direction.

The similarity of the eight problem statements between the science educators at major universities and the cross level (i.e., the group which included teachers, supervisors, curriculum leaders, graduate students, and a college sample) group is significant. Though the ordering of the problem areas varies, seven of the eight problem statements are similar for both samples. Interestingly, it was the cross-level group which identified the lack of professional dialogue across academic levels as one of the top professional problems.

When the recommendations for the future of science education are compared, the statements are all more philosophical and futuristic for the sample groups. The recommendations appear to be general and not restricted to a particular group of science educators. Whether describing current indicators, outlining broad solution areas, making policy recommendations, or identifying action areas, the directions for the future are generally consistent and compatible among all facets of the profession represented in the surveys.

A synthesis of the recommendations for the future of science education from the studies involve the following:

1) Identify the leadership in science education at all levels and begin the task of defining the discipline more explicitly and identify new directions for the 1980's and beyond.

2) Increase communication and cooperation among professionals at all levels of science education and with professionals from related disciplines. This might include: establishing networks, clearinghouses, development centers, evaluation schemes, Chautuaqua-type programs for constantly assessing and improving the profession.

3) Confront the full meaning of and new meanings for many science education related social issues: science, technology, education, teacher education, school, scientific literacy, social issues, and equality.

4) Concentrate research and development in science education on significant problems of science teaching.

5) Develop a rationale for the discipline of science education.

12. A Comparison of Twenty-Two Doctoral Programs Over a Fourteen Year Period.

David P. Butts, The University of Georgia; and Robert E. Yager, The University of Iowa

Science Education, in press.

Graduate programs in science education became common and grew in terms of staff and doctoral students during the 1960's. The first Guidelines for the doctorate in science education were published in 1966; at that time some demographic information was collected that can now be used for studying program trends during the past fourteen years. In 1974 new Guidelines were adopted and published. A major study was conducted to determine the degree of fit between the Guidelines and the twenty-two institutions with specific doctoral programs in science education per se. In 1979 other data were collected -- partially as a follow-up of the 1974 study. Although one of the recent studies looked broadly at all graduate institutions in the United States, this is a report of the trends discernible when the same twenty-two institutions are studied 1965-79 with respect to enrollments, faculty, program features, and placement of graduates.

A comparison of the data from the several sources permits the following statements regarding trends:

1) The data reveal that the numbers enrolled in doctoral programs as well as the number of graduates in science education are declining. The rate of change at the twenty-two institutions reflects the graduate enrollment trends generally.

2) After doubling the staff size in science education during the 1965-70 period, the faculty numbers have been declining up to the present time.

3) Although science preparation remains the most significant part of the doctoral program in science education, the specific courses have become more flexible and they represent more broad fields of science (including some applied/technological areas) than was the case fourteen years ago.

4) Science in a social context as well as specific preparation in philosophy/history/sociology of science have become more important in the doctoral programs. (However, such considerations involve on the average of only two or three courses in the total program at the current time.)

5) Science education courses per se have grown in importance in the total doctoral program; currently they represent the next most common course requirements (next to science) in the degree programs.

6) The science education offerings in doctoral programs have grown from seminars concerned with trends to specialized courses concerned with instructional design, process, and evaluation; currently such courses also deal with the science-society interface.

7) General courses in curriculum and instruction remain as required features of most doctoral programs in science education; these requirements have increased in number during the fourteen year period.

8) Research design has increased in terms of specific requirements; twice as much is required in 1979 as was the case in 1966.

9) Research procedures have tended to become less traditional and more flexible in nature.

10) Emphasis upon external funding has become broader and less "training-oriented"; much current effort with external funding includes employment possibilities for doctoral graduates.

11) The development of interpersonal skills has become more important; currently most programs now require one course in this area.

12) The employment of doctoral graduates has changed significantly.
   a) Fewer graduates are becoming college teachers of science.
   b) More graduates are returning to leadership positions in K-12 schools.
   c) The opportunity for employment as a college or university science educator has declined during the past fourteen years; however, it remains a major area for employment.
   d) More graduates are finding employment in industry, health fields, public centers (museums, nature centers), and government, as well as state and regional agencies.

13. Priorities for Needed Policies and Research in Science Education.

Robert E. Yager, The University of Iowa; and Jane Butler Kahle, Purdue University

Journal of Research in Science Teaching, submitted for publication.

The research priorities identified by the twenty-eight contacts as part of the 1979 crisis/status studies in science education at the major institutions with doctoral programs are compared to two other recent attempts at establishing research priorities in science education.

One of these was the Task Force report in 1979 for the National Institute of Education in cooperation with the National Association for Research in Science Teaching.

Following the work of the task force the National Association for Research in Science Teaching authorized Butts and his colleagues at the University of Georgia to conduct a Delphi study to establish research priorities as viewed by the entire NARST membership. That effort resulted in the publication of another list of priorities.

There are several areas where there is complete agreement in terms of research needs in science education in all three of the studies. This agreement underscores the importance of pursuing research in the following areas:

1) Scientific/technological literacy. What is such literacy? How is it recognized? What affects its attainment?

2) Teaching behavior. What teacher actions affect learning outcomes? Can they be changed? How do they differ for different learners?

3) Goals of science instruction. How are goals changing? How do they reflect current advances in the discipline? How are they responsive to society? What are the parameters of the discipline of science education?

4) Student attitudes. How does science instruction and science learning affect attitudes? How are they related to other outcomes of instruction?

5) Learning and cognitive development theories and their application in classrooms. How does what we know affect classroom practice? Student outcomes? Curriculum?

6) Social imperatives. How does science education consider major issues affecting modern society? How do societal concerns affect science teaching and learning?

There are also several differences among the three sets of priority statements for research in science education. These differences include the following:

1) The NIE/NARST priorities represent specific areas located within a map outlining the domain for science education. Because of this, the eight priority areas tended to be areas with little or no attention suggested or implied for strategies for considering them. The other lists were both concerned with such actions.

2) The study arising from the NSF Status Study of Graduate Centers of Science Education included several suggestions for research syntheses. Such synthesis efforts involved science education per se as well as related fields of research. The study also tended to view science education across levels -- i.e., researchers, practitioners, the public.

3) The latest study (as #2 above) presented science education as a discipline with a need for specific definition and maturation. Often the research suggested tended not to be an end in itself.

4) The latest effort (as in #2 and #3 above) emphasized a vertical approach to research -- a continuing effort. Current efforts seemed to point to a future use and interpretation.

5) The latest statements (as in #2, #3, and #4 above) for needed research suggest a broader view of science (than the traditional disciplines) and science education (than school science). The priorities suggest science as a many dimensional enterprise. (This is also exemplified by the suggested policy statements extracted from the current study.)

6) The latest effort (as in the above items) suggests more correctives, more interrelationships. Such correctives are not only suggested; at this time they are essential.

14. An Analysis of the Current Crisis in the Discipline of Science Education.

Robert E. Yager, The University of Iowa; Rodger Bybee, Carleton College; James Joseph Gallagher, Michigan State University; and John W. Renner, The University of Oklahoma

Journal of Research in Science Teaching, in press.

Several occurrences at science education centers during the past twenty years suggest crises for 1980. Some of these include the following observations:

1) Graduate enrollments are declining in science education and the average faculty size is decreasing as well. The graduate faculty at the thirty-five major institutions tends to be homogeneous in terms of age, preparation, rank, past experience, sex, and research productivity.

2) Research is a major activity for relatively few faculty members in major research settings. Area of research interest are general and not discipline specific. There is little evidence of sustained programs of research; new research tends to concentrate on doctoral dissertations.

3) Graduate programs in science education have remained rather uniform throughout a twenty year period; approximately half the courses required are science. Specific courses in science education have increased in terms of number and specificity for graduate degrees.

4) External funding for science education activities at the major graduate centers has shown a drastic decline during the past five years.

5) Internal support for science education within the universities has increased slowly during the past decade; support for graduate students has declined during the past five years.

6) The employment picture for Doctoral graduates has changed significantly during the past two decades.

   a) University positions in science education continue as a major employment possibility but far less important than a decade ago.

b) College science teaching remains as an employment possibility. However, it is less feasible than it was ten years ago.

c) More Doctoral graduates are finding employment in leadership roles in K-12 schools. However, this possibility is less feasible than it was five years ago.

d) Employment in allied health fields, government, industry, and other non-traditional areas increased in importance between 1965-75. Currently, this employment possibility has stabilized (or declined slightly) between 1975 and 1980.

e) There are more foreign students enrolled in doctoral programs in science education than ever before; their enrollment and their return to their native countries for specific positions may tend to decrease the appearance of crisis both with respect to enrollment and employment patterns.

APPENDIX C

List of 365 Institutions in Status Study*

***Auburn University
Auburn, Alabama 36830

*Samford University
Birmingham, Alabama 35209

**University of Alabama in Birmingham
Birmingham, Alabama 35294

*University of Alabama in Huntsville
Huntsville, Alabama 35807

**University of Alabama
University, Alabama 35486

*University of South Alabama
Mobile, Alabama 36688

***Arizona State University
Tempe, Arizona 85281

*University of Arizona
Tucson, Arizona 85721

**Arkansas State University
State University, Arkansas 72467

***University of Arkansas
Fayetteville, Arkansas 72701

*California Institute of Technology
Pasadena, California 91125

*California State College, Bakersfield
Bakersfield, California 93309

*California State Polytechnic University, Pomona
Pomona, California 91768

*California State University, Chico
Chico, California 95929

*California State University, Fresno
Fresno, California 93740

**California State University, Fullerton
Fullerton, California 92634

*California State University, Hayward
Hayward, California 94542

*California State University, Long Beach
Long Beach, California 90804

*California State University, Los Angeles
Los Angeles, California 90032

*California State University, Northridge
Northridge, California 91330

*California State University, Sacramento
Sacramento, California 95819

*Claremont Graduate School
Claremont, California 91711

*Holy Names College
Oakland, California 94619

*Immaculate Heart College
Los Angeles, California 90027

*Loyola Marymount University
Los Angeles, California 90045

*Naval Postgraduate School
Monterey, California 93940

*Pepperdine University
Malibu, California 90265

*San Diego State University
San Diego, California 92182

*San Francisco State University
San Francisco, California 94132

**San Jose State University
San Jose, California 95192

**Santa Monica College
Santa Monica, California 90406

***Stanford University
Stanford, California 94305

*United States International University
San Diego, California 92126

***University of California, Berkeley
Berkeley, California 94720

*University of California, Davis
Davis, California 95616

*University of California, Irvine
Irvine, California 92717

**University of California, Los Angeles
Los Angeles, California 90024

*University of California, Riverside
Riverside, California 92521

*University of California, San Diego
La Jolla, California 92093

*University of California, Santa Barbara
Santa Barbara, California 93106

*University of the Pacific
Stockton, California 95211

*University of San Francisco
San Francisco, California 94117

**University of Santa Clara
Santa Clara, California 95053

*University of Southern California
Los Angeles, California 90007

*Colorado School of Mines
Golden, Colorado 80401

*Colorado State University
Fort Collins, Colorado 80523

***University of Colorado
Boulder, Colorado 80309

*University of Denver
Denver, Colorado 80210

***University of Northern Colorado
Greeley, Colorado 80639

*Western State College of Colorado
Gunnison, Colorado 81230

*Connecticut College
New London, Connecticut 06320

°University of Bridgeport
Bridgeport, Connecticut 06602

*University of Connecticut
Storrs, Connecticut 06268

*University of New Haven
New Haven, Connecticut 06516

*Wesleyan University
Middletown, Connecticut 06457

*Yale University
New Haven, Connecticut 06520

**University of Delaware
Newark, Delaware 19711

***American University
Washington, D.C. 20016

*Catholic University of America
Washington, D.C. 20064

*Georgetown University
Washington, D.C. 20057

*George Washington University
Washington, D.C. 20052

*Howard University
Washington, D.C. 20059

*University of the District of Columbia
Washington, D.C. 20001

***Florida Atlantic University
Boca Raton, Florida 33431

***Florida State University
Tallahassee, Florida 32306

*Nova University
Fort Lauderdale, Florida 33314

**Stetson University
DeLand, Florida 32720

**University of Central Florida
Orlando, Florida 32816

***University of Florida
Gainesville, Florida 32611

*University of Miami
Coral Gables, Florida 33124

***University of South Florida
Tampa, Florida 33620

*Atlanta University
Atlanta, Georgia 30314

***Emory University
Atlanta, Georgia 30322

°Georgia Institute of Technology
Atlanta, Georgia 30332

*Georgia Southern College
Statesboro, Georgia 30458

***Georgia State University
Atlanta, Georgia 30303

*Medical College of Georgia
Augusta, Georgia 30901

***University of Georgia
Athens, Georgia 30602

***University of Hawaii
Honolulu, Hawaii 96822

*Idaho State University
Pocatello, Idaho 83209

***University of Idaho
Moscow, Idaho 83843

*Bradley University
Peoria, Illinois 61625

*Chicago State University
Chicago, Illinois 60628

°DePaul University
Chicago, Illinois 60604

°Eastern Illinois University
Charleston, Illinois 61920

**Governors State University
Park Forest South, Illinois 60466

*Illinois Institute of Technology
Chicago, Illinois 60616

**Illinois State University
Normal, Illinois 61761

*Loyola University of Chicago
Chicago, Illinois 60611

*Northeastern Illinois University
Chicago, Illinois 60625

*Northern Illinois University
DeKalb, Illinois 60115

*Northwestern University
Evanston, Illinois 60201

*Roosevelt University
Chicago, Illinois 60605

*Sangamon State University
Springfield, Illinois 62708

***Southern Illinois University at Carbondale
Carbondale, Illinois 62901

°Southern Illinois University at Edwardsville
Edwardsville, Illinois 62026

*University of Chicago
Chicago, Illinois 60637

*University of Health Sciences/
The Chicago Medical School
Chicago, Illinois 60612

*University of Illinois at Chicago Circle
Chicago, Illinois 60680

*University of Illinois at the Medical Center
Chicago, Illinois 60612

***University of Illinois at Urbana
Urbana, Illinois 61801

*Western Illinois University
Macomb, Illinois 61455

***Ball State University
Muncie, Indiana 47306

**Indiana State University
Terre Haute, Indiana 47809

***Indiana University
Bloomington, Indiana 47401

***Purdue University
West Lafayette, Indiana 47907

**University of Evansville
Evansville, Indiana 47702

*University of Notre Dame
Notre Dame, Indiana 46556

**Drake University
Des Moines, Iowa 50311

*Iowa State University
Ames, Iowa 50011

***University of Iowa
Iowa City, Iowa 52242

**University of Northern Iowa
Cedar Falls, Iowa 50613

**Emporia State University
Emporia, Kansas 66801

**Fort Hays State University
Hays, Kansas 67601

**Kansas State University
Manhattan, Kansas 66506

*Pittsburg State University
Pittsburg, Kansas 66762

***University of Kansas
Lawrence, Kansas 66045

**Wichita State University
Wichita, Kansas 67208

*Eastern Kentucky University
Richmond, Kentucky 40475

*Murray State University
Murray, Kentucky 42071

*University of Kentucky
Lexington, Kentucky 40506

***University of Louisville
Louisville, Kentucky 40208

*Western Kentucky University
Bowling Green, Kentucky 42101

***Louisiana State University
Baton Rouge, Louisiana 70803

*Louisiana State University Medical Center, School of Graduate Studies
New Orleans, Louisiana 70112

°McNeese State University
Lake Charles, Louisiana 70609

°Northeast Louisiana University
Monroe, Louisiana 71201

°Northwestern State University of Louisiana
Natchitoches, Louisiana 71457

*Southern University
Baton Rouge, Louisiana 70813

°Tulane University
New Orleans, Louisiana 70118

**University of New Orleans
New Orleans, Louisiana 70122

***University of Maine at Orono
Orono, Maine 04469

°Coppin State College
Baltimore, Maryland 21216

*Johns Hopkins University
Baltimore, Maryland 21218

*Loyola College
Baltimore, Maryland 21210

°Morgan State University
Baltimore, Maryland 21239

*Towson State University
Towson, Maryland 21204

*University of Baltimore
Baltimore, Maryland 21201

***University of Maryland
College Park, Maryland 20742

***Boston College
Chestnut Hill, Massachusetts 02167

***Boston University
Boston, Massachusetts 02215

*Brandeis University
Waltham, Massachusetts 02154

*Bridgewater State College
Bridgewater, Massachusetts 02324

*Clark University
Worcester, Massachusetts 01610

**Fitchburg State College
Fitchburg, Massachusetts 01420

°Framingham State College
Framingham, Massachusetts 01701

***Harvard University
Cambridge, Massachusetts 02139

*Massachusetts Institute of
Technology
Cambridge, Massachusetts 02139

*Northeastern University
Boston, Massachusetts 02115

*Tufts University
Medford, Massachusetts 02155

*University of Lowell
Lowell, Massachusetts 01854

*University of Massachusetts
at Amherst
Amherst, Massachusetts 01003

*Westfield State College
Westfield, Massachusetts 01085

*Worcester Polytechnic Institute
Worcester, Massachusetts 01609

*Worcester State College
Worcester, Massachusetts 01602

°Andrews University
Berrien Springs, Michigan 49104

*Central Michigan University
Mount Pleasant, Michigan 48859

*Eastern Michigan University
Ypsilanti, Michigan 48197

***Michigan State University
East Lansing, Michigan 48824

*Michigan Technological University
Houghton, Michigan 49931

*Oakland University
Rochester, Michigan 48063

*University of Detroit
Detroit, Michigan 48221

***University of Michigan
Ann Arbor, Michigan 48109

***Wayne State University
Detroit, Michigan 48202

***Western Michigan University
Kalamazoo, Michigan 49008

*Mankato State University
Mankato, Minnesota 56001

**St. Cloud State University
St. Cloud, Minnesota 56301

***University of Minnesota
Minneapolis, Minnesota 55455

°Jackson State University
Jackson, Mississippi 39217

°Mississippi College
Clinton, Mississippi 39058

***Mississippi State University
Mississippi State, Mississippi 39762

***University of Mississippi
University, Mississippi 38677

***University of Southern Mississippi
Hattiesburg, Mississippi 39401

**Central Missouri State University
Warrensburg, Missouri 64093

*St. Louis University
St. Louis, Missouri 63013

**Southeast Missouri State University
Cape Girardeau, Missouri 63701

**Southwest Missouri State University
Springfield, Missouri 65802

***University of Missouri, Columbia
Columbia, Missouri 65201

***University of Missouri, Kansas City
Kansas City, Missouri 64110

**University of Missouri-Rolla
Rolla, Missouri 65401

**University of Missouri, St. Louis
St. Louis, Missouri 63121

*Washington University
St. Louis, Missouri 63130

*Montana State University
Bozeman, Montana 59717

**University of Montana
Missoula, Montana 59812

**Creighton University
Omaha, Nebraska 68178

*University of Nebraska
Lincoln, Nebraska 68583

***University of Nebraska, Lincoln
Lincoln, Nebraska 68588

*Wayne State College
Wayne, Nebraska 68787

°University of Nevada, Las Vegas
Las Vegas, Nevada 89154

**University of Nevada, Reno
Reno, Nevada 89557

*Dartmouth College
Hanover, New Hampshire 03755

*University of New Hampshire
Durham, New Hampshire 03824

*College of Medicine and Dentistry
of New Jersey
Newark, New Jersey 07103

**Montclair State College
Upper Montclair, New Jersey 07043

*New Jersey Institute of Technology
Newark, New Jersey 07102

*Princeton University
Princeton, New Jersey 08540

***Rutgers
New Brunswick, New Jersey 08903

°Seton Hall University
South Orange, New Jersey 07079

*Stevens Institute of Technology
Hoboken, New Jersey 07030

**Trenton State College
Trenton, New Jersey 08625

**New Mexico Institute of Mining and Technology
Socorro, New Mexico 87801

*New Mexico State University
Las Cruces, New Mexico 88003

*University of New Mexico
Albuquerque, New Mexico 87131

*Aldelphi University
Garden City, New York 11530

°Alfred University
Alfred, New York 14802

**Brooklyn College
Brooklyn, New York 11210

**City College of the City University of New York
New York, New York 10031

*City University of New York
New York, New York 10036

*Clarkson College of Technology
Potsdam, New York 13676

*College of Saint Rose
Albany, New York 12203

***Columbia University
New York, New York 10027

***Cornell University
Ithaca, New York 14853

*Fordham University
Bronx, New York 10458

**Hofstra University
Hempstead, New York 11550

*New School for Social Research
New York, New York 10003

***New York University
New York, New York 10003

*Niagara University
Niagara University, New York 14109

*Polytechnic Institute of New York
Brooklyn, New York 11201

*Queens College of the City University of New York
Flushing, New York 11367

*Rensselaer Polytechnic Institute
Troy, New York 11367

*Rockefeller University
New York, New York 10021

*St. Bonaventure University
St. Bonaventure, New York 14778

*St. John's University
Jamaica, New York 11439

***State University of New York at Albany
Albany, New York 12222

°State University of New York at Binghamton
Binghamton, New York 13901

***State University of New York at Buffalo
Amherst, New York 14260

*State University of New York
at Stony Brook
Stony Brook, New York 11794

*State University of New York
Downstate Medical Center
Brooklyn, New York 11203

***Syracuse University
Syracuse, New York 13210

***University of Rochester
Rochester, New York 14627

*Wagner College
Staten Island, New York 10301

°Yeshiva University
New York, New York 10003

*Appalachian State University
Boone, North Carolina 28608

***Duke University
Durham, North Carolina 27706

**East Carolina University
Greenville, North Carolina 27706

*North Carolina Agricultural and
Technical State University
Greensboro, North Carolina 27411

*North Carolina Central University
Durham, North Carolina 27707

***North Carolina State University
at Raleigh
Raleigh, North Carolina 27650

***University of North Carolina
at Chapel Hill
Chapel Hill, North Carolina 27514

*University of North Carolina
at Charlotte
Charlotte, North Carolina 28223

*University of North Carolina
at Greensboro
Greensboro, North Carolina 27412

*Wake Forest University
Winston-Salem, North Carolina 27109

*Western Carolina University
Cullowhee, North Carolina 28723

**North Dakota State University
Fargo, North Dakota 58105

*University of North Dakota
Grand Forks, North Dakota 58201

*Air Force Institute of Technology
Wright-Patterson Air Force Base,
Ohio 45433

*Bowling Green State University
Bowling Green, Ohio 43403

*Case Western Reserve University
Cleveland, Ohio 44106

**Cleveland State University
Cleveland, Ohio 44106

*Hebrew Union College
Jewish Institute of Religion
Cincinnati, Ohio 45220

°John Carroll University
University Heights, Ohio 44118

***Kent State University
Kent, Ohio 44242

**Miami University
Oxford, Ohio 45056

***Ohio State University
Columbus, Ohio 43210

*Ohio University
Athens, Ohio 45701

**University of Akron
Akron, Ohio 44325

***University of Cincinnati
Cincinnati, Ohio 45221

*University of Dayton
Dayton, Ohio 45469

***University of Toledo
Toledo, Ohio 43606

**Wright State University
Dayton, Ohio 45435

**Xavier University
Cincinnati, Ohio 45207

*Youngstown State University
Youngstown, Ohio 44555

*Oklahoma State University
Stillwater, Oklahoma 74074

***University of Oklahoma
Norman, Oklahoma 73069

*University of Tulsa
Tulsa, Oklahoma 74104

***Oregon State University
Corvallis, Oregon 97331

*University of Oregon
Eugene, Oregon 97403

*Bryn Mawr College
Bryn Mawr, Pennsylvania 19010

°Drexel University
Philadelphia, Pennsylvania 19104

*Duquesne University
Pittsburg, Pennsylvania 15219

°Gannon College
Erie, Pennsylvania 16541

*Hahnemann Medical College
and Hospital
Philadelphia, Pennsylvania 19102

**Indiana University of Pennsylvania
Indiana, Pennsylvania 15705

*Lehigh University
Bethlehem, Pennsylvania 18015

*Medical College of Pennsylvania
Philadelphia, Pennsylvania 19129

***Pennsylvania State University
University Park, Pennsylvania 16802

**Shippensburg State College
Shippensburg, Pennsylvania 17257

***Temple University
Philadelphia, Pennsylvania 19122

*Thomas Jefferson University
Philadelphia, Pennsylvania 19107

***University of Pennsylvania
Philadelphia, Pennsylvania 19104

*University of Pittsburgh
Pittsburgh, Pennsylvania 15260

**University of Scranton
Scranton, Pennsylvania 18510

*Villanova University
Villanova, Pennsylvania 19085

°West Chester State College
West Chester, Pennsylvania 19380

*Brown University
Providence, Rhode Island 02912

°Rhode Island College
Providence, Rhode Island 02908

°University of Rhode Island
Kingston, Rhode Island 02881

**Clemson University
Clemson, South Carolina 29631

*Medical University of South Carolina
Charleston, South Carolina 29403

°University of South Carolina
Columbia, South Carolina 29208

**Winthrop College
Rock Hill, South Carolina 29733

*South Dakota School of Mines and Technology
Rapid City, South Dakota 57701

*South Dakota State University
Brookings, South Dakota 57007

*University of South Dakota
Vermillion, South Dakota 57069

**Austin Peay State University
Clarkesville, Tennessee 37040

**East Tennessee State University
Johnson City, Tennessee 37601

*Fisk University
Nashville, Tennessee 37202

°George Peabody College for Teachers
Nashville, Tennessee 37203

°Memphis State University
Memphis, Tennessee 38152

*Middle Tennessee State University
Murfreesboro, Tennessee 37132

*Tennessee State University
Nashville, Tennessee 37203

*Tennessee Technological University
Cookesville, Tennessee 38501

**University of Tennessee at Chattanooga
Chattanooga, Tennessee 37401

***University of Tennessee at Knoxville
Knoxville, Tennessee 37916

**University of Tennessee at Martin
Martin, Tennessee 38238

*University of Tennessee Center for The Health Sciences
Memphis, Tennessee 38163

*Vanderbilt University
Nashville, Tennessee 37240

*Abilene Christian University
Abilene, Texas 79601

*Angelo State University
San Angelo, Texas 76901

*Baylor College of Medicine
Houston, Texas 77030

*Baylor University
Waco, Texas 76703

**East Texas State University
Commerce, Texas 75428

°Lamar University
Beaumont, Texas 77710

*Midwestern State University
Wichita Falls, Texas 76308

*North Texas State University
Denton, Texas 76203

*Pan American University
Edinburg, Texas 78539

*Rice University
Houston, Texas 77001

*St. Mary's University
San Antonio, Texas 78284

*Southern Methodist University
Dallas, Texas 75275

*Southwest Texas State University
San Marcos, Texas 78666

*Stephen F. Austin State University
Nacogdoches, Texas 75962

*Texas A & M University
College Station, Texas 77843

°Texas Christian University
Fort Worth, Texas 76129

*Texas Southern University
Houston, Texas 77004

*Texas Tech University
Lubbock, Texas 79409

°Texas Woman's University
Denton, Texas 76204

*Trinity University
San Antonio, Texas 78284

***University of Houston
Houston, Texas 77004

*University of Texas at Arlington
Arlington, Texas 76019

***University of Texas at Austin
Austin, Texas 78712

**University of Texas at Dallas
Richardson, Texas 75080

**University of Texas at El Paso
El Paso, Texas 79968

*University of Texas at San Antonio
San Antonio, Texas 78285

*University of Texas Graduate School of Biomedical Sciences
San Antonio, Texas 78284

**West Texas State University
Canyon, Texas 79016

**Brigham Young University
Provo, Utah 84601

**University of Utah
Salt Lake City, Utah 84112

*Utah State University
Logan, Utah 84322

*University of Vermont
Burlington, Vermont 05401

**College of William and Mary
Williamsburg, Virginia 23185

°George Mason University
Fairfax, Virginia 22030

*James Madison University
Harrisonburg, Virginia 22807

**Old Dominion University
Norfolk, Virginia 23508

*University of Richmond
Richmond, Virginia 23173

***University of Virginia
Charlottesville, Virginia 22903

**Virginia Commonwealth University
Richmond, Virginia 23220

***Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

°Virginia State College
Petersburg, Virginia 23803

**Central Washington University
Ellensburg, Washington 98926

*Eastern Washington University
Cheney, Washington 99004

*Seattle University
Seattle, Washington 98122

***University of Washington
Seattle, Washington 98195

**Washington State University
Pullman, Washington 99164

**Western Washington University
Bellingham, Washington 98225

*Marshall University
Huntington, West Virginia 25701

*West Virginia College of
Graduate Studies
Institute, West Virginia 25112

°West Virginia University
Morgantown, West Virginia 26505

*Marquette University
Milwaukee, Wisconsin 53223

*Medical College of Wisconsin
Milwaukee, Wisconsin 53226

***University of Wisconsin, Madison
Madison, Wisconsin 53706

*University of Wisconsin, Milwaukee
Milwaukee, Wisconsin 53201

°University of Wisconsin, Oshkosh
Oshkosh, Wisconsin 54901

*University of Wisconsin, Stout
Menomonie, Wisconsin 54751

*University of Wyoming
Laramie, Wyoming 82071

° indicates non-respondents
* indicates no Graduate Program of any kind in Science Education
** indicates the existence of a Master's degree program <u>only</u>
*** indicates the existence of a Doctoral program

(Note: Stanford and Harvard no longer have programs in Science Education.)

APPENDIX D

THE STATUS OF PROFESSIONAL SCIENCE EDUCATION

Information from Graduate Institutions

1) Do you have a graduate program in science education?

Yes No (please circle appropriate response)

2) When was it established? ____________(year)

3) What specific degrees are offered with a major in science education?

BA BS MAT MA MS EdS EdD PhD

4) How many have graduated each of the following years with a major in science education?

	Bachelor	Master	Specialist	Doctoral
1969				
1974				
1979				

5) List Faculty members who are considered members of a faculty in science education. Please provide information requrested for each member.

NAME	Identify Full or Percent Time	Year Each Degree Awarded B.A.	M.S.	PhD	Date of Employment at your institution	Current Academic Rank and Date Achieved
1)						
2)						
3)						
4)						
5)						
6)						
7)						
8)						
9)						
10)						

6) Is your graduate program in science education:

____Part of Curriculum and Instruction in School of Education

____Science Education Center

____Department within School of Education

____Program Area Designation

____None of above (please specify)______________________________

7) What changes have occurred in the following areas with respect to your science education program in the past ten years?

Courses______________________________

Faculty______________________________

Program Design______________________________

Graduate Students Enrollment______________________________

Please indicate date for each change when possible.

8) How does your science education program relate administratively with each of the following:

College of Liberal Arts (Humanities)______________________________

School of Education______________________________

Graduate College or School______________________________

Extension Division/Continuing Education______________________________

College or School of Science______________________________

9) What percentage of time does your general faculty designate for research?

____

How does this compare with your faculty in science education?__________

What is the normal rate of publication expected of your staff in science education? (research manuscripts per year)____________________

10) Estimate the percent of time devoted to each of the following areas of concern for science educators at your institution.

Teaching in a field of Science____________%

Teacher Education ____________%(includes methods and student teaching)

Graduate Courses in Science Education per se (exclusive of teacher education) ____________%

General Courses in Education__________%

Off-campus Workshops/Teaching__________%

Undergraduate Advising____________%

Graduate Advising________%

Funded Training and Research Projects________%

Research___________%

Would you expect the members of your faculty would agree that their time is accurately reflected in the above estimates? YES NO

11) What are the major interests of your faculty?

____Teacher Education; specify level______________________________________

____Graduate Level Teaching (exclusive of Teacher Education; Courses such as:

____

____Research; specify major lines of investigation________________________

____Service; specify major projects_______________________________________

Do these interests represent areas of research for your graduate students in Science Education? YES NO

How many science education faculty members are active researchers?__________

How many science education faculty members are actively involved with research involving doctoral students?__________________

How many faculty research publications appear in refereed journals each year?____________________

Are other faculty members at your institution (i.e., scientists, sociologists, psychologists) doing research that could be called research in science education? YES NO

EXAMPLES:____

APPENDIX E

QUESTIONNAIRE FOR STATUS OF PROFESSIONAL SCIENCE EDUCATION

Name ____

Institution __________________________________

Date ____

Please indicate with an asterisk when information is a best estimate

Graduates Each Year

	1960	1965	1970	1975	1980
1. Graduates Each Year					
a. Secondary Science Teaching					
b. Masters					
c. Doctorate (i.e., Ph.D., Ed.D.)					
2. Nature of Master's Program					
a. Science (semester hours required)					
b. Science Education (semester hours required)					
c. History/Philosophy/Sociology of Science (semester hours required)					
d. Curriculum/Instruction Component (semester hours required)					
3. Nature of Doctoral Program					
a. Science (semester hours required)					
b. Science Education (semester hours required)					
c. History/Philosophy/Sociology of Science (semester hours required)					
d. Curriculum/Instruction Component (semester hours required)					

If there is a brochure for describing your undergraduate and graduate programs, please enclose such information.

4. Number of Personnel

	1960	1965	1970	1975	1980
Faculty					
Teaching Assistants (or staff)					
Research Assistants (or staff)					
Service Assistants (or staff)					
Lecturers and/or Adjunct Staff					
Secretarial					
Work Study and/or other undergraduate employees					

5. Faculty Roster and Teaching Assignments

Name	Rank	Teaching Assignments
a.		
b.		
c.		
d.		
e.		
f.		
g.		
h.		
i.		
j.		

6. Training/Research Contracts/ Grants

a. High ability students

	1960	1965	1970	1975	1980
1. Number					
2. Total dollar amount					

b. Teacher Institutes

1. Number					
2. Total Dollar Amount					

Training/Research Contracts/ Grants (cont)

c. Research Grants

1. Number
2. Total dollar amount

	1960	1965	1970	1975	1980
1. Number					
2. Total dollar amount					

7. Research

List Ph.D. Dissertation titles in Science Education for each year indicated. Use reverse side if more space is needed.

a. 1960	Names	Title of Dissertation	Advisor
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			
b. 1965			
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			
c. 1970			
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			

d. 1975

Names	Title of Dissertation	Advisor
(1)		
(2)		
(3)		
(4)		
(5)		
(6)		

e. 1980

(1)		
(2)		
(3)		
(4)		
(5)		
(6)		

8. Budget (Dollar Amounts)

	1960	1965	1970	1975	1980
a. Faculty					
b. Graduate Students					
c. Support Staff					
d. Equipment					
e. Supplies					

9. Employment of Ph.D. Graduates

Number Employed as:	1960	1965	1970	1975	1980
Science Educators at University Level					
Science Educators at 4-year Colleges					
Community Colleges					
College/University Science Instructors					
Public Schools: Administration/ Supervision					
K-12 Teaching					
Industry					
Health Related					
State and Intermediate Units					
Government					
Other ____________					
____________					
____________					
10. Facilites for Science Education (Number of each)					
a. Classrooms					
b. Laboratories					
c. Offices					
d. Curriculum Centers					
e. Special Rooms Specify					
1. ____________					
2. ____________					
3. ____________					

THE SCIENCE EDUCATION CONTACTS AT THE THIRTY-FIVE LARGEST PROGRAMS

Cornell University Stone Hall Ithaca, NY 14850	Joseph D. Novak Professor
Florida State University 431 Education Building Tallahassee, FL 32306	Charles C. Matthews Professor
Georgia State University University Plaza Atlanta, GA 30303	Ashley G. Morgan Professor
Harvard University Cambridge, MA 02138	Fletcher Watson Professor
Indiana University School of Education 202 Education Building Bloomington, IN 47405	Hans O. Andersen Professor
Kansas State University Manhattan, KS 66506	Robert R. James Professor
Michigan State University McDonnel Hall East Lansing, MI 48824	James Joseph Gallagher Professor and Director
New York University 52 Press Building New York, NY 10003	Fletcher Watson Professor and Director
North Carolina State University Raleigh, NC 27605	Norman D. Anderson Professor
Ohio State University Room 310, 1200 Chambers Rd. Columbus, OH 43210	Robert W. Howe Professor and Director
Oregon State University Weniger Hall 251 Corvallis, OR 97331	Thomas P. Evans Professor and Chairman
Pennsylvania State University 165 Chambers Building University Park, PA 16802	H. Seymour Fowler Professor and Chairman

Purdue University Chemistry Building West Lafayette, IN 47907	Jane Butler Kahle Associate Professor
Stanford University 549 Hilbar Lane Palo Alto, CA 94303	Paul DeHart Hurd Professor Emeritus
State University of NY - Buffalo Amherst, NY 14260	Rodney L. Doran Professor
Syracuse University 101 Heroy Hall Syracuse, NY 13210	Ann C. Howe Associate Professor
Teachers College Columbia University Education Building New York, NY 10027	Willard J. Jacobson Professor
Temple University 347 Ritter Hall Philadelphia, PA 19122	Donald W. Humphreys Associate Professor
University of California Lawrence Hall of Science Berkeley, CA 94702	Herbert D. Thier Associate Director
University of Colorado School of Education Hellems Annex Boulder, CO 80302	Ronald D. Anderson Professor
University of Florida Normal Hall 353 Gainesville, FL 32611	John J. Koran, Jr. Professor and Chairman
University of Georgia Room 212, Aderbold Hall Athens, GA 30601	David P. Butts Professor and Chairman
University of Houston Central Campus Houston, TX 77004	Eugene L. Chiappetta Associate Professor
University of Iowa 450 Physics Building Iowa City, Iowa 52242	Robert E. Yager Professor and Coordinator

University of Kansas Bailey Hall Lawrence, KS 66045	William S. LaShier Professor
University of Maryland Science Teaching Center College Park, MD 20742	Emmett L. Wright Professor
University of Michigan East & South University Ave. Ann Arbor, MI 48104	Burton E. Voss Professor
University of Minnesota Minneapolis, MN 55455	Eugene Gennaro Professor
University of Nebraska - Lincoln Lincoln, NB 68588	Donald W. McCurdy Professor
University of Northern Colorado 343 Ross Hall of Science Greeley, CO 80639	Leslie W. Trowbridge Professor and Chairman
University of Oklahoma College of Education 820 Van Vleet Oval Norman, OK 73069	John W. Renner Professor
University of Texas at Austin Science Education Center Austin, TX 78712	Rolland B. Bartholome Associate Professor
University of Virginia Curry Memorial School of Educ. Ruffner Hall Charlottesville, VA 22903	Ertle Thompson Professor
University of Washington Seattle, WA 98195	Roger G. Olstad Professor
University of Wisconsin Teacher Education Building Madison, WI 53706	Fred N. Finley Assistant Professor

APPENDIX G

168 FACULTY MEMBERS IN SCIENCE EDUCATION AT THIRTY-FIVE MAJOR PROGRAMS

1. Listing by Institution

Columbia University
- O. Roger Anderson
- Gary C. Bates
- Willard J. Jacobson
- Warren E. Yasso

Cornell University
- Richard B. Fischer
- Joseph D. Novak
- Verne N. Rockcastle

Florida State University
- Ronald G. Good
- Charles C. Matthews
- Dorothy M. Schlitt

Georgia State University
- Ted Colton
- Louis Gardner
- Mildred W. Graham
- Jack Hassard
- Edward C. Lucy
- Ashley G. Morgan, Jr.
- Sidney P. Smith, Jr.

Harvard University
- Maurice Bellanger
- Fletcher G. Watson

Indiana University
- Hans O. Andersen
- Michael R. Cohen
- Joseph C. Cotham
- Dorothy L. Gabel
- Harold Harty
- Albert W. Strickland
- James E. Weigand
- Donald Winslow

Kansas State University
- Robert K. James
- Harry McAnarney
- Terry Joe Shaw

Michigan State University
- Charles W. Anderson
- Glenn D. Berkheimer
- Jere Confrey
- N. Jean Enochs
- James Joseph Gallagher
- Martin T. Hetherington
- Richard J. McLeod
- Carl J. Naegele
- Willard M. Rose
- Edward L. Smith
- David F. Treagust

New York University
- James V. Conner
- Judith S. Klein
- F. James Rutherford
- Fletcher G. Watson

North Carolina State University
- Norman D. Anderson
- Ronald D. Simpson
- Herbert E. Speece

Ohio State University
- Patricia E. Blosser
- Roger Cunningham
- John F. Disinger
- Rosanne W. Fortner
- Stanley L. Helgeson
- Robert W. Howe
- Marlin L. Languis
- Victor J. Mayer
- Robert Earl Roth
- Victor M. Showalter
- Barbara S. Thomson
- Arthur L. White

Oregon State University
- Gene F. Craven
- Thomas P. Evans
- Fred W. Fox
- Karl J. Nice
- Howard L. Wilson

Pennsylvania State University
Paul E. Bell
H. Seymour Fowler
Robert L. Shrigley
Joseph Zafforoni

Purdue University
Alfred De Vito
James D. Herron
Harold H. Jaus
Jane Butler Kahle
Gerald H. Krockover
Van E. Neie
Floyd H. Nordland
Samuel N. Postlethwait

Stanford University
Paul DeHart Hurd

State University of New York at Buffalo
Rodney L. Doran
Ronald J. Raven

Syracuse University
Alfred T. Collette
Marvin Drugar
Ann C. Howe
Larry E. Schafer

Temple University
Gene Abraham
Matthew H. Bruce
Donald W. Humphreys
Chester E. Rahn
Wayne E. Ransom
Joseph S. Schmuckler
Francis Xavier Sutman
Eugene Udell

University of California at Berkeley
Lawrence F. Lowery
John D. Miller

University of Colorado
Harold M. Anderson
Ronald D. Anderson
James R. Wailes

University of Florida
Thomas Gadsden, Jr.
John J. Koran, Jr.
Mary Budd Rowe

University of Georgia
David P. Butts
William R. Capie
James R. Okey
Michael Padilla
Kenneth S. Ricker
Joseph P. Riley
John W. Shrum
Russell H. Yeany
William R. Zeitler

University of Houston
Jacob W. Blankenship
Eugene L. Chiappetta
Martha Kime Piper

University of Iowa
George W. Cossman
Avi Hofstein
Classie G. Hoyle
Vincent N. Lunetta
John E. Penick
Darrell G. Phillips
Edward L. Pizzini
Daniel S. Sheldon
James A. Shymansky
Doris G. Simonis
John T. Wilson
Robert E. Yager

University of Kansas
William S. LaShier, Jr.
Walter S. Smith

University of Maryland
George Eley
Marjorie H. Gardner
Henry Heikkinen
John W. Layman
J. David Lockard
Robert William Ridky
Jack H. Wheatley
David Lee Williams
Emmett L. Wright

University of Michigan
Carl F. Berger
Burton E. Voss

University of Minnesota
Eugene D. Gennaro
Patricia A. Heller
Alan H. Humphreys
Roger T. Johnson

University of Nebraska at Lincoln
Donald W. McCurdy
Ward L. Sims
David C. Ulmer, Jr.
Mary H. Williams

University of Northern Colorado
George L. Crockett
Janet M. Davies
Jay K. Hackett
Kenneth V. Olson
Leslie W. Trowbridge

University of Oklahoma
John W. Renner

University of Texas at Austin
Rolland B. Bartholomew
James P. Barufaldi
Lowell J. Bethel
Frank E. Crawley III
John P. Huntsberger
Addison E. Lee
Earl J. Montague

University of Virginia
William E. Royalty
Ertle Thompson

University of Washington
Lillian C. McDermott
Ingrith Deyrup-Olsen
Roger G. Olstad
Leonie K. Piternick
John P. Smith
Darrell J. Woodman

University of Wisconsin at Madison
Fred N. Finley
Milton O. Pella
James H. Stewart

168 FACULTY MEMBERS IN SCIENCE EDUCATION AT THIRTY-FIVE MAJOR PROGRAMS

2. Alphabetical Listing

Gene Abraham - Temple University

Hans O. Andersen - Indiana University

Charles W. Anderson - Michigan State University

Harold M. Anderson - University of Colorado

Norman D. Anderson - North Carolina State University

O. Roger Anderson - Teachers College Columbia University

Ronald D. Anderson - University of Colorado

Rolland B. Bartholomew - University of Texas at Austin

James P. Barufaldi - University of Texas at Austin

Gary C. Bates - Teachers College Columbia University

Paul E. Bell - Pennsylvania State University

Maurice Bellanger - Harvard University

Carl F. Berger - University of Michigan

Glenn D. Berkheimer - Michigan State University

Lowell J. Bethel - University of Texas at Austin

Jacob W. Blankenship - University of Houston

Patricia E. Blosser - Ohio State University

Matthew H. Bruce - Temple University

David P. Butts - University of Georgia

William R. Capie - University of Georgia

Eugene L. Chiappetta - University of Houston

Michael R. Cohen - Indiana University

Alfred T. Collette - Syracuse University

Ted Colton - Georgia State University

Jere Confrey - Michigan State University

James V. Conner - New York University

George W. Cossman - University of Iowa

Joseph C. Cotham - Indiana University

Gene F. Craven - Oregon State University

Frank E. Crawley III - University of Texas at Austin

George L. Crockett - University of Northern Colorado

Roger Cunningham - Ohio State University

Janet M. Davies - University of Northern Colorado

Alfred De Vito - Purdue University

John F. Disinger - Ohio State University

Rodney L. Doran - State University of New York at Buffalo

Marvin Drugar - Syracuse University

George Eley - University of Maryland

N. Jean Enochs - Michigan State University

Thomas P. Evans - Oregon State University

Fred N. Finley - University of Wisconsin at Madison

Richard B. Fischer - Cornell University

Rosanne W. Fortner - Ohio State University

H. Seymour Fowler - Pennsylvania State University

Fred W. Fox - Oregon State University

Dorothy L. Gabel - Indiana University

Thomas Gadsden, Jr. - University of Florida

James Joseph Gallagher - Michigan State University

Louis Gardner - Georgia State University

Marjorie H. Gardner - University of Maryland

Eugene D. Gennaro - University of Minnesota

Ronald G. Good - Florida State University

Mildred W. Graham - Georgia State University

Jay K. Hackett - University of Northern Colorado

Harold Harty - Indiana University

Jack Hassard - Georgia State University

Henry Heikkinen - University of Maryland

Stanley L. Helgeson - Ohio State University

Patricia A. Heller - University of Minnesota

James D. Herron - Purdue University

Martin T. Hetherington - Michigan State University

Avi Hofstein - University of Iowa

Ann C. Howe - Syracuse University

Robert W. Howe - Ohio State University

Classie G. Hoyle - University of Iowa

Alan H. Humphreys - University of Minnesota

Donald W. Humphreys - Temple University

John P. Huntsberger - University of Texas at Austin

Paul DeHart Hurd - Stanford University

Willard J. Jacobson - Teachers College Columbia University

Robert K. James - Kansas State University

Harold H. Jaus - Purdue University

Roger T. Johnson - University of Minnesota

Jane Butler Kahle - Purdue University

Judith S. Klein - New York University

John J. Koran, Jr. - University of Florida

Gerald H. Krockover - Purdue University

Marlin L. Languis - Ohio State University

William S. LaShier, Jr. - University of Kansas

John W. Layman - University of Maryland

Addison E. Lee - University of Texas at Austin

J. David Lockard - University of Marylard

Lawrence F. Lowery - University of California at Berkeley

Edward C. Lucy - Georgia State University

Vincent N. Lunetta - Univers[illegible]y of Iowa

Charles C. Matthews - Florida State University

Victor J. Mayer - Ohio State University

Harry McAnarney - Kansas State University

Donald W. McCurdy - University of Nebraska at Lincoln

Lillian C. McDermott - University of Washington

Richard J. McLeod - Michigan State University

John D. Miller - University of California at Berkeley

Earl J. Montague - University of Texas at Austin

Ashley G. Morgan, Jr. - Georgia State University

Carl J. Naegele - Michigan State University

Van E. Neie - Purude University

Karl J. Nice - Oregon State University

Floyd H. Nordland - Purdue University

Joseph D. Novak - Cornell University

James R. Okey - University of Georgia

Ingrith Deyrup-Olsen - University of Washington

Kenneth V. Olson - University of Northern Colorado

Roger G. Olstad - University of Washington

Michael Padilla - University of Georgia

Milton O. Pella - University of Wisconsin at Madison

John E. Penick - University of Iowa

Darrell G. Phillips - University of Iowa

Martha Kime Piper - University of Houston

Leonie K. Piternick - University of Washington

Edward L. Pizzini - University of Iowa

Samuel N. Postlethwait - Purdue University

Chester E. Rahn - Temple University

Wayne E. Ransom - Temple University

Ronald J. Raven - State University of New York at Buffalo

John W. Renner - University of Oklahoma

Kenneth S. Ricker - University of Georgia

Robert William Ridky - University of Maryland

Joseph P. Riley - University of Georgia

Verne N. Rockcastle - Cornell University

Willard M. Rose - Michigan State University

Robert Earl Roth - Ohio State University

Mary Budd Rowe - University of Florida

William E. Royalty - University of Virginia

F. James Rutherford - New York University

Larry E. Schafer - Syracuse University

Dorothy M. Schlitt - Florida State University

Joseph S. Schmuckler - Temple University

Terry Joe Shaw - Kansas State University

Daniel S. Sheldon - University of Iowa

Victor M. Showalter - Ohio State University

Robert L. Shrigley - Pennsylvania State University

John W. Shrum - University of Georgia

James A. Shymansky - University of Iowa

Doris G. Simonis - University of Iowa

Ronald D. Simpson - North Carolina State University

Ward L. Sims - University of Nebraska at Lincoln

Edward L. Smith - Michigan State University

John P. Smith - University of Washington

Sidney P. Smith, Jr. - Georgia State University

Walter S. Smith - University of Kansas

Herbert E. Speece - North Carolina State University

James H. Stewart - University of Wisconsin at Madison

Albert W. Strickland - Indiana University

Francis Xavier Sutman - Temple University

Ertle Thompson - University of Virginia

Barbara S. Thomson - Ohio State University

David F. Treagust - Michigan State University

Leslie W. Trowbridge - University of Northern Colorado

Eugene Udell - Temple University

David C. Ulmer - University of Nebraska at Lincoln

Burton E. Voss - University of Michigan

James R. Wailes - University of Colorado

Fletcher G. Watson - Harvard University, New York University

James E. Weigand - Indiana University

Jack H. Wheatley - University of Maryland

Arthur L. White - Ohio State University

David Lee Williams - University of Maryland

Mary H. Williams - University of Nebraska at Lincoln

Howard L. Wilson - Oregon State University

John T. Wilson - University of Iowa

Donald Winslow - Indiana University

Darrell J. Woodman - University of Washington

Emmett L. Wright - University of Maryland

Robert E. Yager - University of Iowa

Warren E. Yasso - Teachers College Columbia University

Russell H. Yeany - University of Georgia

Joseph Zafforoni - Pennsylvania State University

William R. Zeitler - University of Georgia

APPENDIX H

DISSERTATIONS LISTED FROM THE MAJOR PROGRAMS, 1960, 1965, 1970, 1975, AND 1980

Doctoral Graduate / Title of Dissertation	Year	Institution	Adviser (if given)
Adalis, Dorothy An appraisal of broad subject-matter areas in the pre-service preparation program of biology teachers in West Virginia	1965	Ohio State University	Richardson
Alton, Elaine V. An experiment using programmed material in teaching a non-credit algebra course at the college level	1965	Michigan State University	Mason
Anderson, Harold D. The geochemistry and minerology of the Pennsylvanian clays of Mahaska County	1970	University of Iowa	Yager
Anderson, Norman D. An analysis of programs for the preparation of secondary-school science teachers	1965	Ohio State University	Richardson
Arnston, Wayne The effect of an interdisciplinary course in futuristics on attitudes toward science among students in a two-year college	1975	University of North Carolina	
Ashley, James	1970	Indiana University	
Baker, Kenneth An investigation into the role of teaching models in science concept learning in secondary school science	1970	Pennsylvania State University	Fowler
Ballard, Ruie D. An analysis of the nature of and changes in college students' reactions to biology and biologists from 1955 to 1968	1970	University of Texas, Austin	Lee
Banks, William H. Practices in the preparation of elementary teachers for the teaching of science	1965	Ohio State University	Richardson
Bailey, John H. Conservation projects by community organizations	1960	Cornell University	Fischer
Beard, Jean Group achievement tests developed for T B processes of AAAS sciences—a process approach	1970	Oregon State University	Williamson

Bellisario, Joseph 1970 Pennsylvania State University Fowler
E. Lawrence Paliver, his contributions to nature, science conservation education

Benson, Bernard W. 1970 University of Iowa Yager
The development and implementation of an instrument to assess cognitive performance in high school biology

Berzofsky, Max 1970 Ohio State University Schlessinger
A study of patterns of perceptions and explanation exhibited by children in grades 3, 6, and 9 when classifying pictures representing five biological levels of organization

Berger, Carole 1975 Teachers College Columbia University Jacobson
Clinical study of immune responses in systemic carddiasis patients cutaneous cadidates patioents and cartiol

Berty, Roland B. 1975 Ohio State University Coon
A study of the relationships between classroom activities, student-teacher relationships and the characteristics of in-service secondary school science teachers of Costa Rica

Best, Effie D. 1970 Ohio State University Howe
An exploratory study of the correlates of student decision making in the secondary school biology laboratory

Bitkouski, Marianne B. 1975 University of Texas, Austin Montague
A study of the effect of science knowledge and coping strategies related to stress on student behavior

Blosser, Patricia E. 1970 Ohio State University Howe
A study of the development of the skill of effective questioning by prospective secondary school science teachers

Bomberr, Tony 1975 University of Michigan Voss
Longitudinal study of student success in IPS

Bondurent, Russell L. 1975 Michigan State University Alam
An assessment of certain skills possessed by fifth-grade students used to successfully identify constellations in a planetarium

Boonstra, Paul Henry 1970 Michigan State University Mason
A pilot project for the investigation of the effects of a mathematics laboratory experience: a case study

Bowyer, Jane 1975 University of California, Berkeley Lowery
SCIS and Scientific Literacy

Braius, Edward 1965 Pennsylvania State University Fowler
A comparison of two methods of laboratory instruction in tenth grade biology

Broughton, Jessica P. 1975 University of Texas, Austin Carter
An investigation of analytical-global congnitive style and classification ability among elementary school children

Brunner, Carl 1975 Syracuse
A comparison between college students and ninth grade students in learning biological concepts

Butterworth, Thomas 1970 Teachers College Columbia University Bate
A study of the effect of lesson verbal structure on aspects of student affective learning in freshman college biology

Camp, David L. 1975 University of Iowa Phillips
An investigation of six major logical groupings of concrete operational thought

Cannon, Richard 1975 University of North Carolina
Comparison of two laboratory methods investigating interest and understanding of process of science in general education physical science

Carter, Karl C. 1970 Michigan State University Brandou
A historical study of the objectives of National Science Foundation teacher training programs as exemplified specifically by the academic year institute programs in science

Carter, Kaywin 1980 University of Texas, Austin Gavenda
An approach to the use of computer-assisted instruction in ninth grade physical science

Castalki, Peter L. 1975 Cornell University Novak
A summary of cognitive education research done in introductory science courses at Cornell University and a study of the effects of tutoring mode and learners' conceptual abilities on learning efficiency in introductory college physics

Castleberry, Samuel J. 1970 University of Texas, Austin Montague
The development and evaluation of computer-assisted instruction programs on selected topics in introductory college chemistry

Champlin, Robert F. 1970 Ohio State University Howe
The development and field testing of an instrument to assess student beliefs about and attitudes about science and scientists

Chan, Gordon 1970 University of California, Berkeley Lowery
Analysis of the effects of publican educational school field trips on a marine environment

Chge, On 1970 Stanford University Bridgham
Communication (science)

Chiraphongse, B. 1970 Kansas State University James
A study of the characteristics of elementary science teachers in Thailand and the competencies needed for improving their teaching

Church, Glenn 1965 Stanford University Hurd
Cognitive Development

Clark, Thomas 1975 Temple University
The relationships of teacher characteristics and classroom behaviors recommended by the intermediate science curriculum study (ICIS) to pupil achievement in the ICIS level one

Collings, Brian 1975 Syracuse University
The effects of mastery learning and studied proctors upon achievement and attitude formation in personalized tutorial biology college program

Connor, Jause 1975 Teachers College Columbia University Bates/Yasso
Humanistic approach to physical science development to evaluation of college science for non-scientist

Cooley, Adrian B. 1970 University of Texas, Austin Montague
The identification and evaluation of Certain interactions of science and society

Cosgriff, Steven 1975 Indiana University Yeany
Relationships between perceived and observed science teaching strategies and selected classroom and teacher variables

Cotham, Joseph C. 1975 Michigan State University Smith
The development, validation, and application of an instrument to assess teachers' understanding of philosophic aspects of scientific theories

Couter, John 1965 University of Minnesota Boech
Inductive laboratory, inductive demonstration, and deductive laboratory in biology

Crawley, Frank E. 1975 Indiana University Shrum
Effects of learning style congruency with personality characteristics

Cross, Whitman 1975 Temple University
Status of earth science programs and profile of earth science teachers in public secondary schools of Pennsylvania: 1971-72

Currie, James F. 1970 Pennsylvania State University Fowler
A study of the effects of a teacher aid experience on the preparation of secondary science student teachers

Deck, James 1975 University of North Carolina
A study of an elementary school auto-tutorial mode of selected factors relating to comprehension of metrological use and measurement

Dillon, J. C. 1975 Kansas State University James
Black college students' attitudes and other factors related to Black's participation in the sciences

Durkee, G. Phillip 1975 University of Iowa Cossman
An inventory of views on the nature of science among college science faculty

Dyar, Nancy 1975 University of California, Berkeley Miller
Assessing the environmental attitudes and behaviors of a seventh grade school population

Ellis, Ronald 1970 Teachers College Columbia University Yasso
The effects of verbilization during training of performance at critereon for physical science students

Flansburg, Leonard D. 1970 University of Iowa Cossman
Magnetism in austenitic stainless steels

Fleming, Joseph 1980 University of Michigan Voss
History of public attitudes towards science and scientists and technology

Flores-Ortiz, Ruben 1975 Temple University
A description of the classroom verbal and non-verbal behavior of a selected group of junior high school science teachers in Puerto Rico

Fournier, James 1975 University of North Carolina
An investigation of the correlation differences in science concepts held by fifth grade Mexican and Anglo American students: a cross cultural study

Fryback, William 1965 Oregon State University Williamson
Evaluation of multi-level reading materials, intra-class discussion techniques and student experimentation on achievement in fifth grade elementary science

Fulton, Harry F. 1970 University of Iowa Yager
An analysis of student outcomes utilizing two approaches to teaching biology

Gardner, Marjorie 1960 Ohio State University Hyer
A follow-up study of graduates from the undergraduate science education curriculum at the Ohio State University 1948-59

Gates, Richard W. 1970 University of Iowa Yager
An analysis of student outcomes using audio tapes to supplement reading in the level one course

Gebhart, James W. 1960 Ohio State University
The teaching of science in the secondary schools of Montana

Geer, Charles E. 1970 University of Texas, Austin
An analysis of the effectiveness of training and opportunity to provide feedback to teachers on pupil achievement of specific objectives in elementary school science

Giese, Ronald 1970 Temple University
The relationships of selected teacher characteristics to certain behaviors of teachers using the curriculum of the intermediate science curriculum study

Glass, Lynn W. 1970 University of Iowa Yager
An analysis of the influence of teacher attitudes upon development of student attitudes

Graham, Robert 1975 University of Nebraska-Lincoln McCurdy
A comparative study of learning physics concepts by quantitative and qualitative methods

Granger, Charles R. 1970 University of Iowa Yager
The physiologic role of the apex in the geotropic response

Grayson, Thomas D. 1975 University of Texas, Austin Lee
An analysis of the relationships between certain pupil characteristics and the grading system used in a science course

Green, John I. 1960 Cornell University Johnson
A study of the conservation acts of rural non-farm residents of Broome County

Green, Tom 1980 University of Minnesota Voss
Moral reasoning in dental students

Grgurich, Thomas J. 1970 Michigan State University Mason
An evaluation of the achievement of general course objectives for a secondary biology program

Gubrud, Allen R. 1970 Cornell University Novak
The effect of an advance organizer and a concrete experience on learning the concept of vectors in junior and senior high school

Haberly, Steven 1980 University of Texas, Austin Montague
The effects of modeling on student teacher behavior in secondary science

Hamilton, Nancy B. 1965 Ohio State University Richardson
The scientific literacy of seniors in urban, suburban, and rural high schools in Kentucky

Hampton, Charles E. 1970 Univeristy of Texas, Austin Cain
The relationship of religious attitudes to certain aspects of mathematics learning

Hayward, Robert 1975 Georgia State University Lucy
The developing and testing of an instrument using planetarium to evaluate attainment

Heller, Philip 1980 Michigan State University Smith
A descriptive analysis of the chemical reasoning of college chemistry teaching assistants in a tutorial setting

Hernandez, Norma G. 1970 University of Texas, Austin Carry
An observation system to analyze cognitive content of teacher discourse in a mathematics lesson

Highsmith, Phillip E. 1965 Ohio State University Richardson
The image of the high school science teacher as seen by various groups

Hillis, Shelby R. 1975 University of Texas, Austin Montague
Relationship of inquiry orientation in secondary physical science classrooms and student's critical thinking skills, attitudes and views of science

Hoff, Darrel B. 1970 University of Iowa Yager
A comparison of directed laboratory versus an enquiry laboratory versus a non-laboratory approach to general education college astronomy

Holliday, William B. 1970 University of Texas, Austin Lee
An analysis of science instructional techniques using different media in learning and testing modes

Horak, Willis J. 1975 University of Iowa Lunetta
An analysis of science teachers' beliefs about teacher classroom behaviors

Hovey, Larry 1970 University of California Lowery
Measuring SCIS teachers' attitudinal changes toward science

Irwin, Roger S. 1970 University of Texas, Austin Butts
A comparative study of the effect of certain factors on the teaching behavior of preservice elementary teachers of science

Ismail, Mohamed 1980 University of Nebraska-Lincoln McCurdy
A comparative study of the perceptions of secondary science teachers and college science educators of competencies needed by science teachers

Jackson, Jim L. 1970 Ohio State University Howe
An assessment of an inservice program in earth science for producing changes in teacher behavior and pupil achievement

Jeffrey, Jack C. 1965 University of Texas, Austin Westmeyer
Identification of objectives of the chemistry laboratory and development of means for measuring student achievement of some of these objectives

Johnson, Susan M. 1975 University of Texas, Austin Lee
The use of an instructional model in the development of a hierarchy of skills involved in posing research questions

Johnson, Theodore M. 1975 Pennsylvania State University Alfke
An experimental study of the placement of classification strategies in SAPA employing Piaget's theory of cognitive development

Jones, Linda 1970 University of Texas, Austin Butts
The relative effects of alternative instructional sequences including interaction analysis and piaget-type interviews on teacher concerns and behavior in elementary school science

Kaiser, Bruce 1965 Stanford University Hurd
Curriculum chemistry

Kelsey, Lawrence 1980 University of Iowa Phillips
An investigation of the development of the notions of chance and probability in adolescents

Kelsey, Linda 1980 University of Iowa Phillips
The performance of college astronomy students on two of Piaget's projective infralogical grouping tasks and their relationship to problems dealing with phases of the moon

Kernaghan, Joe 1970 Temple University
The development of analysis of a pictorial physics test for grades five and six

Kimball, Mevill 1960 Stanford University Hurd
Philosophy of science

Kiny, Robert 1970 Pennsylvania State University Zafforoni
Student teacher changes in beliefs and practices related to teaching elementary school science

Kress, Stephen W. 1975 Cornell University Rockcastle
A study of the modification of children's negative attitudes toward animals

Krockover, Gerald H. 1970 University of Iowa Yager
A comparison of learning outcomes in CBA chemistry when group and individualized instruction techniques are employed

Lamb, Ronald 1970 Oregon State University Williamson
An evaluation of a differential program for able and gifted high school students in southwestern Oregon

Lamb, William G. 1975 University of Texas, Austin Montague
The development and evaluation of a module designed to train secondary science teachers to ask a wide cognitive variety of questions

Langbort, Carol 1980 University of California, Berkeley Miller
Investigation of the ability of fourth grade children to solve word problems with hand-held calculators

Langford, Jim 1980 Kansas State University James
Application of the concerns basic adoption model to ISCS implementation and student achievement

Larsen, Philip 1970 Pennsylvania State University Fowler
A study of the effects of instructional methods upon prospective elementary school science teachers ability to identify and demonstrate the inquiry strategy of instruction

LaShier, William S. 1965 University of Texas, Austin Westmeyer
An analysis of certain aspects of the verbal behavior of student teachers of 8th grade students participating in a BSCS laboratory block

Lene, Gene 1980 University of Texas, Austin Boyer
A study of the comprehension of selected earth science textbook illustrations by eighth grade students

Lindgren, Gordon E. 1970 University of Iowa Cossman
Electron spin resonance study of the production, transmission and decay of free radicals in x-irradiated catalase

Lindquist, Panula 1980 Teachers College Columbia University Anderson
Chloroplast development in cotyledons in light inhibited seeds of cucumis sativis L.

Lu, Phillip 1975 Teachers College Columbia University Anderson
Analytical study of various kinetic structural patterns in teaching astronomy effects on learning

Luong, Nguyen T. 1970 Cornell University Rockcastle
The relative effectiveness of two methods of instruction in teaching the principles of work to fifth grade and eighth grade students

Lutz, John L. 1970 Pennsylvania State University Fowler
Instructional efficiency with 3 dimensional objects as a task of identifying keying techniques

Lynch, Connie 1975 University of California, Berkeley Miller
Measuring Piagetian formal operation levels: an alternative technique designed for group

Madson, Marland 1970 University of Minnesota Boech
Methods, including CCTU, of presenting introductory biology; their "affect" on college freshmen

Mahoney, Vince 1970 University of California, Berkeley Lowery
A branch analysis of graphing behavior in two learning hierarchies within Piagetian stages

Mallette, David 1980 North Carolina State University Anderson
The acceptance of scientific literacy as the central goal of science teaching by North Carolina science teachers, supervisors and science educators

Mauldin, John 1975 University of Texas, Austin Little
A study of the effectiveness of a physical science inquiry course in changing the attitudes of college students toward scientific methods

McClelland, John A. 1970 Cornell University Novack
An approach to the development and assessment of instruction in science at second grade level

McClury, James 1970 University of Michigan Voss
Development and evaluation of an open scheduled A-T lab in geology

McDonald, Allyson 1980
The effects of science education project materials and training on the teaching methods junior secondary science teachers

McKenna, Harold 1970 Teachers College Columbia University Yasso
An innovative environmental science education program for secondary school science teachers

McKnight, Betty J. 1965 Cornell University Rockcastle
A study of the development of elementary school children's concept of volume

Mechling, Kenneth R. 1970 Michigan State University Brandou
The differential adoption and diffusion of selected elementary science curriculum innovations among elementary school teachers

Menefee, Robert W. 1965 Ohio State University Richardson
Measuring elementary school children's ability to use evidence from scientific instruments in decision-making situations

Miller, Robert J. 197[illegible] University of Texas, Austin Montague
An investigation of the cognitive and affective verbal behavior of selected groups of physical science teachers

Milson, James L. 197[illegible] University of Texas, Austin Montague
The development and evaluation of physical science curriculum materials designed to improve the attitudes of the secondary school slow teachers

Minmer, Jeanne 1965 University of Texas, Austin Reynolds
A critical analysis of the introductory college biology program in Catholic Warren's Junior Colleges in the United States

Mizauer, M. 1970 Stanford University Bridgham
Sociology of Science

Montaldi, Francis 1970 Indiana University Shrum
The ultrastructure of exosporia of *Bacillus* species

Moore, Calvin 1970 University of Michigan Voss
Comparison of two physical science programs

Moore, Maggie 1980 Oregon State University
Achievement and attitude effects of mathematical computer games in college level algebra

Moritz, Albert F. 1965 Ohio State University Richardson
The relationship of educational administration to decision-making in science education

Moyer, Richard 1975 University of North Carolina
The development and standardization of the Moyer Unobtrusive Survey of Environmental Attitudes

Muehlke, Marjorie 1970 Teachers College Columbia University Bates
Kiulie structure analyses of college biology lecture

Neal, Bandick 1970 University of Michigan Voss
Core cardiovascular physiology for medical students

Nicholas, John 1970 University of California, Berkeley Lowerey
Modality of verbal instruction for problems and transfer for a science hierarchy

Nord, Richard P. 1970 Indiana University Shrum
Achievement in audio-tutorial college biology under varied attendance requirements

Novak, John 1980 University of Michigan Voss
Student personality type in relations to cognitive preference, achievement and attitudes towards science of eighth grade students

Nunley, Bobby G. 1965 University of Texas, Austin Westmeyer
A study of the effectiveness of tele-lecture in the retraining of elementary teachers in mathematics

Odegaard, Gordon E. 1975 University of Iowa Phillips
An investigation of Piaget's groupings: seriation and projective space

Odunusi, Taiwo 1975 Teachers College Columbia University Anderson
The performance of Nigerian children in science-related cognitive tasks: validation of Bloom's taxonomy of objectives

Padilla, Michael 1975 Michigan State University Berkheimer
The teaching and transfer of seriation strategies using non-visual variables with first-grade children

Parakh, Jal Sohrab 1965 Cornell University Johnson
A study of teacher-pupil interaction in high school biology classes

Patelmo, Philip J. 1975 Temple University
The relationship of selected teacher characteristics and classroom behaviors of teachers to critical thinking growth in students using the introductory physical science (IPS) program as the content vehicle

Pendaeli, John 1975 Teachers College Columbia University Anderson
Analysis of a chemistry curriculum in Tanzonia

Peterson, Rita 1970 University of California, Berkeley Lowery
Identification and analysis of some aspects of exploratory behavior (curiosity) in elementary school children

Philp, Charles F. 1975 University of Iowa Yager
Effect of the kinetic structure level of classroom dialogue subsets on student perceptions of the teacher, discussion and learning materials

Pisane, Dorothy 1975 Temple University
The effects of supervisory feedback on behavior and attitudes in the micro teaching of elementary school science

Podrasky, Edward F. 1970 Pennsylvania State University Fowler
The development and validation of a quasi non-verbal test for attainment of relational concepts implications

Pohala, Ronald 1975 Temple University
A comparative study of teaching anatomy and physiology based on Popham's model versus an alternative instructional model

Pohlmann, Mary 1975 Indiana University Yeany
The relationship between student perception of teacher behaviors and student change in attitude toward a selected course in preservice teacher education

Ponzio, Richard 1975 University of California, Berkeley Lowery
Evaluation of an auto-tutorial criterion-referenced science education program for pre-service elementary teachers

Pringle, Rhodell 1975 Georgia State University Morgan
The effects of lab oriented experiences in science education on cognitive style

Quick, Sue 1975 Stanford University Walker/Hurd
Curriculum (biology)

Rahn, James 1975 University of North Carolina
The effect of training in interaction analysis on attitudes towards education of prospective elementary school teachers

Richard, Donald E. 1970 Ohio State University Languis
The acquisition of selected life-science concepts by beginning kindergarten children from three different community settings

Richter, Erwin W. 1970 University of Iowa Yager
The role of ethylene in plant growth

Riley, James E. 1970 Michigan State University Taylor
A comparison of the abilities of late elementary school children to learn tasks on the operation of signed numbers

Roberts, Robert 1980 Oregon State University
Student nonverbal behavior and frustration during individual testing

Robinson, David 1975 Indiana University Shrum
Assessment of a competency-based college biology course

Robinson, Dianne Q. 1975 University of Iowa Wilson
Effect of inserted questions when learning from inductively and deductively sequenced written materials

Robinson, James T. 1960 Stanford University Hurd
Philosophy of science

Rogers, Robert Earl 1970 Ohio State University Languis
Classroom verbal behavior as related to teachers' perception of pupils in fifth-grade science classes

Rowe, Mary B. 1960 Stanford University Hurd
Cognitive development

Roy, Protima 1975 University of Florida Koran
Differential effects of pictorial and written presentations on the acquisition of scientific concepts by Indian taught in Bengali and English

Royce, George K. 1980 University of Nebraska-Lincoln McCurdy
The development and validation of a diagnostic criterion referenced test of science processes

Rupley, William 1980 University of California, Berkeley Lowery
The effects of numberical characteristics on the difficulty of proportional reasoning tasks

Ryder, Exyie 1970 University of Michigan Voss
Experience background and pupil understanding of science concepts

Sagness, Richard L. 1970 Ohio State University Howe
A study of selected outcomes of a science pre-service teacher education project emphasizing early involvement in schools of contrasting environmental settings

Sanchez, Margarita De   1975 University of Texas, Austin   Little
An analysis of the three year physics curriculum in the secondary public schools offering science curricula in Venezuela

Schenken, Larry L.   1970 University of Iowa   Yager
The effects of X-irradiation of the nucleohistones of murine S-109 ascites tumor cells

Schulert, David H.   1965 Michigan State University   Mason
A study of a laboratory centered ninth grade physical science course

Senoff, George   1975 University of North Carolina
Competency based teacher education course in elementary science

Sherrill, James M.   1970 University of Texas, Austin   Cain
The effects of differing presentations of mathematical word problems upon the achievement of tenth grade students

Simmons, Ellen S.   1975 University of Iowa   Yager
The effects of kinetic structure on knowledge about and performance of a psychomotor skill: teaching students to use the compound microscope

Simpson, Ronald D.   1970 Indiana University   Shrum
Effects of teacher science support on student science support in selected tenth grade biology classes

Slesnick, Twila   1980 University of California, Berkeley   Miller
Algorithmic skill vs. conceptual understanding

Smith, Geroge F.   1970 Cornell University   Rockcastle
A study of the effects of student achievement in elementary science programs resulting from teacher in-service training and additional instructional aids

Smith, John P.   1960 Stanford University   Hurd
Curriculum (early science)

Smith, Paul M.   1980 University of Texas, Austin   Huntsberger
An analysis and comparison of information retained by middle school students of science museum exhibits

Stallings, Mark   1980 Kansas State University   James
Development of 12th grade environmental competencies for Kansas graduates

Steffani, Ronald   1970 Oregon State University   Wilson
Some effects of grouping by subject matter major on student performance in college algebra

Steiner, Harrel E. 1970 University of Texas, Austin Lee
A study of the relationships between teacher practices and student performance of selected inquiry process behaviors in the affective domain in high school biology classes

Strawitz, Barbara M. 1970 University of Texas, Austin Montague
The development and evaluation of a verbal interaction system designed to modify the verbal behavior of secondary science student teachers

Streitberger, Horst 1970 Oregon State University Fox
Teacher influence-behaviors and teacher-student interactions patterns in selected Oregon chemistry classes

Strickmeier, Henry B. 1970 University of Texas, Austin Cain
An analysis of verbal teaching behaviors in seventh grade mathematics classes grouped by ability

Swami, Piyush 1975 Ohio State University Howe
A follow-up study for evaluation of the pre-service secondary science teacher education program at the Ohio State University

Tanner, Thomas 1965 Stanford University Hurd
Cognitive Development

Thompson, Thomas 1975 Oregon State University Williamson
A survey of the status and needs opinion of science education in Oregon during the 1973-4 school year, grades K-12

Toth, George P. 1975 Pennsylvania State University Fowler
The effects of prior knowledge and critical thinking on the interpretation of an advance organizer in the learning of a biology chart

Trent, John 1960 Stanford University Hurd
Curriculum (physics)

True, Clayton 1980 University of Nebraska-Lincoln McCurdy
Selected factors and academic success in college level A T and traditional biology

Vargo, Robert 1975 Syracuse University
Pupil/science teacher interpersonal compatibility and science attitudes

Vega, Juan Saldana 1980 University of Texas Gavenda
Design, implementation and evaluation of a set of computer-based units of instruction for an introductory college physics course

Voltmer, Rita 1980 Kansas State University James
Needed laboratory teaching skills as viewed by pre-service teachers and science educators

Werner, Neila 1975 Teachers College Columbia University Anderson
Case study of decision making in elementary school science curriculum improvement 1961-74

Welliver, Paul 1965 Pennsylvania State University Fowler
The effect of television instruction on the attainment of a new state-adopted ninth grade physical science course during the introductory year

Williams, Robert 1975 Georgia State University
The effects of the national environment education development program on self concept and change

Willingham, David C. 1970 University of Texas, Austin Lee
A study of the relationship of selected student and teacher characteristics to the biological sciences as perceived by junior college students

Wilson, Roosevelt L. 1975 University of Iowa Yager
An evaluation of the use of an anthology of articles on the understanding of science selected to improve student attitudes toward science

Wilson, Shirley Ann 1980 University of Minnesota Gennaro
The effect of use of pre-instructional materials for a field trip to the zoo on cognitive learnings

Wise, Ronald 1970 Pennsylvania State University Zafforoni
Outdoor vs. indoor learning in elementary school science

Wright, Robert R. 1975 Ohio State University Mayer
Cognitive preferences of college students majoring in science, mathematics and engineering

Zeitler, William R. 1965 Ohio State University Richardson
The effectiveness of cooperative children's achievement in science

Zitelli, Patsy 1965 Pennsylvania State University Fowler
An evaluation of a cooperative teaching method in basic physical science required of nonscience majors

Zubulake, Richard 1970 University of Michigan Voss
A study of learning by discovery in science teaching